Analysis Methods for the Southwest Corridor Light Rail Project Environmental Impact Statement

In accordance with the Agency Coordination Plan, the Federal Transit Administration (FTA), Metro and TriMet prepared methods of analysis for each of the issue areas to be addressed in the Environmental Impact Statement (EIS).

The methods were drafted and finalized in consultation with the agencies that accepted FTA's invitation to participate in the environmental review process. The final methods were transmitted to participating agencies in spring and summer 2017.

Each method considers applicable set of laws, regulations and guidance for that issue area.

The same methods have been applied to the Draft and Final EIS analysis.

ACQUISITIONS, DISPLACEMENTS AND RELOCATIONS ANALYSIS METHODS

Introduction

This report describes the methods that will be used to collect data and evaluate impacts to acquisitions, displacements and relocations for the Southwest Corridor Light Rail Project. This analysis will be developed to comply with the National Environmental Policy Act (NEPA); local and state policies, standards, and regulations; and to respond to community concerns raised through environmental scoping.

The analysis will consider several factors about the nature of construction and operation of the proposed transit project. First, to the degree possible at the level of engineering available for the alternatives, the analysis will consider the estimated maximum extent of potential property acquisitions needed. The analysis will address issues such as direct acquisitions of property, as well as impacts due to changes in access, parking, and other built environment features during and after construction; the ability to maintain living, activity, and business operation patterns; and the relationship of affected properties to the proposed transit improvements and the surrounding area.

This methods report is focused primarily on impacts to property, which is one element of the Community Impacts analysis for the project.

The primary focus of the analysis is on the long-term impacts of permanent acquisitions due to acquisition of the right of way needed for the construction and operation of the project.

It will generally be assumed that there is potential for acquisition and/or displacement if part of a proposed project alternative or related improvements, such as rails, structures (including walls), station platforms, substations, traffic lanes, roadway widenings, street and sidewalk improvements, bike lanes, extended right-turn lanes, etc., would require all or part of a property parcel, structure, or other real estate feature. Generally, public streets or other transportation rights of way are not included in the assessment of property acquisitions.

A project element will be considered as having the potential for displacement if any one or more of the following circumstances would occur:

- Any building or developed property used for residential, social/recreational, business or public/institutional purposes within the footprint of a portion of the proposed project alternatives (including construction staging areas), and altered to a degree that it could not continue to function in its current use;
- Any building or property where the access would be completely and permanently eliminated by the proposed project alternatives and could not be restored by reconfiguring the property's access;
- The widening of streets, construction of sidewalks or water quality facilities, or other improvements required in conjunction with the proposed project alternatives would come into physical contact with or encroach upon a building such that it could not continue to function in its current use; or
- The nature and extent of construction would likely have a severe impact on a use and could not be mitigated.

Related Laws and Regulations

Federal statutes provide regulations that address displacement and relocation that could occur as a result of the Southwest Corridor Light Rail Project alternatives. In addition, implementing guidelines have been issued by the Federal Transit Administration (FTA), the Oregon Department of Transportation (ODOT), and TriMet that would apply to any displacements. Following is a list of the statutes and guidelines that are in effect and would be applied to the Southwest Corridor Light Rail Project, with a brief explanation of how each would apply.

- *Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 as amended*. This act defines the federal regulations governing property acquisition and relocation for federally funded projects.
- *49 CFR Part 24, titled Uniform Relocation Assistance and Real Property Acquisition Regulations for Federal and Federally Assisted Programs, Final Rule and Notice*, issued by the U.S. Department of Transportation. This is the federal regulation governing acquisition and relocation for transportation projects utilizing federal funding. It implements the statutory amendments to the Uniform Act of 1970 and establishes definitions, standards, requirements, eligibility, and procedures for all activities associated with acquisition and relocation. A related federal regulation, *23 CFR Part 710, right-of-way and Real Estate*, also applies to the project, and addresses the steps a federally funded project must follow in the acquisition process.
- *UMTA Circular C 5010.1A dated July 22, 1988, as revised, titled Urban Mass Transportation Project Management Guidelines for Grantees*. Requires that all federal grantees carry out acquisition and relocation consistent with the requirements of the Uniform Act.
- *ORS 35, Eminent Domain, Public Acquisition of Property*
- *Oregon Department of Transportation, Right-of-Way Manual*. This document provides ODOT's interpretations and implementing procedures for discretionary elements of the Uniform Act.
- *TriMet Right of Way Procedures Manual.* This document provides TriMet's interpretations and implementing procedures for discretionary elements of the Uniform Act.
- *TriMet Administrative Rules for Relocation Appeals*. This document provides guidelines for conducting relocation appeals hearings on relocations specific to rail transit projects being constructed by TriMet.

Contacts and Coordination

The following local jurisdictions and agencies are participants in the Southwest Corridor Light Rail Project: TriMet, ODOT, Washington County, the City of Tigard, the City of Tualatin, the City of Portland, and Metro. Some of the alternatives also may affect railroads or their right of way.

When one of the alternatives would potentially operate on a public street, traffic impacts or parking displacements could occur. Traffic impacts and potential displacement of on-street and off-street parking will be identified and evaluated in the Transportation Impacts Results Report.

Data Collection

The primary data source used to determine estimated acquisitions, displacements and relocations will be the conceptual engineering drawings and related project engineering studies, which include initial identification of right-of-way needs. This conceptual design information was developed by TriMet but is not proposed to be reproduced directly in the Environmental Impact Statement (EIS). Aerial photos; base maps showing tax lots, streets, existing building footprints, driveways and other physical features; county assessor records; and field inventories will also be used as necessary to research potential property characteristics and to estimate displacements.

Conceptual Engineering Drawings

The number of parcels affected by the right-of-way requirements for the project will be tabulated, based on the conceptual design developed by TriMet for the project alternatives. The tabulation will include the type of acquisition (acquisition of all or part of a parcel), and it will include a listing of potentially affected parcels by each alternative. However, the EIS information will not include parcel-level discussions, because the underlying design information used remains conceptual.

The analysis will also consider properties that may lose access related to modifications to state- or city-managed transportation facilities, such as near major arterial intersections or at interstate interchanges or ramps where driveways or turn movements may be restricted for safety or operational needs. This information will be developed in coordination with the analysis conducted in the Transportation Impacts Results Report and as part of Metro's and TriMet's ongoing agency coordination and design efforts for the project.

Research and Field Investigation

Preliminary information on the ownership of properties proposed for acquisition will be compiled from county tax assessor data and other available sources including employment data. This information, including the occupancy of affected properties, will be verified through field investigations.

Affected Environment

The Affected Environment section will summarize existing conditions in the corridor that could be changed substantially by one or more of the alternatives. Additional details on existing land use and economic activity, transportation patterns, and neighborhood characteristics will be described in the Community Impact section of the Draft Environmental Impact Statement (Draft EIS), as well as in other topic sections including Land Use, Economic Activity, and Transportation.

Impact Assessment

Long-Term Impacts

The right of way required for each of the project alternatives will be as defined in the conceptual engineering drawings. For each alternative, the number and location of potential displacements will be identified and described. Where applicable, the need for relocation will be identified.

The analysis of the extent of potential displacements will be supplemented by data from various sources, including tax assessor data, state employment data, census data, and other available

public database sources. In order to ensure an accurate accounting of existing conditions, mapping and other recorded data will be verified through field investigation. The location, type of use, and condition of existing buildings and other improvements will be checked. Notations will be made regarding the operating characteristics of potentially displaced properties to assess whether the displacement would be necessary. Additional information will be collected on the following items:

- Socioeconomic characteristics of potential residential displaced parties – The Community Impact section of the Draft EIS will outline general household characteristics of potential displaced parties associated with each alternative. This will be determined in order to assess the possible number, race, gender, age, and income of persons that could be displaced. The primary sources of information will include existing census reports, information gathered by local government agencies, and other generally available sources.
- Potential business displaced parties – The Economic analysis will evaluate the extent of potential business displacements associated with each alternative, including the type of business and a determination of the ownership or tenant status of business occupants, and, if available, the number of employees. The primary sources of information will be tax assessor data and other public databases. The location and type of business use will be verified through field investigations, and if the number of employees is not available, professional judgment and industry standards will be used to estimate employees based on square footage and business type.
- Location and type of public/institutional facilities – Public and most types of institutional facilities potentially affected by the alternatives will be identified and further discussed in the Public Services section. Public and institutional facilities include any offices, recreational centers, warehouse or storage buildings, parking lots, etc., that are operated and maintained by public or institutional parties. This will include any facilities housed on property leased from private parties. The location, type, and condition of any such facilities will be verified through field investigations.

Short-Term Impacts

Construction period effects on properties, generally considered to be short-term but that usually do not require acquiring full parcels or displacing uses, will be considered at a project level but not detailed alternative by alternative because they depend on more detailed final design information and the nature and extent of the construction approach.

Indirect Impacts

Most impacts for acquisitions, displacement, and relocations would be addressed through the direct long-term or short-term impacts analysis, but the indirect impact assessment would consider other activities that may occur. Examples of these other activities include station area transit-oriented developments or street/transit system improvements that parties, other than FTA and TriMet, may undertake in support of the light rail project.

Cumulative Impacts

If other recent past, current, or future projects with acquisitions or displacements are nearby, or if the project is displacing a use that has been relocated or altered due to previous projects,

cumulative effects may be present. The analysis would review available information about past or current projects and the location of other proposals in the vicinity to determine the potential for cumulative impacts.

Potential Mitigation and Relocation Requirements

The availability of replacement properties for relocation, as well as specific relocation requirements for individual displacement cases, will be explored during the Preliminary Engineering and Final Design phases of the study and will be discussed in the Final EIS. Most aspects of mitigation for displacement will be as required by federal relocation regulations. These regulations require that all residential displaced parties be provided with decent, safe, and sanitary replacement housing. Federal and state guidelines determine the standards and procedures for providing such replacement housing based on the characteristics of individual households. In general, relocation benefit packages include the cost of replacement housing for owners and renters, moving costs, and assistance in locating replacement housing for owners and renters.

Similarly, the regulations provide for relocation benefits for businesses including moving costs, site search expenses, and business re-establishment expenses. As with residential displaced parties, the specifics of a relocation package are determined on an individual basis based on ownership or tenant status.

Documentation

Documentation of displacement impacts associated with the alternatives will be summarized in the Draft EIS. Tables will be included that identify the number of potential displacements associated with each alternative. The displacements will be summarized as residential displacements by single-family and multifamily units, business displacements by number and type (commercial, industrial, retail), and the number and type of public (and institutional) facilities. Locations and specific parcel identification will not be documented in the Draft EIS.

After selection of the Preferred Alternative, the associated displacements will be updated and documented in the Final EIS.

AIR QUALITY AND GREENHOUSE GAS ANALYSIS METHODS

Introduction

The Southwest Corridor Light Rail Project (project) is within a large metropolitan area and has the potential to impact air quality on a regional scale. Air quality impacts for light rail projects are typically closely related to traffic impacts. Regional air quality impacts could occur as a result of the transfer of trips between transportation modes or the selection of alternatives that either increase or decrease general levels of traffic and congestion and associated air pollution levels.

This report describes the methods that will be used to collect data and evaluate impacts to air quality and greenhouse gas (GHG) emissions conditions for the Southwest Corridor Light Rail Project. This analysis will comply with the National Environmental Policy Act (NEPA), and federal, state, and local policies, standards, and regulations.

The purpose of the air quality analysis is to compare air quality of three scenarios: (1) existing conditions; (2) the No-Build Alternative, which looks at future conditions without the project; and (3) a Light Rail Alternative, which looks at future conditions with the maximum build-out of the project. While some sections of the Southwest Corridor Light Rail Project Environmental Impact Statement (EIS) will assess several different segment-level light rail alternatives, the Light Rail Alternative studied for this analysis will be a single full-corridor-length alternative that represents any combination of the shorter alternatives. The analysis of regional impacts will be based primarily on average weekday regional vehicle miles traveled (VMT) and average weekday regional speeds as a surrogate for emissions.

The entire project corridor is within an area that in October 2017 will change designation from a maintenance area to an attainment area for carbon monoxide (CO). Although the Portland area is in attainment for ozone, it is designated as an anti-backsliding maintenance area. The project is in attainment for all other criteria pollutants. An area designated as a maintenance area for CO is required to perform hot-spot analysis to assess localized impacts of projects on CO levels, and such analysis was included in Metro's past light rail EIS documents. Since the Draft EIS for the Southwest Corridor Light Rail Project will be published after the region is designated an attainment area for CO, a hot-spot analysis is not required and will not be included.

Related Laws and Regulations

- National Environmental Policy Act (NEPA)
- Oregon HB 2001 (2009), Oregon Jobs and Transportation Act
- Code of Federal Regulations Title 40, Part 93, *Determining Conformity of Federal Actions to State or Federal Implementation Plans* (40 CFR 93)
- EPA, *MOVES2014a Policy Guidance*, 2014
- Federal Highway Administration, *Updated Interim Guidance on Mobile Source Air Toxic Analysis in NEPA Documents*, 2016
- Climate Smart
- Federal Transit Administration, *Greenhouse Gas Emissions from Transit Projects: Programmatic Assessment* (January 2017) and the *Greenhouse Gas Emissions Estimator Tool* (November 2016)

- City of Portland Climate Action Plan, 2009

Affected Environment

The EIS will discuss the air quality and GHG regulatory environment of the Portland metropolitan region and trends in air pollution from monitoring data obtained from the Oregon Department of Environmental Quality (DEQ).

Impact Assessment

Long-Term Impacts

Transportation sources are the largest contributor to GHG emissions, responsible for 39 percent of GHG emissions in Oregon, according to DEQ's *2015 Oregon Air Quality Data Summaries*.

For the Southwest Corridor Light Rail Project Draft EIS, GHG emissions impacts will be assessed in two ways: (1) through a regional assessment which looks at the projected GHG emissions impacts with or without a light rail project; and (2) through a partial lifecycle assessment looking at the GHG emissions produced in the construction, operations, and maintenance of the project.

The regional GHG impact will be assessed using 2015 base-year (existing conditions) and 2035 design-year (future conditions) estimates of regional miles traveled, by average speed and by facility type, produced by the regional transportation model. A set of emissions factors generated by the U.S. Environmental Protection Agency (EPA)–approved emissions model, MOVES2014, will then be applied to these VMT to produce an estimated GHG emissions inventory. The analysis region will include all of Clark, Washington, Multnomah, and Clackamas Counties, and, as such, contains vehicles subject to multiple inspection and maintenance (I/M) regimes: Oregon-inspected vehicles, Washington-inspected vehicles, and non-inspected vehicles. The emissions factors and VMT estimates account for the relative mix of these vehicle fleets throughout the model networks.

Table 1. MOVES2014a Input Assumptions

Parameter	Details
Emission Model Version	MOVES2014a
Time Spans	Time Aggregation Level: Hour Month of Evaluation: July Type of Day of Evaluation: Weekday Hour of Evaluation: All 24
Road Type	Urban Restricted Access Urban Unrestricted Access Off-Network (for stationary emission processes)
Pollutants & Processes	Pollutant: CO2-equivalent Processes: all valid processes
Meteorology Data	Used EPA spreadsheet convertor tool to convert previous MOBILE6.2 inputs

Source Type Population	Oregon: developed using Oregon DMV fleet database, MOVES Washington: provided by Washington Department of Ecology
Age Distribution	Oregon: developed using Oregon DMV fleet database, EPA convertor on previous MOBILE6.2 inputs Washington: provided by Washington Department of Ecology
Vehicle Type VMT	Oregon: developed using HPMS summary reports from Oregon DOT, EPA convertor tools Washington: provided by Washington Department of Ecology
Average Speed Distribution	Post-processed transportation model assignment results
Road Type Distribution	Post-processed transportation model assignment results
Fuel Formulation and Supply	Oregon: provided by Oregon DEQ Washington: provided by Washington Department of Ecology
I/M Programs	Oregon: provided by Oregon DEQ Washington: provided by Washington Department of Ecology
California LEV standards	Oregon: provided by Oregon DEQ Washington: provided by Washington Department of Ecology

The partial lifecycle assessment will use the FTA-issued *Greenhouse Gas Emissions from Transit Projects: Programmatic Assessment* (January 2017) and the *Greenhouse Gas Emissions Estimator Tool* (November 2016) to estimate GHG emissions and impacts of the Southwest Corridor Light Rail Alternative's construction and ongoing operations and maintenance. The programmatic assessment states that "light rail projects with a high proportion of displaced VMT to annual transit VMT… are expected to result in a net reduction in greenhouse gas emissions," and recommends that such projects incorporate by reference the analysis for a sample light rail project published in the assessment. VMT outputs produced by Metro's travel demand model will be analyzed to confirm that the Southwest Corridor Light Rail Alternative fits the assessment's sample; and if so, the project's GHG production will be calculated using the Transit GHG Emission Factor Typology Matrix.

To gather more detail on the partial lifecycle assessment of GHG emissions for the Southwest Corridor project, the Estimator Tool will be used with inputs specific to the details of the project. The tool uses details about a transit project's construction and physical and operating characteristics to estimate GHG emissions by project phase.

Short-Term Impacts

A qualitative analysis of potential effects associated with emissions from dust-generating activities, operation of heavy-duty diesel equipment, and trucking activities within major construction areas will be conducted to evaluate the potential effects during project-related construction.

The construction analysis will evaluate GHG emissions, discussed in terms of CO_2e.[1] Assumptions will be made regarding diesel fuel usage from construction consistent with the energy analysis to estimate carbon dioxide emissions.

Indirect Impacts

The air quality analysis will be performed using projected traffic volumes for the future years derived from Metro's regional travel demand model. Therefore, the air quality analysis will include the indirect effects of the project and other traffic growth that would be associated with the project.

Indirect GHG emissions are also known as embodied and life cycle emissions. At this time, there is no consistent and standardized method for calculating the embodied and life cycle emissions for transportation projects. There are no tools currently available for clearly and meaningfully discerning which emissions are attributable to a specific project and which emissions would have occurred without the project.

Cumulative Impacts

The air quality analysis evaluates projected future traffic volumes and delays that incorporate anticipated traffic generation from planned development in the project area and at a regional scale. Therefore, the air quality analysis already includes a general discussion of the cumulative effects of the project and other traffic growth that would be associated with the project. However, this section will address past trends and anticipated future trends in air quality and GHG emissions.

Mitigation Measures

Impact minimization measures will be presented for construction activities. Specific best management practices for reducing impacts from construction activities will be discussed as part of the project's commitments to address air quality impacts consistent with DEQ requirements and local construction policies.

Documentation

Existing air quality and impacts will be discussed in the Air Quality section of the EIS. The EIS section will be summary-level, focused primarily on identifying the long-term and short-term/construction period impacts to air quality. Background information, existing conditions information, and details of the analysis will be included in a technical memorandum available for review through Metro, and will be included in cooperating agency reviews of the Preliminary Draft EIS.

[1] Carbon dioxide equivalent is a standard unit for measuring greenhouse gases relative to one unit of CO_2.

COMMUNITY IMPACTS ANALYSIS METHODS

Introduction

This report describes the methods that will be used to collect data and evaluate community impacts for the Southwest Corridor Light Rail Project Environmental Impact Statement (EIS). This analysis will be developed to comply with the National Environmental Policy Act (NEPA) and local and state policies, standards, and regulations.

The community impacts analysis will address how the project would affect community quality of life, community cohesion, and community facilities. In addition to considering effects to the general population, this analysis will consider impacts to population groups that are not specifically addressed by Executive Order 12898, the 1994 regulation directing federal agencies to identify and address the disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations. The Environmental Justice analysis methods are described in a separate methods report and will be documented in a separate section of the EIS. The other populations that would be considered in the community effects analysis include seniors, those with limited English language proficiency, youth, people with disabilities, households with no cars or limited access to private vehicles, and people/households with low and medium wage jobs.

Related Laws and Regulations

Federal

- Title VI of the Civil Rights Act of 1964
- Age Discrimination Act of 1975
- Americans with Disabilities Act of 1990 (ADA)
- Federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended
- Presidential Executive Order 12898 – Federal Actions to Address Environmental Justice to Minority Populations and Low-Income Populations
- Presidential Executive Order 13166 – Improving Access to Services for Persons with Limited English Proficiency
- U.S. Department of Transportation Order 5610.2 – Order to Address Environmental Justice in Minority Populations and Low-Income Populations
- Title 49 of the Code of Federal Regulations (CFR) Part 21, Nondiscrimination in Federally Assisted Programs of the Department of Transportation, Effectuation of Title VI of the Civil Rights Act of 1964
- U.S. Department of Transportation (USDOT) Federal Transit Administration (FTA), Circular FTA C 4702.1B, Title VI Requirements and Guidelines for Federal Transit Administration Recipients (October 1, 2012)
- USDOT FTA, Final Circular FTA C 4703.1, Environmental Justice Policy Guidance for FTA Recipients (August 15, 2012)

- Community Impact Assessment: A Quick Reference for Transportation, Publication No. FHWA-PD-96-036 (September 1996)

State and Local

- City of Portland Affordable Housing Policy, Ordinance 00-882C, Housing and Affordable Housing
- The Portland Metro Council adopted an ordinance on January 18, 2001, amending the Regional Framework Plan and the Urban Growth Management Functional Plan to ensure a choice of housing types and to help reduce regulatory barriers to affordable housing
- City of Tigard Housing Strategies Report (2013)

Contacts and Coordination

The analysis of community and neighborhood social impacts will be accomplished in conjunction with Metro and TriMet's public involvement and outreach efforts for the project, which are described in the *Southwest Corridor Light Rail Project Coordination Plan*. These efforts involve neighborhood and community groups and invite property owners, residents, and other interested parties in the corridor to participate in the project. This continues the efforts of Metro, TriMet and the local jurisdictions previously conducted during the earlier phases of the Southwest Corridor Plan.

Staff will coordinate with local jurisdictions and other social services agencies and groups to identify important community facilities and features, characterize key features of neighborhoods, and identify formal and informal networks serving community members. The analysts will also review public scoping comments to identify community concerns about the potential impacts of the project, as well as the results of previous outreach conducted during the earlier phases of the Southwest Corridor Plan.

The community impacts analysis will consider findings from other disciplines within the EIS, including:

- Acquisitions and Displacements
- Air Quality
- Water Quality
- Economics
- Historic, Archaeological, and Cultural Resources
- Land Use
- Noise and Vibration
- Public Services
- Utilities
- Parks and Recreation
- Hazardous Materials
- Transportation

- Visual Quality

Data Collection

Neighborhood boundaries will be used to describe certain aspects of the affected environment and the anticipated impacts. Adopted neighborhood boundaries will be used from Metro's Regional Land Information System (RLIS), but local jurisdictions will be consulted to refine boundaries where appropriate.

Where data from other disciplines within the EIS may change qualities, attributes, features, or functions integral to a community, they will be used in the analysis of social and neighborhood impacts. These include factors such as land use, economics, traffic, noise and vibration, and visual quality.

The U.S. Census Bureau will be a primary data source for information about population and economic conditions in the study area. This includes data from the 2010 U.S. Census, as well as information from the Census Bureau's American Community Survey, which continues to survey communities for changes every year.

Data from TriMet's Transit Equity Index, which is partly derived from U.S. Census data sources, will also be used to identify populations from the following groups:

- Limited English language proficiency population
- Senior population
- Youth population
- People with disabilities
- Limited vehicle access households
- Low and medium wage jobs
- Affordable housing units
- Key retail/human/social service destinations in the corridor.

Affected Environment

Study Area

Because the community impacts analysis incorporates findings from several other disciplines in the EIS, the broader community impacts study area is a composite of the individual study areas from these other disciplines (transportation being the broadest). At the neighborhood scale, the community impacts analysis will consider neighborhoods located either partially or fully within a 0.5-mile buffer of the light rail alignments and stations.

Socioeconomic Profile

The affected environment profile will summarize socioeconomic data at the regional and corridor level, with additional detail as appropriate. This information will be based on the U.S. Census and Transit Equity Index data sources above. While projected population growth and the regionally forecast increases in households and employment will be addressed in more

detail in the land use and economics analysis, the anticipated future growth in communities along the corridor will be briefly reviewed as well.

Neighborhoods

The neighborhood is the primary unit of analysis to describe impacts to community cohesion and quality of life. Neighborhoods located either partially or fully within a 0.5-mile buffer of the light rail alignments and stations will be described, focusing in particular on changes to the major land use patterns and their underlying socioeconomic characteristics, including residential, employment, and commercial activities.

Community Facilities

The analysis will identify and map community facilities that are important to the social characteristics and function of neighborhoods or to certain historically marginalized populations. These facilities will be identified within the study neighborhoods and may include:

- Parks, trails and recreation areas
- Schools and colleges
- Libraries
- Community centers and gathering places
- Religious facilities
- Senior centers
- Health care facilities
- Government facilities and services
- Cemeteries and funeral chapels
- Affordable housing
- Ethnic grocery and retail stores
- Farmer's markets
- Major public entertainment facilities

Impact Assessment

Long-Term Impacts

The analysis will discuss beneficial and adverse impacts to neighborhoods as a result of the proposed project and associated changes in land use, transportation and other factors. The EIS findings from other disciplines will be analyzed on a neighborhood basis. The analysis will consider effects on:

- Neighborhood cohesion – Factors that relate to a sense of community or social interaction within a neighborhood, such as significant changes to the traffic circulation system, including bicycle and pedestrian access, that would create or remove barriers between certain sections of the neighborhood, and the overall impacts of displacement

- Neighborhood quality of life – Factors that relate to the satisfaction residents derive from living in the neighborhood, such as aesthetics, noise, vibration and safety and security
- Community facilities – Factors that affect access to community facilities, such as physical displacement of the facility or noise and vibration impacts that reduce its utility

The analysis will also summarize the findings of the Environmental Justice Analysis, which is considering impacts and benefits affecting low income and minority populations. The community impacts analysis will then discuss the impacts and benefits the project may have on other community groups along the corridor where it appears an impact may affect them differently or more severely than the general population, particularly if impacts remain after potential mitigation measures have been applied. The discussion will also identify if alternatives in a segment involve notable differences in their level of impacts to specific community groups.

Short-Term Impacts

This section of the report describes community impacts that would result from construction of the project, primarily based on the detailed analysis conducted for the analysis of construction for other areas of the environment, such as noise, air quality, traffic and visual, land use, and economics.

Indirect Impacts

Indirect impacts for neighborhoods will incorporate findings from other EIS topic areas about the effects of other anticipated changes that may be related to the development of the project but may result by the actions of others or be separated in time from project opening. This could include development in station areas or street/transit system or other supporting infrastructure improvements aside from those that TriMet may directly undertake in support of the project.

Cumulative Impacts

The effects of the project will be evaluated in combination with other past, present, and reasonably foreseeable future actions. This includes other transportation or infrastructure projects or other planned or pending land use actions or developments in the study area, focusing on those that may occur with or without the project.

Mitigation Measures

Potential mitigation measures will be identified to address anticipated adverse impacts. Mitigation measures will focus on:

- Preserving or enhancing neighborhood cohesion and quality of life
- Minimizing the negative impact on historically marginalized communities

Documentation

Documentation of community impacts associated with the project alternatives will be summarized in an EIS section, with supporting background information provided in a technical memorandum available for review through Metro.

ECONOMICS ANALYSIS METHODS

Introduction

This report describes the methods that will be used to evaluate impacts to regional, city, and site-specific economic conditions for the Southwest Corridor Light Rail Project Environmental Impact Statement (EIS). This analysis will be developed to comply with the National Environmental Policy Act (NEPA), and local and state policies, standards, and regulations.

The economics analysis will address how the project affects regional economic conditions, fiscal conditions for cities, and the anticipated short-term and long-term economic effects and benefits of the alternatives on general economic activity. The analysis will consider the effects of the alternatives on business activity, including regional employment, and property tax revenue for affected jurisdictions.

Related Laws and Regulations

The following is a list of federal and state regulations and policies that guide the assessment of economic effects:

- National Environmental Policy Act of 1969, as amended
- Title 42 United States Code (USC) Section 4601, Federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended
- Federal Transit Administration, 23 Code of Federal Regulations (CFR) Part 771
- 49 CFR Part 611, Major Transit Capital Investment Projects
- Transit Cooperative Research Program, Report 35, Economic Impact Analysis of Transit Investments: Guidebook for Practitioners, 1998

Contacts and Coordination

Coordination outside the project team will include gathering information on property tax rates from state, county, and city sources. Within the project team, the economic analysis will draw from information on capital and operating costs, acquisitions and displacements, noise and vibration, transportation, and land use.

Data Collection

The following is a list of the data that will be analyzed in the Economics section of the EIS:

- General descriptions of the economies of the cities, counties, and the Portland region will be based on information collected from a variety of federal, state, and local sources, including the U.S. Census Bureau, U.S. Bureau of Economic Analysis, Oregon Department of Revenue, Metro, City of Portland Office of Management and Finance, and the community and economic development programs of the local jurisdictions.
- Information on population and employment will be based on 2035 forecasts developed by Metro in cooperation with local jurisdictions. These forecasts will be the same as those used to develop transportation demand and ridership forecasts, as discussed in more detail in the transportation analysis methods report. These data will be supplemented with employment

data from the Quarterly Census of Employment and Wages (QCEW) by the U.S. Bureau of Labor Statistics (previously known as the ES-202 program).

- Property acquisition information will be used to evaluate impacts to economic activity and property tax revenue. QCEW data will be used to estimate the potential number of businesses and jobs displaced as a result of property acquisitions. Assessed value by parcel and property tax rates will be used to quantify potential reductions in property tax revenue, which will be compared to the overall budgeted property tax revenue in each affected jurisdiction. Assessed valuations and tax rates for properties that may be acquired as a result of the project will be obtained from the Multnomah and Washington County Departments of Assessments.
- Capital cost estimates will be used to quantify short-term employment increases resulting from project construction. Operations and maintenance cost estimates will be used to calculate long-term employment resulting from the additional transit service. For both short-term and long-term employment, an economic impact assessment model will be used to generate estimates of economic output, employee compensation, and number of jobs. These estimates will include the direct, indirect, and induced effects of the project expenditures.

Affected Environment

Demographic and economic trends will be described at the regional level and by jurisdiction. Current and future households and employment will be summarized at regional and jurisdictional levels. The affected environment section will also examine the role of property taxes as a source of revenue for jurisdictions with potentially acquired privately owned parcels.

Impact Assessment

The impacts analysis will address the long-term and short-term economic and fiscal impacts of the project alternatives.

Long-Term Impacts

The analysis of long-term economic impacts will consider:

- Displacement of businesses and jobs as a result of property acquisitions.
- Reduction in tax revenue as a result of property acquisitions.
- The potential indirect effects of accelerated or more intense development around proposed light rail stations.
- Long-term employment resulting from transit operations and maintenance.
- Potential adverse and beneficial impacts to general economic activities along the corridor due to factors such as noise and vibration, and transportation changes including changes in access, circulation, multimodal mobility, or the levels of traffic and related activities.

Initial employment impacts will be based on the displacement of businesses and jobs as a result of property acquisitions. Long-term employment associated with the added transit service will be estimated using economic forecasting models, using the additional operations and maintenance cost of the build alternatives over the No-Build Alternative as an input.

Initial property tax revenue impacts will be based on the potential private property acquisitions associated with the project. The associated decrease in property tax revenues will be based on the

latest assessed value of potentially acquired parcels and property tax rate information from the Oregon Department of Revenue. The potential decrease in property taxes will be summed by jurisdiction and compared to each jurisdiction's annual budgeted property tax revenues.

The long-term impacts analysis will also consider the economic implications of potential direct and indirect impacts to nearby businesses. For example, existing nearby businesses could potentially be adversely affected by long-term changes in traffic patterns, access restrictions, parking loss, or unmitigated noise and vibration impacts. Property acquisitions associated with the project could also affect or alter existing business activity levels by removing a business or businesses that have activities related to the economic viability of surrounding enterprises.

Short-Term Impacts

The assessment of short-term impacts will review potential changes in business activity levels in the corridor due to the effects of construction activities such as access changes, reduced parking availability, or increased congestion.

The analysis of the short-term impacts will also estimate the employment generated during the project construction period due to an influx of capital construction funds. The economic impacts at the regional level are quantified as direct and indirect impacts. The direct impacts are the construction jobs created and the wages and benefits paid to the construction workforce. An economic assessment model will be used to estimate the direct, indirect, and induced economic effects of the construction expenditures, using the estimated project capital cost as an input.

Indirect Impacts

Indirect economic impacts could occur from other developments around station areas related to the light rail project. Most impacts for economics would be addressed through the direct long-term or construction impacts analysis, but the indirect impact assessment would consider other activities that may occur. Examples of these other activities include station area transit-oriented developments or street/transit system improvements that parties other than FTA and TriMet may undertake in support of the light rail project.

Cumulative Impacts

Based on the list of foreseeable transportation and other development projects that are anticipated to occur in the study area within the same time frame, a qualitative analysis of potential cumulative effects will be conducted for economic impacts. It is assumed that the list of foreseeable projects for this analysis will be based on information provided in the transportation and land use analysis. It is also assumed that the cumulative effects will be prepared for all elements of the environment based on this same list of foreseeable projects. The analysis of potential cumulative economic impacts will be examined for both near-term construction effects as well as long-term operational impacts.

Mitigation Measures

Potential mitigation measures will be identified for significant adverse economic impacts. This analysis may incorporate measures already being applied for other environmental topics, including acquisitions and displacements, transportation, land use, and community impacts.

Documentation

Documentation of economic impacts associated with the alternatives will be summarized in an EIS section, with supporting background information, references, and calculations including economic modeling information provided in a technical memorandum available for review through Metro. The Acquisition, Displacements, and Relocation section of the EIS will also be referenced.

ECOSYSTEMS ANALYSIS METHODS

Introduction

This report describes the methods that will be used to collect data and evaluate impacts to biological resources for the Southwest Corridor Light Rail Project. This analysis will be developed to comply with the National Environmental Policy Act (NEPA); federal, local and state policies, standards, and regulations; and to respond to comments made during environmental scoping.

The ecosystems analysis will focus on identifying and characterizing the biological resources that may be affected by the Southwest Corridor Light Rail Project. Biological resources include living organisms and the natural and physical environment in which they occur. For this study, these resources will be categorized as follows:

- Vegetation and wildlife – Vegetation communities, wildlife habitats, and characteristic plant and wildlife species.
- Fishery resources – Characteristic fish species and fish habitat including streams and riparian area.
- Wetlands – Wetland condition and functional characteristics.

Threatened, Endangered, and Sensitive (TES) plants, wildlife, and fish in the project study area will be discussed. The potential impacts of the alternatives on these and other biological resources will be reviewed, and the criteria for determining level of significance will be based upon regulatory guidelines, resource agency consultation, and review of locally regulated natural resources. For significant impacts, potential mitigation measures will be identified. The ecosystems section of the Environmental Impact Statement (EIS) will document the analysis and mitigation.

Related Laws and Regulations

Construction of the Southwest Corridor Light Rail Project will be subject to federal, state, and local regulations concerning potential impacts to biological resources. Therefore, a goal of conducting the ecosystems study and the Draft Environmental Impact Statement (Draft EIS) leading to a Final EIS is to prepare documentation that can support the environmental review of other agencies' permit decisions for the project following the Federal Transit Administration's (FTA's) Record of Decision (ROD) on the Final EIS. The principal regulations, ordinances, and permit actions that could apply to implementation of the selected alternative are summarized in Table 1 and discussed below.

Table 1. Summary of Potential Natural Resource Permit Requirements

Regulation/Permit	Responsible Agency	Documentation or Processes Required	Regulated Resources
Federal			
National Environmental Policy Act (NEPA)	Federal Transit Administration (FTA)	NEPA EIS addressing natural resource conditions, impacts, and mitigation	Human and natural environment, and related social and economic effects.

Regulation/Permit	Responsible Agency	Documentation or Processes Required	Regulated Resources
Clean Water Act (CWA) Section 404 Individual Permit	U.S. Army Corps of Engineers (USACE)	Alternatives analysis; wetland delineation study; wetland functional assessment and impact analysis; mitigation plan	Waters of the U.S., including wetlands
Federal Endangered Species Act (ESA) and Magnuson-Stevens Fishery Conservation Management Act	National Marine Fisheries Service (NMFS); U.S. Fish and Wildlife Service (USFWS)	Biological Assessment addressing project impacts to listed species, species proposed for listing, and candidate species	Vegetation, wildlife, fisheries
Fish and Wildlife Coordination Act	USFWS; NMFS; Oregon Department of Fish and Wildlife (ODFW)	Agency consultation; identify impacts to fish and wildlife resources; recommend mitigation	Vegetation, wildlife, fisheries
Federal Migratory Bird Treaty Act	USFWS	Identify impacts to migratory birds	Wildlife
Bald Eagle and Golden Eagle Protection Act	USFWS	Identify bald eagle nesting habitats; agency consultation	Wildlife
State			
Oregon Removal – Fill Permit	Oregon Department of State Lands (DSL)	Alternatives analysis; wetland delineation study; wetland functional assessment and impact analysis; mitigation plan	Waters of the state, including wetlands
Oregon State ESA	ODFW; Oregon Department of Agriculture (ODA)	Identify project impact to state listed and candidate species not currently listed under federal ESA	Vegetation, wildlife, fisheries
CWA Section 401 Water Quality Certification	Oregon Department of Environmental Quality (DEQ)	Assess project compliance with state water quality standards; implement mitigation measures	Rivers, streams, other bodies of water
Fish Passage Act	ODFW	Agency consultation; identify crossed streams with native migratory fish; implement passage at identified streams	Native migratory fish
Local			
Environment Zone Overlay	City of Portland	Identification of adverse impacts; impact minimization; mitigation plan; impact evaluation/alternatives analysis	Rivers, streams, wetlands and floodplains, vegetation, wildlife and fisheries
Title 11: Trees	City of Portland	Identification and mitigation of trees to be removed	Trees

Regulation/Permit	Responsible Agency	Documentation or Processes Required	Regulated Resources
Stormwater Management Plan – coordinated with water resources discipline	City of Portland	Manage impervious surface runoff and discharge points	Rivers, streams and wetlands
City of Tigard Sensitive Lands	City of Tigard	Identification of adverse impacts; mitigation plan	Vegetation, wildlife, fisheries
Title 8: Urban Forestry	City of Tigard	Identification and mitigation of trees to be removed, including significant tree groves	Trees
City of Tualatin Natural Resource Overlay Zone	City of Tualatin	Protection of natural resources and areas of public value	Vegetation, wildlife, fisheries
Clean Water Services Sensitive Areas	Clean Water Services	Sensitive areas pre-screening; delineation report; natural resource assessment report	Sensitive natural areas and vegetated corridors
Surface Water Management Agency of Clackamas County	Water Environment Services	Protection of natural resources and areas of public value; stormwater treatment plans	Sensitive natural areas and buffers

In addition to NEPA, the primary federal natural resource regulatory approvals that will be required include the Endangered Species Act (ESA) Section 7 process and the Clean Water Act (CWA) Section 404 permit. The federal ESA Section 7 process must be initiated when a federal action, such as funding or permitting, that could affect a species listed or proposed for listing under the federal ESA is undertaken. Section 7 of the ESA requires consultation with the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS). Additionally, an analysis of effects on Essential Fish Habitat under the Magnuson-Stevens Fishery Conservation Management Act (MSFCMA) would be conducted. Consultation under the federal ESA and the MSFCMA would be initiated once a preferred alternative is selected. A Biological Assessment (BA) is anticipated for the Final EIS.

Section 404 of the CWA regulates the discharge of dredged or fill materials into "waters of the U.S." (waters), which includes rivers, streams, wetlands, and some ditches. Applicants for Section 404 permits must demonstrate that all wetland and water impacts have been avoided to the extent practicable and that unavoidable impacts are compensated. An alternatives analysis may be required if the project impacts trigger an Individual Permit rather than a Nationwide Permit. That analysis would be completed after the NEPA process is completed, but the alternatives analysis in the EIS should address the CWA issues to the extent practicable.

In Oregon, permit applications for impacts to wetlands are jointly filed with the U.S. Army Corps of Engineers (USACE) (Section 404 permit) and the Oregon Department of State Lands (DSL) (Oregon Removal-Fill permit). Prior to approval of a Section 404 permit, the USACE needs to receive reviews and approvals through the following processes:

- ESA review by the USFWS and the NMFS
- Coordination with state and federal fish and wildlife agencies

- CWA 401 Water Quality Certification from the Oregon Department of Environmental Quality (DEQ).
- Section 106 Compliance from the State Historic Preservation Office (SHPO)

State Regulations

In Oregon, the principal state regulations for biological resources are the CWA Section 401 Water Quality Certification; the Oregon Removal-Fill Law; Oregon Fish Passage Law; and the Oregon ESA (see Table 2).

A Section 404 permit application for wetland and waters impacts triggers review for a Section 401 Water Quality Certification through DEQ. Approval of a post-construction stormwater management plan to address impacts from stormwater to waters and aquatic receptors is necessary prior to issuance of a Water Quality Certification.

The Oregon Removal-Fill Law requires a permit for any removal or fill activities within Essential Salmonid Habitat (ESH) or of 50 cubic yards or more in any other water of the state (including wetlands). This permit application will be filed jointly with USACE through the federal CWA Section 404 permitting process. DSL review of the joint application will also include consultation with the Oregon Department of Fish and Wildlife (ODFW), DEQ, the Department of Land Conservation and Development (DLCD), Washington County, the City of Portland, the City of Tigard, and the City of Tualatin.

The Oregon Fish Passage Law requires that passage for fish be maintained or restored in streams with current or historical presence of native migratory fish. Review of fish passage designs is conducted by ODFW.

The Oregon ESA gives the Oregon Department of Agriculture (ODA) and ODFW responsibility and jurisdiction over state TES species. These agencies, in cooperation with the USFWS, carry out research and conservation programs for plant and wildlife species under the auspices of the federal ESA. The Oregon Biodiversity Information Center (ORBIC) is a data storehouse that is a resource for species presence. Federal ESA Section 7 consultation with USFWS and NMFS includes consultation with ODFW for fishery issues and with ODA for federally listed plant species. See Table 2 for a broad list of potentially occurring state and federal TES species within the corridor. This list will be refined during the analysis and may include mainstem Willamette River and Columbia River fish species due to stormwater runoff.

Table 2. Potentially Occurring State and Federal Threatened, Endangered and Sensitive Plant and Wildlife Species in the Southwest Corridor (not including ORBIC data at this time)

Scientific Name	Common Name	Federal	State
Plants			
Erigeron decumbens var. *decumbens*	Willamette daisy	LE	LE
Howellia aquatilis	Water howellia	LT	–
Lomatium bradshawii	Bradshaw's lomatium (desert-parsley)	LE	LE
Lupinus sulphureus ssp. *kincaidii*	Kincaid's lupine	LT	LT
Delphinium leucophaeum	White rock larkspur	SoC	LE
Sericocarpus rigidus	White-topped aster	SoC	LT

Scientific Name	Common Name	Federal	State
Sidalcea nelsoniana	Nelson's checkermallow	LT	LT
Fish			
Lampetra tridentata	Pacific lamprey	SoC	SV
Acipenser medirostris	Green Sturgeon	SoC	_
Oncorhynchus clarki	Coastal cutthroat trout	–	SC
	Southern Washington/Lower Columbia River ESU		
Oncorhynchus keta	Chum salmon	LT(CH)	SC
	Columbia River ESU		
Oncorhynchus kisutch	Coho salmon	LT(CH)	LE
	Lower Columbia River/SW Washington ESU		
Oncorhynchus mykiss	Steelhead		
	Lower Columbia River ESU	LT(CH)	SC
	Upper Willamette River ESU	LT(CH)/SC	SC
Oncorhynchus tshawytscha	Chinook Salmon		
	Lower Columbia River ESU	LT(CH)	SC
	Upper Willamette River ESU	LT(CH)	–
Insects			
Icaricia icarioides fenderi	Fender's blue butterfly	LE	–
Birds			
Coccyzus americanus	Yellow-billed cuckoo	LT	SC
Eremophila alpestris strigata	Streaked horned lark	LT	SC
Strix occidentalis caurina	Northern spotted owl	LT	LT

Source: ODFW (2017); USFWS (2017); NMFS (2017)

Federal Status - USFWS and NMFS
LE - Listed Endangered.
LT - Listed Threatened.
C - Candidate for listing. (Taxa for which the U.S. Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.)
SoC - Species of Concern. (Taxa that was previously Category 1 (C1) or Category 2 (C2) candidates for which further information is needed to warrant listing as threatened or endangered.)
PDL – Proposed for Delisting.
CH - Critical Habitat has been designated for this species.

Oregon State Status – ODFW and ODA
LE - Listed Endangered.
LT - Listed Threatened.
C - Candidate for listing.
SC - Sensitive Critical: Taxa for which listing is pending.
SV - Sensitive Vulnerable: Taxa for which listing can be avoided through continued protection and monitoring.
SU - Sensitive Undetermined: Taxa for which the status in unclear.

Under Oregon land use regulations, local and state jurisdictions are required to compile inventories of wetland and other natural areas and protect the highest-ranking inventoried sites. Within the project corridor, this protection is provided by local regulations as discussed below.

Local Regulations

Permit approvals from local jurisdictions will include City of Portland Environmental Overlay Zone, City of Tigard Sensitive Land Overlay Zone, City of Tualatin Natural Resources Overlay Zone, and Clean Water Services Sensitive Areas and Vegetated Corridors (see Table 1).

The local jurisdictions' environmental zones, sensitive lands overlay zones, and other locally identified regulated areas are generally intended to provide protection for natural resource values that provide benefit to the public. Such areas include sites that meet the standards of Statewide Planning Goal 5 for open space, scenic, or natural values. In general, the overlay zones are intended to allow development in situations where adverse impacts from the development can be avoided or mitigated. The regulations of these ordinances provide guidelines for, among other things, identifying, protecting, and mitigating impacts, and managing important natural resources. Each jurisdiction has its own process for assessment and approval of development projects in the vicinity of sensitive ecosystem resources. The processes generally include an assessment of existing conditions, analysis of potential impacts from a project, and documentation of actions taken to avoid, minimize, or compensate for impacts to the resources.

Study Area

The approximate boundaries will be identified for rivers, outfalls, streams, wetlands, floodplains and riparian corridor functions within 50 feet of the edge of construction.

The study area for fish will include any downstream impacts for stormwater quality and hydrologic modifications. Impacts to ESA-listed species and Essential Fish Habitat will include an action area that extends to the ocean because of indirect effects to these species.

Inventory for wildlife will be 0.25 mile from the edge of construction for general habitats and impacts, but ground-truthing will not go that distance. The distance for ground-truthing will be determined based on the inventory data.

Contacts and Coordination

Coordination with resource and government agencies will be essential for obtaining regulatory approval of the project. Therefore, the following federal, state, and local agencies will be contacted regarding natural resources issues in the potentially affected area:

- U.S. Army Corps of Engineers (USACE)
- U.S. Fish and Wildlife Service (USFWS)
- National Marine Fisheries Service (NMFS)
- Oregon Department of State Lands (DSL)
- Oregon Department of Fish and Wildlife (ODFW)
- Oregon Department of Agriculture (ODA)
- Oregon Department of Environmental Quality (DEQ)
- Oregon Biodiversity Information Center (ORBIC)
- City of Portland
- City of Tigard
- City of Tualatin
- City of Lake Oswego
- Metro
- Clean Water Services

Data Collection

Before field studies are conducted, relevant data will be obtained to compile a natural resources database for guiding and supplementing field investigations. Information regarding vegetation, wildlife, fisheries, and wetlands will be obtained from a variety of sources that include, but are not limited to, the following:

- Local Wetland Inventories (LWI) maps (if available)
- National Wetlands Inventory (NWI) maps
- Natural Resources Conservation Service (NRCS)
- ORBIC database
- Oregon Department of Forestry (ODF) fish presence maps
- StreamNet Interactive Mapper
- City of Portland Environmental Zone Overlay
- City of Portland Natural Resources Inventory
- City of Portland Southwest Hills Resource Protection Plan
- City of Portland Fanno and Tryon Creeks Watershed Management Plan
- Clean Water Services Healthy Streams Plan
- City of Tigard Sensitive Lands Inventory
- City of Tualatin Natural Resources Inventory
- Metro's Regional Land Information System (RLIS) database
- Metro's Greenspaces Natural Resources Inventory
- Intertwine Regional Conservation Strategy
- Recent color and historical aerial photographs

Previous studies and reports will also be reviewed, including resource agency reports and various technical studies and manuals. Also included in this review will be federal, state, county, and local regulations and ordinances pertaining to natural resource protection. A list of the primary documents reviewed will be provided in the reference section of the Ecosystems Results Report.

A records search for property ownership on any large parcels with wetland features will be conducted to identify potential pre-established compensatory mitigation sites.

Affected Environment

Vegetation and Wildlife

Field evaluations for vegetation and wildlife will be conducted within 50 feet of the footprints of all alternatives. A vegetation map of the potentially affected area will be prepared using interpretation of aerial photographs, NWI maps, maps and data from previously prepared vegetation studies, and field surveys. Vegetation polygons will be classified by type using accepted classification systems for wetland and upland habitats. Wetland habitats will be classified according to the USFWS Classification of Wetlands and Deep Water Habitats (Cowardin et al. 1979) and hydrogeomorphic class (Adamus 2001). Classification of upland vegetation types will be based on descriptions of vegetation associations in Franklin and Dyrness

(1988) and the Intertwine Regional Conservation Strategy (2012), where appropriate. Final maps will indicate locations and areal extent of vegetation types along with sensitive plant associations, important wildlife habitat, and other key ecological features necessary to evaluate the alternatives.

Vegetation boundaries and classifications will be verified and refined as necessary in the field during reconnaissance-level field surveys for the Draft EIS; more-detailed surveys and field investigations may be conducted for the Final EIS, focusing on the Preferred Alternative and supporting permitting requirements for the project. Assessment of habitat quality will include consideration of factors such as native species composition, invasive species prevalence, past disturbance, edge effect, and degree of fragmentation and isolation.

The relative function of each plant community in providing a habitat to wildlife will be assessed based on field evaluations, literature and existing dataset (e.g., natural resource inventories) review, professional opinion, and agency consultation. Lists of observed and expected wildlife species will be compiled.

TES Plants and Wildlife

Reconnaissance-level surveys for plant species will not be conducted along the alternative alignments. Where specific rare plant species (i.e., those listed under state and federal ESAs) are already indicated in jurisdictional records/literature, the reconnaissance for rare plants will be conducted in conjunction with wetland reconnaissance. The need for conducting surveys for TES plants at specific locations within the study area will be determined in part by species' locational information obtained from an ORBIC database query, coordination with ODA and USFWS, and the presence of appropriate habitat conditions. If habitats identified as having the potential to support TES plant species cannot be surveyed, presence will be assumed.

Surveys for TES wildlife species will focus on habitat evaluation to predict the likelihood that TES species occur in the potentially affected area. Results of these surveys will be used to supplement information obtained from the resource agencies and existing reports.

Fisheries

An evaluation will be conducted to assess the existing conditions of all watercourses intersected or potentially impacted by the alternatives. These watercourses are assumed to consist of unnamed or locally named tributaries (such as Stephens Creek, Woods Creek, and Red Rock Creek) to the Willamette River, Tryon Creek, Tualatin River, and Fanno Creek.

Existing information will provide documentation of fish species known (or expected) to occur in the area. Consultation with local ODFW biologists and a review of available information about fish usage of the smaller tributary streams within the potentially affected area will assist in identifying potential impacts of the alternatives to these resources.

Existing information also will be used to develop a description of each watershed impacted by the alternatives. Aerial photography and existing geographic information systems (GIS) datasets (Metro, SSCGIS, and local jurisdictions') will be used to help determine riparian vegetation, degree of development, and other characteristics of these watersheds. A review of published data from local jurisdictions will also be conducted.

Field reconnaissance activities will be used to supplement and update existing fishery resource information. Stream corridors will be characterized by including descriptions of stream width,

riparian vegetation, streambank stability, in-stream habitat and cover, substrate composition, and fish passage obstructions. A photographic record of key habitat features, areas of degraded habitat, barriers, riparian condition, etc., will be made for each potential crossing area.

In addition to the general descriptions of stream corridor characterizations, information on existing (or potential) fish usage will be collected. Existing usage information consists of visual sightings of fish during the reconnaissance surveys and existing documentation. Potential fish usage will be estimated through existing distribution information, specific habitat features (e.g., spawning habitats), and by the identification of fish barriers at or below the project area or other physical factors that might limit use by particular species.

TES Fish

Consultation with resource agencies and a review of existing information will facilitate identifying the distribution of TES fish in the potentially affected area. Focused surveys for potentially occurring TES species will not be conducted; field surveys will instead focus on habitat evaluation (along with existing information) to help predict the likelihood that TES species occur in the potentially affected area. Therefore, field surveys for TES will focus on evaluating the habitat characteristics of the alignment's watercourses. Other species surveys performed will be cursory and will be conducted in conjunction with the fishery habitat assessment.

Wetlands

Wetlands will be identified and evaluated using definitions from USACE's Wetlands Delineation Manual (Environmental Laboratory 1987) and the Western Mountains, Valleys, and Coast regional supplement. Potential wetlands will be identified based on their likelihood of meeting the criteria for jurisdictional wetlands based on vegetation and surface hydrology. The approximate wetland boundaries will be hand mapped on digital aerial photographs, then digitized for use in GIS or, where property access is available, will be collected using a hand-held GPS data collector. In areas where property access is not possible, the location of likely wetland boundaries will be estimated using aerial photo interpretation; topographic information; review of NWI, LWI, and soils maps; and observations from adjacent areas where access is granted. After mapping likely wetland boundaries, the area of each wetland will be calculated and the total wetland area will be tabulated by alternative. Wetland quality will be assessed using professional judgment. Wetland delineations that meet USACE and DSL criteria for jurisdictional determinations will not be conducted for this Draft EIS process.

For streams, tops of banks and ordinary high water (OHW) elevations will be estimated in the field where possible, given property accessibility. The tops of banks and OHW elevations will be hand mapped on digital aerial photographs, then digitized for use in GIS.

Impact Assessment

Long-Term and Short-Term Impacts

The alternatives will be assessed for both long-term (permanent) and short-term (temporary) effects to biological resources. Long-term impacts are those that are associated with placement of facilities and operation of the project. Long-term impacts would include the irreversible removal, disturbance, or destruction of biological resources. Short-term impacts are generally associated with construction activities and would include reversible effects on biological resources. Impacts

to all resources will be evaluated quantitatively (or qualitatively, where appropriate) by alternative.

Vegetation and Wildlife

Project impacts to vegetation, wildlife, and wildlife habitats will be determined by evaluating quantities (i.e., acreage) of each vegetation type to be removed by each alternative. Impacts will also be assessed qualitatively by considering factors such as:

- The regional significance of the resource (e.g., priority habitats)
- Wildlife habitat value (including the site's role as a wildlife movement corridor)
- The degree of fragmentation and isolation of the habitat before (and following) project implementation
- Overall habitat quality
- Potential for enhancement or restoration

Construction and operation impacts to wildlife, including disturbances from increases in human access, noise, and light, will be assessed based on available data (including results of the noise and vibration analysis) and professional opinion. Potential impacts to vegetation and wildlife associated with water quality effects will be assessed using information presented in the water resources analysis for the project. Results from the water resources analysis will also be used to determine the potential for direct impacts to vegetation due to increases in soil erosion and streambed scouring (e.g., uprooting of trees and shrubs).

Population sizes for TES plant species encountered within the potentially affected area will be determined during field surveys if possible. Otherwise, areas of suitable habitat with likely presence will be quantified by size. Impacts will be assessed by determining direct losses to those populations, as well as by assessing potential indirect effects (both short- and long-term) associated with construction and operation. Status, size, and regional importance of populations and the potential for implementing successful mitigation measures (e.g., feasibility of propagation or transplantation) will be considered in determining significance of potential impacts.

Assessment of impacts to potentially occurring TES wildlife species will be based primarily upon determining the effects from project alternatives to suitable breeding and foraging habitat. Because focused surveys for most of these species are beyond the scope of this study, occurrence in the area will be determined by incidental observations, records of past sightings, habitat suitability, and consultation with resource agencies. Both direct habitat losses and decreased habitat quality due to indirect construction and operation-related effects will be assessed.

Although delisted under the ESA, the bald eagle is still protected under the Bald Eagle and Golden Eagle Protection Act. Consequently, an assessment of surrounding habitat will be conducted to determine likely nesting sites in the vicinity of the project. The assessment of impacts on breeding and nesting individuals will include identifying existing and predicted levels of noise, lighting, vibration, and human activity during both project construction and operation.

Fisheries

Field reconnaissance descriptions of existing fish habitats will be used to identify sensitive areas that should be avoided and/or protected during the construction process, as well as areas that

might be affected by long-term impacts associated with the alternatives. The descriptions will also identify existing problems or factors that limit fishery resources in the area that might be exacerbated by construction activities and long-term impacts (e.g., accelerated erosion processes caused by increased runoff from developed areas).

The potential effects to fishery resources will include the loss or alteration of fish habitats in tributary streams. This habitat likely consists of food supply areas that fish depend on indirectly. Since the largest supply of food items and nutrients supporting the aquatic food chain originates from outside the stream channel, fishery habitats also include the riparian or buffer zones and floodplains adjacent to the streams.

The alternatives cross several tributaries to the Willamette River, Tryon Creek, Tualatin River, and Fanno Creek. Many of the tributaries are officially unnamed, but several have local names such as Stephens Creek, Woods Creek, and Red Rock Creek. None of the crossed tributaries is known to contain ESA-listed fish or designated critical habitat within the project area. However, proposed activities will be assessed under the federal ESA to determine potential impacts to the habitat and fish runs downstream of the project area.

TES fish species and species protected under the Magnuson-Stevens Fisheries Conservation Management Act will be identified by determining fish usage of potentially affected waterways. Fish usage information is useful for verifying the appropriate in-water construction timing schedules to avoid or minimize impacts to these and other fish stocks. It will also be used to identify habitat quality and quantity and to determine the potential extent or significance of habitat impacts from project development. This information will be incorporated into the Draft EIS.

Additionally, after agency review of the Draft EIS, a Draft BA will be prepared to address Section 7 of the ESA. The Section 7 consultation process will be used to identify agency concerns with specific alignment and design alternatives and to discuss appropriate reasonable and prudent measures to minimize impacts to listed species. Through this process, project design criteria will be developed. Agency concerns likely to be relevant include the potential for water quality degradation during construction and long-term stormwater treatment from pollutant-generating impervious surfaces. Special/detailed studies that may be required in the future to identify significant impacts, such as pollutant loading, are currently beyond the scope of this investigation.

Wetlands

Impacts to wetlands will be evaluated by calculating the anticipated extent, duration, and magnitude of adverse effects to each wetland. The impact assessment considers direct wetland losses (i.e., filling), as well as indirect impacts associated with long-term operational and short-term construction-related impacts. Qualitative determinations of wetland quality will be completed. The environmental effects to wetlands from each alternative will be compared in tabular form and in discussions to satisfy requirements of the CWA 404(b)(1) Alternatives Analysis.

Indirect Impacts

Indirect impacts include those effects that are caused by the project later in time or farther removed in distance, but are still reasonably foreseeable. These may include effects related to station area developments by others, such as changes in the pattern of land use, population

density, or water quality through the project. Indirect impacts may also occur through the implementation of mitigation measures for other environmental impacts, or through supporting projects that are not yet defined or considered part of the project alternatives. Indirect impacts on ecosystem resources will be analyzed qualitatively.

Cumulative Impacts

The total effects of the project on ecosystem resources will be determined by combining the project's impacts with other past, present, and reasonably foreseeable future actions. These actions include other transportation or infrastructure projects, or other planned or pending land use actions or developments in the study area.

Mitigation Measures

NEPA EISs, as well as several environmental permits, require incorporation of mitigation into project designs to reduce or eliminate adverse project impacts to resources of concern. General mitigation measures, as defined under NEPA, will be evaluated and include the following:

- Avoiding the impact
- Minimizing the impact
- Rectifying the impact
- Reducing or eliminating the impact
- Compensating for the impact with substitute resources or environments (e.g., using methods from DSL to determine the appropriate replacement-loss ratio and type of wetland to create or enhance, or using the City of Portland's mitigation criteria). This compensation could include the use of wetland mitigation banking or through on- or off-site habitat mitigation.

The degree to which one or more of these measures is ultimately incorporated into the selected alternative will depend upon the potential impact and the mitigation standards required to meet various permit requirements. Compensatory mitigation for wetlands and other resources is included in the strategies below.

Vegetation and Wildlife

Conceptual mitigation strategies will be identified for significant impacts to wildlife habitats or populations. Mitigation for vegetation and wildlife impacts will be coordinated with mitigation planning for other related ecosystem impacts (e.g., wetlands).

Mitigation could potentially include the following:

- Reducing habitat fragmentation and maintaining wildlife travel routes by strategic placement of the project
- Screening sensitive habitats from project view and noise
- Enhancing vegetation associated with wetlands and water courses for wildlife

Fisheries

The area surrounding the project includes few, if any, fish-bearing streams likely to be directly affected by either project construction or operation. However, concerns with stream crossings include the potential for water quality degradation during construction, long-term stormwater treatment, and loss of floodplain functions. The Ecosystems section of the EIS will evaluate

these potential impacts and, through agency coordination with the project design team, develop potentially effective stream crossing methods and stormwater runoff management.

Potential approaches for addressing these concerns are listed below.

- Limit in-water construction to designated fisheries' windows as follows:
  - Tryon Creek: July 15–September 30
  - Other lower Willamette River tributaries: July 15–September 30
  - All Tualatin River tributaries including Fanno Creek: July 15–September 30
  - Tualatin River (below Scoggins Creek): June 1–September 30
- Provide treatment of stormwater runoff.
- Limit removal of riparian vegetation and restore/replant all areas temporarily disturbed during construction.
- Limit fill within floodplains and effects to floodplain functions.
- Construct bridges or open bottom culverts when feasible.
- Provide restoration and enhancement of fish habitat where feasible.

Wetlands

Conceptual mitigation measures (to avoid wetland filling or to compensate for filling or other adverse impacts to wetland functions) will be identified for each alternative. Compensatory mitigation requirements and potential wetland mitigation sites will be identified for all wetland impacts. Mitigation will be appropriate to compensate for adverse impacts to wetland functions.

Mitigation measures could include the following:

- Incorporation of design modifications to avoid or minimize impacts.
- Implementation of compensatory mitigation for unavoidable adverse impacts could include creation of new wetlands, restoration of former wetland habitat, or enhancement of existing wetlands where impacts are unavoidable.

Wetland mitigation will be coordinated with other ecosystem or water quality/hydrology mitigation planning to minimize mitigation costs and to ensure that a comprehensive approach to mitigation is achieved.

Documentation

The results of the ecosystems analysis will be documented in the Ecosystems Results Report, which will include the existing environment, the expected impacts of the project alternatives, and potential mitigation measures. The analysis, impact findings, and potential mitigation measures will also be summarized in the EIS.

After a Preferred Alternative has been identified, the analysis of the project's potential impacts to listed fish, wildlife, and plant species and fish species protected under the Magnuson-Stevens Fisheries Conservation Management Act will be further documented in a BA and submitted to the appropriate resource agencies. Although not anticipated, if any proposed or candidate species that may occur in the study area are designated, an assessment of impacts to these species also will be included in the BA, because some of those species could be listed prior to project

completion. The BA will evaluate the best available design information for the project and discuss measures to avoid or reduce impacts. The information in the Draft BA will be developed for FTA with NMFS and USFWS to ensure completeness and accuracy and to receive input about any additional information required for preparation of a Final BA and the completion of Section 7 ESA Consultation.

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ENERGY ANALYSIS METHODS

Introduction

This report describes the methods that will be used to collect data and evaluate impacts related to energy and energy use for the Southwest Corridor Light Rail Project. This analysis will be developed to comply with the National Environmental Policy Act (NEPA) and local and state policies, standards, and regulations. There were no comments specifically about energy impacts during environmental scoping, although Portland's Climate Action Plan (CAP) views transit to be a crucial element in achieving its goal to reduce carbon emissions.

Related Laws and Regulations

There are no overriding laws or regulations for the energy analysis, but there are industry best practices that are described below.

Contacts and Coordination

Agencies and organizations have been notified of the intent to prepare an Environmental Impact Statement (EIS) through the Federal Register and through other project outreach activities.

Data Collection

The methods used in the energy analysis were developed by the State of California Department of Transportation (CALTRANS), Division of Engineering Services, Office of Transportation Laboratory in 1978 and published as a study of the energy use in transportation systems. This study was updated in 1983 and has been adapted in practice for other light rail and transportation energy analyses used in environmental reviews by Federal Transit Administration (FTA) as well as Federal Highway Administration (FHWA). The basis of the methods is a CALTRANS computer model developed to establish factors for calculating long-term and short-term energy used by transportation alternatives. The Metro regional model provides similar information, including estimates of travel by mode; light rail is an option as well as is travel by cars and trucks. For the purposes of this energy analysis, factors developed for the CALTRANS model will be updated where necessary. For example, existing and predicted fuel consumption/efficiency factors will be modified based on EPA's and others' estimates, and new cost conversion factors will be developed for construction, including information from other recent projects where construction cost information includes energy consumption costs.

Affected Environment

There will be a general review of current energy use and supply in the Portland metropolitan area for the major types of energy sources. The review will address petroleum (gasoline, diesel, oil, and natural gas), electricity, and renewable resources such as wood, solar, and hydropower. The review will also include a summary of the sources of supply, usage rates, and demand forecasts for energy.

Existing operational energy use for transportation will be determined for general road vehicles (automobiles, motorcycles, trucks, and buses) and the light rail transit (LRT) system. The method for determining existing energy use for vehicles and for LRT and related facilities is summarized below.

Computations for determining energy use for vehicles are:

- Vehicle types are separated into eight categories including light-duty gasoline automobiles, light-duty gasoline trucks, medium-duty gasoline trucks, heavy-duty gasoline trucks, light-duty diesel automobiles, light-duty diesel trucks, heavy-duty diesel vehicles (trucks and buses), and motorcycles.
- The percent of total vehicle miles traveled (VMT) is estimated for each vehicle type. (Total daily VMT is provided by Metro and percent of VMT by vehicle type is provided by the Oregon Department of Environmental Quality [DEQ].)
- The percent of VMT is multiplied by total daily VMT to calculate the daily VMT for each vehicle type.
- Daily VMT is divided by average fuel consumption in miles per gallon for each vehicle type to determine the daily fuel consumption in gallons for each vehicle type. (FHWA provides information on fuel consumption per vehicle type.)
- Finally, the daily fuel consumption is multiplied by a constant (British thermal units [Btu]/gallon of gas or diesel) to give the daily vehicle energy consumption (in Btu) for each vehicle type. (Energy content for gasoline and diesel in Btu is derived from *Comparative Energy Costs of Urban Transportation Systems* by Margaret Fels, 1974.)

Energy use for LRT is determined using the following computations:

- The number of light rail car miles traveled is multiplied by the average electrical energy consumption factor in kilowatt-hours to get the total kilowatt-hours of electrical use. (Light rail car miles are provided by Metro, and the energy consumption factors are provided by TriMet.)
- Total kilowatt-hours are multiplied by a Btu conversion factor to determine energy consumption in Btu for light rail.

Impact Assessment

The energy impacts analysis is separated into two primary components: long-term and short-term impacts. The short-term impact analysis focuses on estimating the energy that will likely be used during construction for each alternative. The assessment of long-term impacts estimates energy consumption required for operation of each alternative, including modes of transportation such as automobiles, trucks, buses, motorcycles, and light rail.

Long-Term Impacts

The regional travel demand model would be used to categorize and estimate VMT for alternatives by vehicle type, road type, and speed. Long-term impacts would consist of energy consumed for operation of the vehicle transportation system including operation and maintenance of the light rail and bus systems, maintenance facilities, and park-and-ride lots. The direct impacts of the alternative would be illustrated by the change in regional energy consumption as a result of the project, based on VMT (i.e., mode shift and improved operations on roadways).

Short-Term Impacts – Construction Energy Use

The short-term impact analysis will use two approaches to determine energy use for construction: input-output analysis and process analysis.

The input-output analysis approach is based on an economic model developed by CALTRANS that uses factors developed for energy consumption per dollar value. Based on the dollar value of the material to be analyzed, an energy consumption factor is applied, and total energy consumption is estimated. The CALTRANS model uses an input-output approach that derives short-term energy consumption estimates from projected energy consumption per dollar of construction cost. For the purposes of the short-term impacts analysis, project costs will be divided into eight main categories: utilities, stations, signals/communications, track work, structures, maintenance facility, roadway, and park-and-ride spaces.

The process analysis approach attempts to measure energy consumption in the actual processes of manufacturing or construction. For the purpose of this energy analysis, the process analysis approach is used to determine energy use for vehicle manufacture—for LRT, cars and buses.

Construction energy impacts under the No-Build Alternative consist of the energy consumed to develop planned road improvements based on costs provided by TriMet. The CALTRANS model is used to determine a Btu/dollar conversion factor. The road improvement costs will be multiplied by the Btu/dollar conversion factor to get the estimated energy consumption in billions of Btu.

Construction energy consumption for the alternatives will be calculated using the CALTRANS model and construction cost estimates from TriMet and Metro. Total construction energy for the build alternatives is based on the dollar figure of each construction component and the number of vehicles.

Indirect Impacts

Indirect impacts to transportation-related energy use, such as future changes to land use and density, would largely be captured in the Metro regional travel demand model, and, therefore, the scale of analysis assumed for direct impacts would also account for indirect impacts. Additional qualitative text could be provided to discuss the limitations of the regional demand model and the extent to which indirect impacts are quantitatively addressed.

Cumulative Impacts

Similar to indirect impacts, cumulative impacts to transportation-related energy use, which consider planned projects and policies within a geographical area, are also accounted for the in Metro regional travel demand model, and, therefore, the analysis of direct impacts due to changes in transportation-related energy use would also be cumulative in nature. While a more complex array of other factors affect the overall conditions for energy supply and demand at the regional level as well as nationally and globally, these types of changes are considered beyond the scope of the proposed project and are not proposed for additional detailed discussion. Brief additional text will be provided to explain the context for the regionally based transportation-related energy demand effects, compared to larger scale conditions in the energy marketplace.

Mitigation Measures

Mitigation for adverse energy impacts involves the utilization of project inputs, materials, or design parameters, which offer energy economies. NEPA does not require substantive mitigation for direct, indirect, or cumulative project impacts, but only prescribes the required process. The Act does not mandate that a project achieve any particular result; "[i]f the adverse environmental effects of the proposed action are adequately identified and evaluated, the agency is not constrained by NEPA from deciding that other values outweigh the environmental costs" (Robertson v. Methow Valley Citizens [May 1, 1989]). Industry best practices involve the use of mitigation measures to reduce any identified wasteful, inefficient, or unnecessary energy consumption, to the extent practicable, which may occur during all phases of the project.

Most recent environmental reviews of light rail projects have not identified adverse long-term impacts, and short-term construction energy use has also not created impacts related to supply and demand. Still, a major project such as this consumes energy during construction. If adverse impacts are identified, proposed mitigation measures will be identified.

Documentation

Impacts related to energy use will be discussed in the energy section of the EIS. The EIS section will be summary-level, focused primarily on identifying the long-term and short-term construction period impacts. Background information, existing conditions information, and details of the analysis, including calculations, will be in a technical memorandum available for review through Metro.

ENVIRONMENTAL JUSTICE ANALYSIS METHODS

Introduction

This report describes the methods that will be used to collect data and analyze impacts to environmental justice communities with respect to the Southwest Corridor Light Rail Project, and to determine whether the project will result in disproportionately high and adverse effects on minority or low-income populations. This analysis will be developed to comply with the Federal Transit Administration (FTA) guidance; National Environmental Policy Act (NEPA); other federal, local and state policies, standards, and regulations; and to respond to community concerns raised through environmental scoping.

The environmental policies of the USDOT agencies, including the FTA, are summarized below. The agencies are to:

1. Avoid, minimize, and mitigate disproportionately high and adverse effects on minority and low-income populations.
2. Ensure full and fair opportunities for public involvement by members of minority and low-income populations during the planning and development (including the identification of potential effects, alternatives, and mitigation measures).
3. Prevent the denial of, reduction in, or significant delay in the receipt of benefits by minority and low-income populations.

FTA environmental justice policy guidance (FTA Circular C 4703.1) defines a disproportionately high and adverse effect as one that:

- Is predominantly borne by a minority or low-income population, or
- Will be suffered by the minority population and/or low-income population and is appreciably more severe or greater in magnitude than the adverse effect that will be suffered by the non-minority population and/or non-low-income population.

The USDOT Order also provides guidance that, "In making determinations regarding disproportionately high and adverse effects on minority and low-income populations, mitigation and enhancement measures that will be implemented and all offsetting benefits to affected minority and low-income populations may be taken into account, as well as the design, comparative impacts, and the relevant number of similar existing system elements in non-minority and non-low-income areas" (USDOT 5610.2(a) Section 8(b)).

Critical issues to be discussed in the Environmental Justice Technical Report include:

- Are there potential environmental justice populations in the analysis area?
- Are there community resources in the analysis area that are important to environmental justice populations?
- Will the proposed project have direct or indirect effects on environmental justice populations? Will any such effects be high and adverse?
- Will the proposed project result in direct or long-term indirect effects to community resources important to environmental justice populations? Will any such effects be high and adverse?
- If the proposed project will have high and adverse effects on environmental justice populations, will any such effects be disproportionate?

- Will the project have benefits for environmental justice populations?
- What fair and full opportunities do environmental justice populations have to participate in project planning and decision making, and identification of potential effects, alternatives, and mitigation measures?

Previous outreach to environmental justice and Title VI populations in the region has identified five primary benefits and burdens of significance: (1) access to important community services such as employment, education, affordable housing, health care, and retail services; (2) project impacts and changes in property values; (3) exposure to environmental impacts; (4) safety and security; and (5) displacement and lack of housing affordability.

Related Laws and Regulations

Federal

- Title VI of the Civil Rights Act of 1964
- Age Discrimination Act of 1975
- Americans with Disabilities Act of 1990 (ADA)
- Federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended
- Presidential Executive Order 12898 – Federal Actions to Address Environmental Justice to Minority Populations and Low-Income Populations
- Presidential Executive Order 13166 – Improving Access to Services for Persons with Limited English Proficiency
- U.S. Department of Transportation Order 5610.2 – Order to Address Environmental Justice in Minority Populations and Low-Income Populations
- Title 42 United States Code (USC) Section 4601, Federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended
- Title 49 of the Code of Federal Regulations (CFR) Part 21, Nondiscrimination in Federally Assisted Programs of the Department of Transportation, Effectuation of Title VI of the Civil Rights Act of 1964
- U.S. Department of Transportation (USDOT) Federal Transit Administration (FTA), Circular FTA C 4702.1B, Title VI Requirements and Guidelines for Federal Transit Administration Recipients (October 1, 2012)
- USDOT FTA, Final Circular FTA C 4703.1, Environmental Justice Policy Guidance for FTA Recipients (August 15, 2012)
- Community Impact Assessment: A Quick Reference for Transportation, Publication No. FHWA-PD-96-036 (September 1996)

State and Local

- City of Portland Affordable Housing Policy, Ordinance 00-882C, Housing and Affordable Housing: The Portland Metro Council adopted an ordinance on January 18, 2001, amending the Regional Framework Plan and the Urban Growth Management Functional Plan to ensure a choice of housing types and to help reduce regulatory barriers to affordable housing.

Contacts and Coordination

Metro's public outreach program will include a targeted effort to engage these populations in the public decision-making process for the Southwest Corridor Light Rail Project. Public outreach will be used to supplement or refine the information above and ensure these households have meaningful opportunities to participate in the process. Outreach will include coordination with the project Community Advisory Committee, any project-specific community groups, and other stakeholders, as appropriate. Other information may come from scoping comments, community meetings, open houses, coordination with community-based organizations, local school involvement, informational tables at community events, and community media. A detailed list of proposed activities for outreach and involvement of minority and low-income communities will be provided in the project's Public Involvement Plan.

Study Area

The environmental justice analysis will study direct and indirect impacts on low-income and minority populations. The direct impact study area for environmental justice is defined as the outer limits of the composite study area of other environmental topics (transportation being the most broad, however), and will include all census geographies that fall either completely or partly within this boundary.

The indirect impacts study area will represent a similar boundary but will incorporate impacts that may occur as a secondary effect of the project, such as intensified development in station areas and other activities or environmental changes that are not directly related to the development and operation of the project, or that are separated in time from the project action.

Data Collection and Affected Environment

Demographics

The project team will use geographic information systems (GIS) to identify and map 2010 U.S. Census data for all block groups entirely or partially in the study areas. This will include census data pertaining to race and ethnicity, poverty status, and means of transportation to work. The 2014 American Community Survey and analysis from Metro used for the demographic analysis in the Regional Transportation Plan will provide additional information to update or confirm the U.S. Census data in the study areas.

In addition, the project team will work with local service organizations to supplement demographic information with client demographics, and to potentially conduct focus groups that will provide information on the location of minority populations and community resources if the demographic analysis and public outreach result in comments suggesting this is appropriate. Staff will review all of the information from prior public and environmental justice–specific outreach to help verify findings. Ongoing public outreach throughout the study period will also supplement these findings.

Information about existing and planned low-income housing projects that are within about 0.5 mile of the study area will be obtained from public housing authorities (Home Forward, Multnomah Housing Authority, Washington County Housing Services, and others as appropriate).

In the 2010 U.S. Census, minority is defined as individuals listed as:

- Black or African American: A person having origins in any of the black racial groups of Africa.
- Hispanic or Latino: A person of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race.
- Asian American: A person having origins in any of the original peoples of the Far East, Southeast Asia, and the Indian subcontinent.
- American Indian/Alaskan Native: A person having origins in any of the original people of North and South America (including Central America) and who maintains tribal affiliation or community attachment.
- Native Hawaiian or Other Pacific Islander: A person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands.
- Some other Race: Includes all other responses not included in the White, Black or African American, American Indian/Alaskan Native, Asian American, and Native Hawaiian or Other Pacific Islander race categories described above. Respondents reporting entries such as multiracial, mixed, interracial, or a Hispanic or Latino group (for example, Mexican, Puerto Rican, Cuban, or Spanish) in response to the race question are included in this category.

At a minimum, low-income is defined by FTA as a person whose household income is at or below the U.S. Department of Health and Human Services poverty guidelines of $24,257 (2015 threshold) for a family of four. The Southwest Corridor Light Rail Project will use the regionally adopted definition of low-income, which is 200 percent of the federal poverty level, adjusted for household size because of the high cost of housing in Portland and surrounding areas.

Identify Community Facilities and Resources

Information on location of significant community facilities and resources gathered from previous stages of the project will be used for initial identification of community facilities and resources, including community services that are culturally specific and/or of cultural importance to communities of color and immigrant and refugee communities. In addition, the project team will work with local service and community organizations to supplement information on key community resources and to conduct focus groups that will provide additional information. Staff will review all prior public and environmental justice–specific outreach information to help verify findings. Ongoing public outreach throughout the EIS development will also supplement these findings.

For this assessment, community facilities and resources will be defined as ethnic grocery and retail stores, religious facilities, parks, affordable housing, and community centers and gathering places that serve environmental justice populations.

Impact Assessment

Per FTA Circular C 4703.1 (August 15, 2012), the environmental justice impact analysis will include:

- A description of the low-income and minority populations within the study areas affected by the project, if any, and a discussion of the method used to identify them.

- A discussion of all adverse effects of the project both during and after construction that would affect the identified minority and low-income populations.
- A description of the project's mitigation and environmental enhancement actions that will avoid or minimize potential effects (e.g., a relocation program that goes beyond the Uniform Relocation Act and addresses adverse community effects such as separation or cohesion, and measures to replace community resources removed by the project).
- A discussion of the remaining effects, if any, and why further mitigation is not proposed.
- A discussion of all positive effects for the identified minority and low-income populations, such as an improvement in transit service, mobility, or accessibility.
- For projects that travel through predominantly minority and low-income and predominantly non-minority and non-low-income areas, a comparison of mitigation and environmental enhancement actions that could affect these different populations, including the specific impact the measures are intended to address.

The location, intensity, and duration of potential environmental effects within the study area will be reviewed based on information from the following draft discipline reports (including long-term, short-term, indirect, and cumulative effects):

- Acquisitions and displacements
- Air quality
- Water quality
- Economics
- Historic, archaeological, and cultural resources
- Land use
- Noise and vibration
- Public services
- Utilities
- Parks and recreation
- Community impacts
- Transportation
- Visual quality

The analysis of potential disproportionately high and adverse effects on minority and low-income populations considers the No-Build Alternative and the build alternatives. Direct construction and long-term effects, indirect and secondary effects, and cumulative effects will be examined for all elements of the environment. The analysis also will examine project benefits accruing to minority and low-income populations that may offset effects that could not be avoided or otherwise mitigated. The primary sources for this analysis will be the technical reports and the EIS sections prepared for transportation and other environmental elements, as noted above. The analysis will also consider public comments received from minority or low-income groups through its outreach and public involvement program, which will include notices to potentially affected property owners.

The effects of each environmental element will be reviewed to determine whether the alternatives would result in significant adverse effects, notwithstanding proposed mitigation measures. Project impacts that were effectively mitigated would not cause disproportionately high and adverse effects.

Where high and adverse effects are identified, they will be examined more closely using U.S. Census data and effect locations identified in the relevant discipline reports to assess whether they disproportionately affect minority or low-income populations.

Using the results of the steps described above, the project team will determine the likelihood that the project would have disproportionately high and adverse effects on minority or low-income populations. Six questions will be discussed to help make this determination:

1. Would the project result in high and adverse effects?
2. Does the project affect a resource that is especially important to a minority or low-income population? For instance, does the project affect a resource that serves an especially important social, religious, or cultural function for a minority or low-income population?
3. Would the project result in high and adverse effects that would be predominantly borne by a minority or low-income population?
4. Would the project result in high and adverse effects that would be suffered by a minority or low-income population that would be appreciably more severe or greater in magnitude than the effect that would be suffered by the non-minority and/or non-low-income population?
5. Does the project propose mitigation and/or enhancement measures?
6. Are there project benefits that would accrue to minority or low-income populations?

Following evaluation of these six questions, a final determination will be made as to whether or not the project would likely result in disproportionately high and adverse effects on minority or low-income populations.

Mitigation Measures

Mitigation and enhancement measures to offset any impacts to environmental justice populations will be analyzed. This analysis will take into account the positive benefits of project implementation as well as offsetting any negative impacts.

Documentation

The results of the environmental justice analysis will be documented in the Environmental Justice Results Report. The results report will document the targeted outreach activities to low-income and minority populations, location of these populations, the expected impacts of the alternatives, potential mitigation measures, and project benefits. The analysis will also be summarized in the EIS.

GEOLOGY AND SOILS ANALYSIS METHODS

Introduction

This report describes the methods that will be used to collect data and evaluate impacts related to geology and soils for the Southwest Corridor Light Rail Project. This analysis will be developed to comply with the National Environmental Policy Act (NEPA) and local and state policies, standards, and regulations. This report describes methods and data sources that will be used to identify existing geologic (hydrogeologic and seismic) and soils conditions for the Southwest Corridor Light Rail Project. These existing conditions will be reviewed in order to evaluate potential conditions that may affect project design, schedule, and costs for proposed alternatives, or resources and conditions that could be impacted by the project.

Design efforts to date are conceptual, which results in limited site-specific or parcel-level field investigation for soil characteristics, engineering properties, or seismic hazards. Site-level information and characterizations of risk are more typically developed during the preliminary to final design phases of a project, after an alignment has been selected.

Related Laws and Regulations

There are no specific regulations and laws pertaining to geology or soil that are applicable to the study area. However, the Environmental Procedures Manual published by Oregon Department of Transportation (ODOT 2002) establishes generally accepted industry practice for transportation projects.

Contacts and Coordination

Agencies and organizations have been notified of the intent to prepare an Environmental Impact Statement (EIS) through the Federal Register and through other project outreach activities. Interested organizations will have the opportunity to review and comment on the geologic and hydrogeologic conditions analysis throughout the course of the project.

The following agencies may be contacted or be cited as data sources for the collection of data and review of project alternatives:

- The U.S. Army Corps of Engineers (USACE)
- The U.S. Geological Survey (USGS)
- The U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS)
- Oregon Department of Transportation (ODOT)
- Oregon Department of Geology and Mineral Industries (DOGAMI)
- Oregon Department of State Lands (DSL)
- Oregon Department of Environmental Quality (DEQ)
- Oregon Water Resources Department (OWRD)
- Local county, city, and regional agencies

Data Collection

The data required for evaluating how construction may be impacted by geologic properties (e.g., what are the seismic and slope hazards?) and how the construction may impact geology (e.g.,

will construction reactivate a landslide?) will be obtained from existing technical reports, maps, and other public information. Existing maps and technical reports published by the USGS, DOGAMI, local and state agencies with past or current projects in the study area, and NRCS will be reviewed for pertinent geologic, hydrogeologic, seismic, and soil property information. Information developed for the project's conceptual engineering efforts and previous planning will also be reviewed.

Affected Environment

The Affected Environment section will be established based on the results of the data collection efforts, and will be briefly describe geologic conditions related to the project's setting, construction and permanent operation.

Impact Assessment

After existing conditions are ascertained, the effect of these conditions on proposed alternatives will be evaluated. The effect of geologic and hydrogeologic conditions on the project is dependent on physical properties and their responses to external forces. These forces include, but are not limited to, severe ground shaking, settlement and/or liquefaction associated with a seismic event, expansion and/or contraction of soils, landslides/rockfalls/rockslides from steep or altered slopes, and erosion. A significant geologic impact would expose people and/or structures to potentially adverse effects including damage, loss, injury, or death.

The potential impacts of the project on the existing conditions (resources) will also be evaluated. Potential conditions can include geologic resources (i.e., aquifers) and fragile soils. A significant impact to these conditions or resources includes degradation of the quality of the condition or resource.

The study will address any known or potential geologic and/or soil hazards that may impact the project. However, a more detailed geotechnical evaluation will be developed as design efforts advance through the Final EIS and into final design.

Short-Term and Long-Term Impacts

Geology and Material Resources

Geology and material resources include DOGAMI-published geologic maps with private quarry and borrow materials sites. The information will be based on surficial geology by aerial photography interpretation or other remote sensing and/or ground reconnaissance techniques available in the geologic references. Short- and long-term impacts will be assessed by evaluating what potential resources would be affected.

Groundwater Hydrology

The groundwater hydrology impacts will be based on the location and definition of groundwater resources. The information will be obtained through a literature search of existing hydrology publications and documents and coordinated with the water resources analysis. Short- and long-term impacts will be assessed by evaluating how construction and operation of the alternatives and options will affect groundwater quality.

Seismic Hazards

The seismic hazards analysis will evaluate how geology in the study area behaves under seismic forces. This evaluation will be based on a review of existing data of past seismic events and

probabilistic analysis of future events. Short- and long-term impacts will be assessed by evaluating the relative earthquake hazard of the study area.

Soil Hazards

The soil hazards analysis will evaluate how the soil in the study area behaves when acted upon by external forces. The short-term and long-term impacts will be assessed by evaluating what soils underlie the alternatives and what the characteristic adverse behaviors of those soils are.

Indirect Impacts

The analysis will qualitatively evaluate potential indirect effects, such as aggregate supplies, and erosion-caused damage to drainage areas or water quality.

Cumulative Impacts

Cumulative effects related to geology and soils will be evaluated by considering the potential longer-term impacts of this project and other past, present, and reasonably foreseeable actions that affected or would affect the geology and soils of the study area and/or region.

Mitigation Measures

Upon completion of the impact assessment, general measures will be suggested for the mitigation of geologic and soils impacts. Potential mitigation measures will correspond to the extent practical to those in other technical disciplines, such as water quality and geotechnical.

Documentation

Existing geology and soils conditions and impacts will be discussed in the Geology and Soils section of the EIS. The EIS section will be summary-level and focused primarily on identifying the long-term and short-term/construction period impacts to geology and soils. More detailed discussions of the background information used, existing conditions information, and details of the analysis will be provided in a technical memorandum on file with Metro and available for review by interested parties.

HAZARDOUS MATERIALS RESULTS METHODS

Introduction

This report describes the methods that will be used to collect data and identify potential hazardous material or hazardous waste sites affecting the Southwest Corridor Light Rail Project. This analysis will be developed to comply with the National Environmental Policy Act (NEPA) and federal, state, and local policies, standards, and regulations.

This report describes the data sources and methods that will be used to identify potential hazardous material or hazardous waste sites within the project study area which is defined as the area within 400 feet on each side from the edge of construction. Hazardous wastes are defined in 40 Code of Federal Regulations (CFR) 261.3 as those specifically named in the regulation or as substances exhibiting ignitability, corrosivity, reactivity, or toxicity. A hazardous materials site is a location or facility which has a known or suspected recognized environmental condition (REC).

The term *recognized environmental condition* is defined in American Society for Testing and Materials (ASTM) E 1527-13 as:

> ...the presence or likely presence of any hazardous substances or petroleum products on a property under conditions that indicate an existing release, a past release, or a material threat of a release of any hazardous substances or petroleum products into structures on the property or into the ground, groundwater or surface water of the property. The term includes hazardous substances or petroleum products even under conditions in compliance with laws.[1] *The term is not intended to include de minimus conditions that generally do not present a material risk of harm to public health or the environment and that generally would not be the subject of an enforcement action if brought to the attention of appropriate governmental agencies*.

In accordance with ASTM Standard E1527-13, some RECs may be further defined as historical recognized environmental conditions (HRECs) or controlled recognized environmental conditions (CRECs).

An HREC is defined as:

> …*a past release* of any *hazardous substances* or *petroleum products* that has occurred in connection with the *property* and has been addressed to the satisfaction of the applicable regulatory authority or meeting unrestricted use criteria established by a regulatory authority, without subjecting the *property* to any required controls.

A CREC is defined as:

> …a recognized environmental condition resulting from a past release of hazardous substances or petroleum products that has been addressed to the satisfaction of the applicable regulatory authority, with hazardous substances or petroleum products allowed to remain in place subject to the implementation of required controls.

[1] Asbestos is not considered a hazardous substance under state rules. Asbestos has been found to be a human carcinogen. There is no regulatory safe level for human exposure to asbestos containing materials (ACMs).

For the Environmental Impact Statement (EIS), the purpose of the hazardous materials analysis is to identify hazardous substances sites of concern and to comparatively evaluate the environmental issues they may present to the construction and operation of the alternatives. The analysis will also identify potential avoidance and mitigation measures, including applicable regulatory standards that could be used to minimize risk. Methods and data sources presented in this report are based on existing information and best professional judgment. However, they may not identify or be inclusive of all RECs in the study area. As the project enters later development stages, including advanced design, property acquisition, and construction, more detailed environmental engineering investigations and analysis will be conducted, including the development of appropriate site-specific management plans.

Related Laws and Regulations

Federal and state laws regulate the generation, sale, use, transportation, and disposal of hazardous materials in the project area, as well as cleanup and reuse of sites contaminated by hazardous materials. Regulatory records will be reviewed to determine which sites may impact the project area.

Federal Environmental Protection Agency (EPA) Laws

The following federal rules and regulations will guide data collection for hazardous material sites in the study area. These rules and regulations are implemented and enforced by the U.S. Environmental Protection Agency (EPA):

- Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) 1980 (42 United States Code [USC] 9601 et seq.)
- Resource Conservation and Recovery Act (RCRA) of 1976 (42 USC 6901 et seq.)
- The Superfund Amendments and Reauthorization Act (SARA) of 1986 (42 USC 9601 et seq.)
- The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) of 1972 (7 USC 136 et seq.)
- The Toxic Substances Control Act (TSCA) (15 USC [C. 53] 2601-2692)

State of Oregon and Local Government Regulations

The following state and local rules and regulations have guided data collection for hazardous material sites in the study area. These rules and regulations are implemented and enforced by the Oregon Department of Environmental Quality (DEQ):

- Hazardous Waste and Hazardous Materials I and Hazardous Waste and Hazardous Materials II (2003 Oregon Revised Statutes [ORS] 465 and 466, as amended)
- Underground Storage Tank Rules, 1990 (Oregon Administrative Rules [OAR] 340-150)
- Residential Heating Oil Underground Storage Tanks, 1998 (OAR 340-177)
- Groundwater Quality Protection, 1998 (OAR 340-040)
- Environmental Hazards Notice, 1998 (OAR 340-130)
- Standards Applicable for Dry Cleaning Stores Facilities and Dry Stores, 2002 (OAR 340-124)

- Illegal Drug Lab Cleanup Assistance, 1999 (OAR 340-140)
- Hazardous Waste Management System, 2003 (OAR 340-100 to 110, 120, 124 and 142)
- Hazardous Substance Remedial Action Rules, 1997 (OAR 340-122)

Contacts and Coordination

Agencies and organizations have been notified of the intent to prepare an EIS through the Federal Register and other project outreach activities. Interested organizations will have the opportunity to review and comment on the hazardous materials analysis through the course of the project, including during the public comment period for the Draft EIS.

The following agencies are sources of data that are expected to be used for the analysis:

- U.S. Environmental Protection Agency
- Oregon Department of Environmental Quality
- Oregon Water Resources Division
- Oregon Division of Consumer and Business Services
- Oregon State Fire Marshall
- Local agencies, as applicable

Study Area

The hazardous materials study area will be within 400 feet from the edge of the project construction. All database searches will extend out to 1/8 mile (660 feet) from the edge of project construction.

Affected Environment

Existing conditions within the study area will be assessed for the presence or suspected presence of hazardous substances and petroleum products. Procedures for the assessment were developed to comply with NEPA and address other federal, state, and local regulations and policies. This assessment includes review of the following:

- Federal and state environmental databases for potential sites within the study area
- Historical and existing land uses

The review will use available Sanborn Fire Insurance Maps and aerial photographs.

Regulatory Databases

A search of federal and state regulatory database records will be conducted by Environmental Data Resources, Inc. (EDR) of Milford, Connecticut. The database search report will meet the government records search requirements of ASTM E1527-13 Standard Practice for Environmental Site Assessments. A detailed list of environmental databases is presented in Table 1. Archived regulatory files are not considered reasonably ascertainable and therefore will not be reviewed. The databases listed in Table 1 will provide information regarding known as well as potential hazardous materials sites.

Table 1. Environmental Database Search Data Sources

Database Abbreviation	Database Name
Federal ASTM Standard	
NPL	National Priority List
Proposed NPL	Proposed National Priority List
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CERC-NFRAP	CERCLIS No Further Remedial Action Planned
CORRACTS	Corrective Action Report
RCRIS-TSD	Resource Conservation and Recovery Information System – Transportation, Storage, or Disposal Facility
RCRIS-LQG	Resource Conservation and Recovery Information System – Large Quantity Generator
RCRIS-SQG	Resource Conservation and Recovery Information System – Small Quantity Generator
ERNS	Emergency Response Notification System
State ASTM Standard	
OR SHWS-ECSI	Oregon Environmental Cleanup Site Information
OR SWF/LF	Oregon Solid Waste Facilities List/ Landfill Sites
OR LUST	Oregon Leaking Underground Storage Tank Database
OR UST	Oregon Underground Storage Tank Database
OR VCS	Oregon Voluntary Cleanup Program Sites
OR CRL	Oregon Confirmed Release List
OR INDIAN UST	Oregon Underground Storage Tank Database on Indian Land
OR INDIAN LUST	Oregon Leaking Underground Storage Tank Database on Indian Land
Federal ASTM Supplemental	
CONSENT	Superfund (CERCLA) Consent Decrees
ROD	Records of Decision
Delisted NPL	National Priority List Deletions
FINDS	Facility Index System/Facility Identification Initiative Program Summary Report
HMIRS	Hazardous Materials Information Reporting System
MLTS	Material Licensing Tracking System
MINES	Mines Master Index File
NPL Liens	Federal Superfund Liens
PADS	PCB Activity Database System
DOD	Department of Defense Sites
RAATS	RCRA Administrative Action Tracking System
TRIS	Toxic Chemical Release Inventory System
TSCA	Toxic Substances Control Act
SSTS	Section 7 Tracking Systems
FTTS	FIFRA/TCSA Tracking System – FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
UMTRA	Uranium Mill Tailings Remedial Action
US ENG CONTROLS	Engineering Controls in Place
ODI	Open Dump Inventory

Database Abbreviation	Database Name
FUDS	Formerly Used Defense Sites
INDIAN RESERV	Indian Reservations
State or Local ASTM Supplemental	
OR SPILLS	Oregon Spill Data
OR AST	Oregon Aboveground Storage Tank Sites
OR HIST LF	Oregon Old Closed Solid Waste Disposal Sites
OR HSIS	Oregon Hazardous Substance Information Survey
OR AOC COL	Oregon Columbia Slough
OR ENG CONTROLS	Oregon Engineering Controls in Place
OR DRYCLEANERS	Oregon Registered Drycleaning Facilities
OR HAZMAT	Oregon Spills Reported to Fire Marshal
OR UIC	Oregon Underground Injection Control
OR CDL	Oregon Uninhabitable Drug Lab Properties
EDR Proprietary Historical Database	
OR Coal Gas	Oregon Former Manufactured Gas (Coal Gas) Sites
Brownfields Databases	
US Brownfields	Brownfields Projects
US Inst Control	Institutional Control Site List
OR Brownfields	Oregon Brownfields Projects
OR Inst Control	Oregon Institutional Control Site List

Historical Land Use Review

Historical land use information will be reviewed using available and relevant fire insurance maps (Sanborn maps) and aerial photographs.

Sanborn maps typically show historical features of current or former buildings, including hazardous chemical or fuel storage areas, potential release pathways (i.e., drains), and use of properties. Additional information includes site address, building materials, property boundaries, utility lines, and underground storage tanks.

Aerial photographs can be used to discern commercial and industrial land uses that have the potential to be impacted by the project. As available, aerial photographs will be reviewed from mid-1930s to the present in 10-year intervals.

Other Data Sources

As available and appropriate, a review of data from previous technical reports and agency file reviews will be conducted on sites showing indicators of concern[2] that are found during the

[2] Indicators of concern are DEQ or EPA cleanup sites, operations or facilities that have potential to impact the subsurface, other known or perceived environmental conditions, spills, etc. that are found to have a potential to impact the project. In some cases, specific DEQ file reviews could be conducted to gain further understanding of the environmental conditions.

regulatory database review or Sanborn map review for the project. Field reviews will also be conducted to confirm findings from database reviews and identified areas of high concern.

Impact Assessment

The following will be considered to help determine impacts of high concern:

- Will project operation pose a risk to human health or the environment by exposing hazardous substances that may not be managed using standard best management practices?
- Will project construction activities expose or exacerbate contamination, posing a risk to human health or the environment? This evaluation would rely on applicable state or federal standards and an assessment of exposure pathways and potential receptors.
- If the project acquires hazardous materials sites, what are the sites that may pose the highest concerns for cleanup, potential project delays, or increased exposure to people or the environment?
- Does one of the project alternatives or a potential design option provide an opportunity to avoid or minimize the above risks?

This evaluation will consider known sites on, adjacent to, or near the light rail alignment, with an emphasis on properties to be acquired. The current status of regulatory and cleanup actions will also be considered. The evaluation will also reflect the type of contamination and the media contaminated, and will apply professional judgment to assess the level of concern that contamination may pose for a potential acquisition property, including the level of cost and difficulty in cleanup, and the potential that contamination may have migrated or could still migrate to other properties, such as through groundwater.

Long-Term Impacts

Long-term impacts could include the need to conduct remedial actions to address contaminated materials that may remain on an existing contaminated site *after construction is complete*, but these are typically beneficial effects. (Construction within a contaminated site typically requires remedial actions to remove or manage contaminated materials, which can also have a long-term beneficial effect.) Post-construction remedial actions could include deed restrictions, engineering controls, placement of soil caps, or groundwater treatment systems, which would reduce contamination associated with the site and allow for more productive use of the property. In any case, it is in the best interest of the project and the environment to identify contaminated sites prior to construction, and either avoid them or determine appropriate courses of action prior to acquisition.

The analysis of long-term impacts will also cover the use of and policies for managing hazardous materials in the operation and maintenance of light rail facilities, including transit centers and operations facilities that are part of the alternatives.

Short-Term Impacts

Short-term impacts are typically associated with the following risks:

- Leakage or a spill associated with construction activities, equipment, and materials including fuel, lubricants, and other hazardous substances.

- Exposure to or migration of contaminants encountered in soil or groundwater during construction.

Indirect Impacts

Indirect impacts occur later in time (sometime after project completion) or are farther removed in distance, but are still reasonably foreseeable in the future. Indirect impacts from hazardous materials as a result of the project might arise during project operation. Examples of indirect effects include hazardous material leaks and spills by the commuting public at transit stations and park-and-ride facilities. Some of these effects could be beneficial, in which reduced vehicle use due to light rail commuters choosing public transportation options would result in diminished vehicle leaks and spills. The evaluation and discussion of indirect impacts will be qualitative.

Cumulative Impacts

Cumulative impacts result from the incremental effects of the project when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts will be qualitatively assessed, but would include known locations, types of issues or effects, and the types of environmental resources potentially affected, including groundwater, surface water, land use, and/or other sensitive resources.

Mitigation Measures

The analysis will cover measures for avoiding or reducing adverse hazardous materials impacts during project development, including during and after construction. More detailed, site-specific measures would be developed during final design and in compliance with applicable regulations, particularly if the project involves construction within hazardous sites. To reduce the risk of liability and decrease the short-term effects of hazardous materials sites to the project, an environmental site assessment would be completed at each site proposed for acquisition or easement in advanced design stages. As the project enters later development stages, including advanced design, property acquisition, and construction, more detailed environmental engineering investigations and analysis will be conducted, including the development of appropriate site-specific management plans.

Documentation

Existing conditions, potential impacts, and mitigation will be discussed in the hazardous materials section of the EIS. The EIS section will be summary-level, focused primarily on impacts but still identifying the long-term and short-term/construction period impacts. Background information, existing conditions information, and details of the analysis will be included in a technical memorandum available for review through Metro and will be included in cooperating agency reviews of the preliminary Draft EIS.

HISTORIC, ARCHAEOLOGICAL, AND CULTURAL RESOURCES ANALYSIS METHODS

Introduction

This report describes the methods that will be used to collect data and assess impacts to historic properties, and other cultural resources for the Southwest Corridor Light Rail Project. This analysis will be developed to comply with the National Environmental Policy Act (NEPA) and local and state policies, standards, and regulations.

NEPA and Section 106 of the National Historic Preservation Act of 1966 (as amended) and its implementing regulations under 36 Code of Federal Regulations (CFR) 800 require that potential impacts of federally assisted projects to historic districts, sites, buildings, structures or objects and to archaeological sites listed on, or eligible for inclusion in, the National Register of Historic Places (National Register) be assessed. Compliance with Section 106 requires federal agencies to consult and coordinate with the State Historic Preservation Office and the appropriate Native American Tribes before undertaking projects that potentially affect such properties. The project will identify and consult with interested parties pursuant to 36 CFR 800.2 and with 36 CFR 800.3, the initiation of the Section 106 process. Section 4(f) of the Department of Transportation Act of 1966 requires consideration for historic sites during transportation project development and will be implemented by the Federal Transit Administration (FTA) for this project. If a project "uses" a historic property, it must be determined that there is no feasible and prudent alternative and that planning to minimize harm was assessed, or a finding is made that the project will have a *de minimis* impact on the Section 4(f) property.

The Advisory Council for Historic Preservation (ACHP) has established procedures for the protection of historic and cultural properties that are on, or determined to be eligible for inclusion in, the National Register (36 CFR 60). There are also Oregon statutes that protect archaeological sites on both private and public lands and historic preservation laws, regulations, codes, and ordinances that protect historic resources. The State of Oregon and the City of Portland apply additional land use regulations to designated and potentially significant historic resources.

The analysis, documentation, and coordination will be conducted to satisfy Section 106 requirements for the Southwest Corridor Light Rail Project Draft Environmental Impact Statement (Draft EIS). The purpose of this analysis is to assess the potential impacts of the Southwest Corridor Light Rail Project alternatives on known and potential historic, archaeological, and cultural resources.

Related Laws and Regulations

The following regulations will be considered in the historic, archaeological, and cultural analysis:

- National Environmental Policy Act (NEPA) of 1969
- National Historic Preservation Act of 1966 (Pub. L. 89-665, as amended; 54 United States Code [USC] 300101 et seq. [formerly 16 USC 470 et seq.]; 36 CFR 800, Protection of Historic Properties), in particular Section 106 (54 USC 306108 [formerly 16 USC 470f])
- National Register of Historic Places criteria for evaluation (36 CFR 60.4)
- U.S. Department of Transportation Act of 1966 (23 USC Section 138 and 49 USC 303 [formerly 49 USC 1653]; 23 CFR 774), Section 4(f), as amended
- Antiquities Act of 1906 (Pub. L. 59-209; 16 USC 431-433)

- Historic Sites Act of 1935 (16 USC 461-467)
- Executive Order 11593, Protection and Enhancement of the Cultural Environment (1971)
- Oregon State Historic Preservation Office (SHPO) guidelines and Secretary of the U.S. Department of the Interior's Standards and Guidelines for Archaeology and Historic Preservation
- Oregon State Laws and Regulations
  - Oregon Revised Statutes (ORS) 358.475 (Policy)
  - ORS 358.622 (State Advisory Committee on Historic Preservation)
  - ORS 358.612 (Duties of State Historic Preservation Officer)
  - ORS 358.635–358.653 (Preservation of Property of Historic Significance)
  - ORS 358.680–358.690 (Oregon Property Management Program for Historic Sites and Properties)
  - ORS 358.905–358.961 (Archaeological Objects and Sites)
  - ORS 390.235 (issuance of archeological permits) and Oregon Administrative Rules (OAR) 736-051-0000 – 0090 (Archaeological Permits)
  - ORS 97.740–97.760 (Indian Graves and Protected Objects)
  - Oregon Statewide Planning Goal 5 (OAR 660-023-0200) Natural Resources, Scenic and Historic Areas, and Open Spaces, Oregon's Statewide Planning Goals and Guidelines, amendments effective August 30, 1996 and January 27, 2017
- City of Portland, City of Tigard, City of Tualatin, Multnomah County, and Washington County respective comprehensive plans and associated ordinances and standards
- City of Portland Zoning Code Title 33.445 Historic Overlay Zone and Title 33.846 Historic Review

Contacts and Coordination

Contact and coordination with federal, state, and local agencies may be conducted during the identification of resources and the evaluation of effects. Agencies involved include Metro, TriMet, the Oregon Department of Transportation (ODOT), SHPO, Multnomah and Washington Counties, and the Cities of Portland, Tigard, and Tualatin. Individual property owners of identified resources may also be consulted. The statewide historic preservation nonprofit group, Restore Oregon, will be contacted to determine if conservation easements have been applied to historic and archaeological resources in the Area of Potential Effects (APE). FTA, acting on behalf of the U.S. government, will lead any contacts with the appropriate Native American Tribes in the area to invite them to participate in and/or consult on historic, archaeological, and cultural resources and issues.

Data Collection

Section 106 requires FTA to delineate an APE that defines "the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties." The APE is the maximum geographic area where the project could potentially have an effect on historic properties, if any are present. Historic properties are historic, archaeological, and other cultural resources that are listed in or have been determined eligible for listing in the National Register. For the Draft EIS,

the APE will initially be defined as 50 feet from the edge of the proposed segments and alternatives in each direction. Resources within or adjacent to the area of construction may be removed or physically altered by the project. After a preferred segment and alternative are identified and further details on properties to be acquired and potentially removed are known, the APE may be adjusted for the Final EIS to include areas within 50 feet of potentially acquired properties. It could also be expanded where new abovegrade structures or the removal of buildings could change the setting or views of historic properties. The Visual Quality and Aesthetics and Acquisitions and Displacements sections of the EIS will help inform any proposed adjustment in the APE.

Historic Resources

An inventory of potentially affected historic resources will be conducted and included in the description of the affected environment. Personnel meeting the professional qualifications of the Secretary of the Interior's Standards and Guidelines for Architectural History and History will perform the work. The methods that will be employed for inventorying and describing historic resources include the following steps:

- Research records of SHPO, the Oregon Historical Society, and other institutions and agencies, as well as identified consulting parties, to gather information regarding the existing conditions and potential resources for the Southwest Corridor Light Rail Project. Local jurisdictions will be consulted to identify known resources and gain information on previously inventoried resources in the project APE. Federal, state, and local jurisdictions, such as SHPO and county and city planning departments, will be contacted for the most current inventories of historic resources within the APE.
- Conduct systematic field studies, beginning with a reconnaissance survey following SHPO's Guidelines for Historic Resource Surveys in Oregon, and followed by a more detailed inventory, along with archival research to identify potentially eligible resources that are within the APE. The period of historic significance will cover resources built up to 1970 (to include resources that may turn 50 years old within the project time frame). Additional properties will be inventoried and evaluated between 1970 and 1975 (or an agreed upon date) for the Preferred Alternative and included in the Final EIS. Field observations and archival research will also be used to identify potential resources not previously included in local inventories, review previously recorded resources, and review locations and conditions of all resources within the APE that may be eligible for or are listed in the National Register. The study will take into account potential effects to individual resources as well as listed and potential historic districts. Given the potential for up to 600 historic resources within the APE, the field studies will emphasize properties that have boundaries or structures that could be physically altered by the project work. Known resources will be re-evaluated if needed.
- Prepare an analysis of indirect impacts to listed and eligible historic resources and districts using the adverse effect criteria under Section 106. Special consideration will be given to potential visual impacts to historic districts affected by the project.
- Conduct a literature review and archival research to identify patterns of settlement and development in the general area of the APE. This information will be used to form a historic context that will assist with the identification of historic resources in the APE and the evaluation of identified resources for historical significance.
- The Oregon Department of Transportation Region 1 historian will review all information prior to submitting to SHPO or FTA. Consultation on Determination of Eligibility (DOE) and Finding of Effect (FOE) will be addressed during the Final EIS development.

The existing historic inventories within the APE include:

- National Register of Historic Places
- SHPO Oregon Historic Sites Database
- City of Portland Historic Resource Inventory (1984)
- City of Portland Local Historic Landmarks and Districts; Local Conservation Landmarks and Districts
- City of Tigard Historic Overlay District (1984)
- City of Tualatin Resource Technical Study and Inventory (1992/1993)
- Tualatin Development Code TDC68 Historic Landmarks
- Multnomah County Cultural Resource Survey (1988)
- Washington County Cultural Resource Inventory (1983)
- Washington County Historic and Cultural Resource Overlay District
- Goal 5 Comprehensive Plans Historic Resources/Landmarks

Archaeological Resources and Traditional cultural properties and historic properties or religious and cultural significance to an Indian Tribe

The methods that will be employed for inventorying and describing the archaeological resources, historic properties of religious and cultural significance to an Indian Tribe, and traditional cultural properties in the affected environment include the following steps, which include coordination that would be conducted by Metro and FTA. Personnel meeting the professional qualifications of the Secretary of the Interior's Standards and Guidelines for Archaeology will perform the following work:

- Conduct a comprehensive records search at SHPO to gather data on any archaeological surveys or related studies conducted within the APE, including all options currently under consideration.
- Contact federal, state, and local officials, such as SHPO, Tribal Historic Preservation Officers, and county and city planning officials for the most current inventories of cultural resources within the APE.
- Conduct a review of historical cartographic materials, photographs, and other documents, as well as LiDAR data that is available for the APE to identify locations considered likely to have archaeological resources.
- Conduct a field reconnaissance within the APE to assess current conditions, supplement the archival research, and verify the areas considered to have a high probability for archaeological resources.
- Conduct field studies within the APE to identify potential archaeological resources not previously included in local inventories, and to review locations and conditions of resources listed on inventories or eligible for, or in, the National Register. Areas that are within the project's construction footprint, except for paved areas, will be included in a pedestrian survey. Shovel testing may be needed to verify the presence or absence of buried archaeological resources in high probability areas; excavation permits will be obtained for shovel testing on public lands or within resources.

Archaeological excavations to evaluate resources for the National Register may be performed, if needed, after a preferred segment and alternative has been selected. The results would be included in the Final EIS. A right-of-entry from individual property owners will need to be obtained prior to this field work being conducted.

FTA will undertake coordination and consultation with the appropriate Native American Tribes for additional information on traditional cultural properties and historic properties or religious and cultural significance to an Indian Tribe in the APE.

Affected Environment

Historic Resources

As described above, a reconnaissance baseline survey of potentially affected historic resources will be conducted, followed by an inventory of historic properties. This information will be summarized in the affected environment section of the Historic, Cultural, and Archaeological Resources Results Report, with background tables, photographs, and maps provided in an appendix. The baseline survey will include summary data for all historic-era resources, along with a photograph of the property and summary information that includes whether the property appears to meet eligibility criteria for listing in the National Register. Historical background research will assist with National Register eligibility evaluations. Eligible/impacted resources will be reported in a table format and keyed to a map for each segment/alternative. The table will list the location (address), parcel number, map ID number, survey number, acquisition, name (if available), type of resource, style, date, siding, materials, integrity, a recommendation on National Register status or eligibility, and a photograph. Properties that are considered eligible will be entered into the SHPO historic sites database. The history of the buildings will be included in the DOE documentation. Coordination with local jurisdictions will allow the historic resource database to be used for local planning purposes pursuant to OAR 660-023-0200.

Archaeological Resources and Traditional Cultural Properties

The archaeological resource inventory documentation will include three tables, each keyed to a map:

- One table will list the previous surveys within the APE and the level of effort and findings.
- The archaeological resource table will list all recorded resources within the APE and will include the location, Smithsonian trinomial (if available), type of archaeological resource, and a recommendation on National Register eligibility.
- The list of high probability areas will include the location; whether the potential is for historic or Native American type of resource, the level of effort previously performed (if any), the recommended level of effort needed for fieldwork (pedestrian survey, shovel testing, monitoring during construction), and a photograph of the high probability area.

Impact Assessment

Long-Term Impacts

National Register Eligible Resources

Potentially eligible historic, archaeological, and other cultural resources will be evaluated according to the National Register Criteria (36 CFR 60.4) and listed in the Draft EIS. The eligibility determinations previously made for archaeological resources recorded within the APE will be listed in the Draft EIS.

Additional archaeological resources may be recommended to be eligible following evaluation fieldwork; these would be included in the Final EIS. The accompanying historic context statement and the narrative that identifies the important themes in history and relates those themes to extant historic resources and property types will be developed. The Draft EIS comment period will provide an opportunity for stakeholders to comment on the preliminary eligibility recommendations. Stakeholders will include but not be limited to previously identified consulting and interested parties. For the Final EIS, DOE forms will be completed for resources that are recommended to be eligible. The public will have additional opportunities to comment between the Draft EIS and Final EIS specifically for properties that are impacted by the Preferred Alternative.

Oregon SHPO Database

For each property previously identified as significant or newly identified historic resources recommended to be potentially eligible, and where one or more of the light rail alternatives have the potential for an adverse effect,[1] the determination of eligibility will be more detailed in order to provide sufficient information for agency review and support in a determination of effect.

For the Draft EIS, archaeological resources will be documented on a resource form, with a preliminary recommendation of eligibility, or a recommendation of further work to determine eligibility. Archaeological excavation may be needed to determine the eligibility of some resources for the Final EIS. The resources will be listed in a table, in addition to the individual resource forms.

Metro and TriMet, in coordination with a qualified professional, will recommend to FTA a determination of eligibility or ineligibility. FTA will consider the recommendations and make its own findings, which it will communicate to SHPO with a request for SHPO concurrence.

Application of Criteria of Adverse Effect

Prepare FOE – A tour of the project area with FTA, SHPO, and the project team will be conducted as part of the process for determining preliminary eligibility and effect. The FOE reports will be prepared in the Final EIS based on the Criteria of Adverse Effect established in 36 CFR 800. FTA will coordinate with appropriate Native American Tribes to provide input on impacts to known or probable archaeological sites and traditional cultural properties and historic properties or religious and cultural significance to an Indian Tribe.

SHPO Concurrence on Level of Effect – FTA (with assistance from the project team) will seek SHPO's concurrence on the FOEs.

Local Input on Level of Effect – The project team will coordinate with local jurisdictions to solicit their input on whether any historic resource that is found to have local historic significance, but that does not meet National Register eligibility criteria, would be adversely affected by one or more of the light rail alternatives, considering local impact assessment criteria. This request for input may coincide with the

[1] Adverse effects occur when an undertaking may directly or indirectly alter characteristics of a historic property that qualify it for inclusion in the National Register. Reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance, or be cumulative also need to be considered.

Draft EIS comment period. Historic Resource Review procedures would likely be required for resources in the City of Portland if the resource has a local historic designation.

Indirect Impacts

For indirect effects, broader changes (such as changes in land use) that the project may cause will be identified and analyzed qualitatively, based primarily on the effects seen from previous similar projects. This analysis could include activities related to the project but not directly part of the project or known at the time of the analysis. Examples include transit-oriented development projects, mitigation or permit compliance activities to respond to other kinds of environmental impacts or permitting requirements (such as for stormwater management), or complementary activities that may be taken by others, such as street or trail improvement projects that enhance connections or access to the light rail project.

Cumulative Impacts

Cumulative effects are effects that result from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions. The cumulative effects analysis will focus on the effects of each of the alternatives with other projects that are anticipated to add to the effects on historic and archaeological resources in the APE.

Mitigation Measures

If there are any unavoidable adverse effects to National Register–listed or eligible resources, a Memorandum of Agreement (MOA) will be negotiated and prepared prior to publishing the Final EIS. FTA will lead this process in coordination with Metro, TriMet, appropriate tribes, and the SHPO office. Certain stipulations within the MOA may need to be fulfilled prior to the undertaking that is specific to an adversely affected historic property. For archaeological resources, mitigation may include data recovery excavations.

Documentation

The Historic, Archaeological, and Cultural Resources Results Report will be prepared to document the methods used for the analysis, the resources encountered, and the beneficial and adverse effects of the light rail alternatives on those resources. This discussion will also include avoidance and minimization measures analyzed and recommended mitigation measures for unavoidable adverse effects. The report will include a summary of archaeological and cultural resources and archaeological high probability areas; although, to protect resources, some specifics about locations and resources may be redacted from the technical report and contained in a separate report to be provided to FTA and filed with SHPO. The Historic, Archaeological, and Cultural Resources Results Report will be reviewed by FTA, TriMet, Metro, appropriate tribes, and other parties as appropriate.

Section 4(f) Evaluation

A Section 4(f) evaluation will be prepared for properties whose National Register–qualifying characteristics, or other locally determined criteria for locally significant resources, might be "used" by the proposed project. The Section 4(f) applicability, requirements, and methods are discussed in a separate methods report.

Appendices

The results report will provide documentation of the detailed inventories of cultural and historic resources within the APE. Appendices to the results report will also include the Historic Context Statement,

comments and coordination documentation, and individual National Register eligibility statements with photographs for the affected/eligible properties. The Historic Context Statement will meet the requirements of SHPO, and it will be resubmitted for additional review and comment. This report will attach all correspondence and coordination with other interested parties, including the documentation of determination of eligibility or effect and correspondence indicating SHPO's concurrence. DOE and FOE forms will be prepared for the Final EIS for ODOT and FTA review.

All primary and secondary sources will be listed as references in bibliographical format in the appendices to the results report. All newspapers, books, interviews, reports, papers, inventories, National Register nominations, and miscellaneous data will be included. As noted above, sensitive archaeological data will be summarized and documented in a separate report, but will not be available for public review, and instead will be filed with SHPO.

Draft EIS Chapter

The historic resource reconnaissance survey will record all resources within the proposed project segments and alternatives. Documentation of impacts to historic resources associated with the segments and alternatives will be summarized in the Draft EIS. Tables will be included that identify the number of potentially impacted historic properties associated with each segment/alternative. Locations of affected properties will be mapped using GIS and identified in tabular form, providing the parcel identification, resource information, eligibility recommendation, and potential effect. An archaeological reconnaissance of the APE will identify recorded archaeological resources and areas with a high probability of having unidentified archaeological resources. Archeological sites that are determined to be eligible will be identified in a confidential document.

LAND USE ANALYSIS METHODS

Introduction

This report describes the methods that will be used to collect data and evaluate impacts to land use for the Southwest Corridor Light Rail Project. This analysis will be developed to comply with applicable policies, standards, and regulations at the federal, state, and local levels.

The land use analysis evaluates how the Southwest Corridor Light Rail Project might affect the region's ability to meet land use planning goals. The land use analysis will accomplish the following:

- Discuss existing and planned land uses in the project vicinity and relevant state, regional, and local plans and policies.
- Assess the compatibility of the alternatives with plans and policies applicable to the study area.
- Identify the direct, indirect, and cumulative land use impacts of the alternatives and potential mitigation measures to address any anticipated adverse land use impacts.

Related Laws and Regulations

Federal laws, regulations, and agency guidance will be considered in the land use analysis. The National Environmental Policy Act (NEPA) and Council of Environmental Quality (CEQ), Federal Transit Administration (FTA), and Federal Highway Administration (FHWA) guidance on preparing NEPA documents will be considered.

Specifically, CEQ regulations state that an Environmental Impact Statement (EIS) must include discussion of the compatibility of the alternatives with land use plans and policies in the project vicinity (see 40 Code of Federal Regulations [CFR] Section 1502.16, included in *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act*).

Contacts and Coordination

The project includes an extensive public involvement and agency coordination effort, including local jurisdictions and neighborhoods in the corridor.

Data Collection

Applicable Plans and Policies

Relevant plans and policies will be compiled, including those listed below:

- Oregon Transportation Planning Rule
- Metro Regional Transportation Plan (RTP)
- Metro Region 2040 Concept Plan and Functional Plan
- Comprehensive plans and implementing regulations of Washington County and the Cities of Portland, Tigard, Tualatin, Durham, and Lake Oswego
- The City of Tigard's Tigard Triangle Strategic Plan
- Hunziker Core Infrastructure Finance Strategy
- City of Tigard Economic Opportunity Analysis

- Tigard Downtown Improvement Plan
- Tigard City Center Urban Renewal Plan
- City of Tigard Downtown Streetscape Plan
- Linking Tualatin plan
- The City of Portland's Central City Plan, the Barbur Concept Plan, the Marquam Hill Plan, plan districts (e.g., Marquam Hill, South Auditorium), neighborhood plans (e.g., Downtown Community, Downtown, Corbett-Terwilliger-Lair Hill, Southwest, Terwilliger Parkway Corridor, West Portland Park) and other subarea and master plans in the area such as plans for the National University of Natural Medicine, Oregon Health Sciences University, and Portland Community College
- Any other urban design, streetscape, and land use plans or other relevant plans that are in process, such as the draft Portland Central City 2035 Plan.

Geographic Data

The primary source of data on existing and planned land uses in the corridor will be the Regional Land Information System (RLIS), which is Metro's compilation of geographic data for the Portland metropolitan area. Anticipated geographic data to be compiled from RLIS are listed below:

- Existing land use
  - Vacant land
  - Single-family residential land
  - Multifamily residential land
  - Office, retail, and other commercial land
  - Public use land, including designated parks and open spaces
  - Industrial land
  - Institutional land
- Comprehensive plan designation
- Zoning designation
- Assessed value of land and improvements by parcel

RLIS generally only contains regulatory information that is in effect; other sources such as the City of Portland's online plan and zoning maps will be used for adopted policies not yet in effect.

Affected Environment

The applicable plans and policies and geographic data described above will inform the description of the affected environment. Maps will be produced showing existing land uses, comprehensive plan designations, and zoning in the corridor.

Impacts Assessment

Compatibility with Applicable Plans and Policies

Applicable plans and policies as described above will be reviewed for compatibility with the alternatives. This includes review of any other urban design, streetscape, and land use plans or other relevant plans that are in process. This more detailed comparison will inform the evaluation of the alternatives based on the project Purpose and Need statement, which includes the purpose to "Support adopted regional and local plans including the 2040 Growth Concept, the Barbur Concept Plan, the Tigard Triangle Strategic Plan, the Tigard Downtown Vision, and Tualatin Development Code Mixed Use Commercial Overlay District Chapter 57 to accommodate projected significant growth in population and employment."

Long-Term Impacts

Long-term direct land use impacts are defined as conversions of land to transportation use from another use because project improvements have been placed on the land. The analysis of direct impacts will be largely based on the acquisitions developed for each alternative. Only property acquisitions that would displace the existing non-transportation land use from a parcel will be included in this analysis. The land area converted to transportation use from other non-transportation uses will be summed by the area needed for the project overall as well as by land needed for each alternative, with an assessment of whether the conversions would constitute a change to the overall land use character of the surrounding area. Direct impacts also include proximity impacts (e.g., traffic, noise, and visual impacts) that could cause changes in adjacent land uses.

Land use can be indirectly impacted by growth and investment around high-capacity transit stations. Indirect land use impacts are defined as changes in land use resulting from how alternatives affect the likelihood that land would be developed or redeveloped. The methodology to assess redevelopment potential will begin with calculating the ratio of the value of improvements to the value of land near proposed light rail stations. Other factors that influence redevelopment likelihood, such as site access, adjacent land uses, physical characteristics, and interventions by local government, will be addressed qualitatively.

Short-Term Impacts

Short-term impacts include changes to land use that could arise from construction impacts on nearby properties. The short-term impacts might include increases in noise levels, dust, and traffic congestion; visual changes; and increased difficulty accessing residential, commercial, and other land uses.

Indirect Impacts

Indirect impacts for land use could occur from other developments around station areas related to the project. Most impacts for land use would be addressed through the direct long-term or short-term impacts analysis, but the indirect impact assessment would consider other activities that may occur. Examples of these other activities include station area transit-oriented development or street/transit system improvements that parties besides FTA and TriMet may undertake in support of the project.

Cumulative Impacts

The effects of the project will be evaluated in combination with other past, present, and reasonably foreseeable future actions, including other transportation or infrastructure projects or other planned or pending land use actions or developments in the study area. Cumulative effects to land use in the study area could result from the following types of project-related changes combined with other developments.

- Reduced or increased traffic congestion, pedestrian or bicycle activity, transit use, or parking
- Increased urbanization in the area
- Increased likelihood of redevelopment for underdeveloped properties
- Increased demands for municipal public services and facilities

The cumulative impact analysis will discuss broad-based changes that are expected to occur as a result of the direct and indirect land use changes of the project and other past, present, and foreseeable projects.

Mitigation Measures

Mitigation will be considered for any long-term or short-term impacts to land use. Measures that would minimize impacts on adjacent land uses may be identified in other discipline topics, such as transportation, air quality, or noise and vibration.

Documentation

Existing land uses and impacts will be discussed in the Land Use section of the EIS. The EIS section will be summary-level, and will be focused primarily on identifying the long-term and short-term impacts to land use.

NOISE AND VIBRATION TECHNICAL ANALYSIS METHODS

Introduction

This report describes the methods that will be used to collect data and evaluate impacts of project-generated noise and vibration from the Southwest Corridor Light Rail Project. This analysis will be developed to comply with the National Environmental Policy Act (NEPA); local and state policies, standards, and regulations; and to respond to environmental scoping comments.

The Noise and Vibration section of the Environmental Impact Statement (EIS) will address how the project affects noise- and vibration-sensitive land uses and will present options to avoid, minimize, or mitigate potential impacts related to the project's long-term operation, as well as its potential impacts during construction. The Draft EIS will compare the magnitude of noise and vibration impacts, as well as mitigation measures, between the different alternatives, while the Final EIS will focus on a Preferred Alternative.

Noise and vibration analysis is generally performed in four steps: (1) define the existing conditions, (2) predict future noise and ground-borne vibration levels that will be generated by the project, (3) identify impacts based on the appropriate criteria, and (4) identify noise and vibration mitigation measures where required and considered reasonable and feasible according to TriMet and Federal Transit Administration (FTA) policy.

Related Laws and Regulations

FTA and the Federal Highway Administration (FHWA) have developed noise and vibration regulations or guidelines that will apply to this project. The FTA criteria for noise and vibration impacts found in *Transit Noise and Vibration Impact Assessment* (2006) (FTA Manual) will be the primary noise and vibration criteria by which transit-related impacts are identified.

The FTA Manual provides a general noise and vibration assessment methodology that is typically used to compare alternatives, such as locations of facilities or alignments, and provides the appropriate level of detail for the Draft EIS that is being prepared to evaluate alternatives. Noise and vibration levels for light rail, park-and-rides, and other transit-related facilities and operations will be predicted using the methods provided in the General Assessment Chapters (Chapter 5 for noise and Chapter 10 for vibration). Details on the actual methods used to determine project noise levels and evaluate impacts are provided below.

Additional tools are used to predict other transportation noise sources, particularly for traffic noise. Under FTA criteria, FTA-funded projects must also consider noise impacts from traffic when the project includes construction of a new roadway, adds capacity to an existing roadway, substantially changes the vertical or horizontal of an existing roadway, or removes shielding that reduces noise at noise-sensitive properties. Where necessary, projected traffic noise levels will be calculated using the latest version of FHWA's Traffic Noise Model (currently, TNM, version 2.5) (U.S. Department of Transportation 2004). FTA requires the use of the FHWA traffic noise impact criteria defined in Title 23 of the Code of Federal Regulations (CFR) Part 772, *Procedures for Abatement of Highway Traffic Noise and Construction Noise* for traffic noise evaluation.

This guidance includes examples of screening and impact assessments for a wide array of situations, including the development or modification of highways and other roadways.

Other sources of noise generated by the project include construction and ancillary facilities such as power substations. Noise regulations applicable in the analysis of these noise sources include the City of Portland noise ordinance, found in Title 18 of the Code of the City of Portland; the City of Tualatin noise ordinance, found in Chapter 6 of the Tualatin Municipal Code; and the City of Tigard noise ordinance, found in Article V of the Tigard Municipal Code. These noise ordinances are applicable for noise generated by project construction, operation and maintenance facilities, and other facilities such as power stations.

Noise and Vibration Background

Noise

What humans perceive as sound is a series of continuous air pressure fluctuations superimposed on the atmospheric pressure that surrounds us. The amplitude of fluctuation is related to the energy carried in a sound wave; the greater the amplitude, the greater the energy, and the louder the sound. The full range of sound pressures encountered in the world is so great that it is more convenient to compress the range by using a logarithmic scale, resulting in the fundamental descriptor used in acoustics, the sound pressure level, which is measured in decibels (dB). When sounds are unpleasant, unwanted, or disturbingly loud, we tend to classify them as noise.

Another aspect of sound is the quality described as its pitch. Pitch of a sound is established by the frequency, which is a measure of how rapidly a sound wave fluctuates. The unit of measurement is cycles per second, called hertz (Hz). When a sound is analyzed, its energy content at individual frequencies is displayed over the frequency range of interest, usually the range of human audibility from 20 Hz to 20,000 Hz. This display is called a frequency spectrum.

Sound is measured using a sound-level meter with a microphone designed to respond accurately to all audible frequencies. However, the human hearing system does not respond equally to all frequencies. Low-frequency sounds below about 400 Hz are progressively and greatly attenuated, as are high frequencies above 10,000 Hz. To approximate the way humans interpret sound, a filter circuit with frequency characteristics similar to the human hearing mechanism is built into sound-level meters. Measurements with this filter enacted are called A-weighted sound levels, expressed in A-weighted decibels (dBA). Community noise is usually characterized in terms of the A-weighted sound level.

The range of human hearing extends from about 0 dBA for young healthy ears (that have not been exposed to loud noise sources) to about 140 dBA. When sounds exceed 110 dBA, there is a potential for hearing damage, even with relatively short exposures.

In most neighborhoods, nighttime noise levels are noticeably lower than daytime noise levels. In a quiet rural area at night, noise levels from crickets or winds rustling leaves on the trees can range between 32 and 37 dBA. As residents start their day and local traffic increases, the same rural area can have noise levels ranging from 50 to 60 dBA. While noise levels in urban neighborhoods are louder than rural areas, they share the same pattern of lower noise levels at night than during the day. Quiet urban nighttime noise levels range from 40 to 50 dBA. Noise levels during the day in a noisy urban area are frequently as high as 70 to 80 dBA.

For a sense of perspective, normal human conversation ranges between 44 and 65 dBA when people are about 3 to 6 feet apart. Very slight changes in noise levels, up or down, are generally not detectable by the human ear. The smallest change in noise level that a human ear can

perceive is about 3 dBA, while increases of 5 dBA or more are clearly noticeable. For most people, a 10-dBA increase in noise levels is judged as a doubling of sound level, while a 10-dBA decrease in noise levels is perceived to be half as loud. For example, a person talking at 70 dBA is perceived as twice as loud as the same person talking at 60 dBA.

The metrics that will be used for the noise and vibration analysis to characterize the existing and future noise environments are defined below.

Maximum Sound Level, Lmax – The Lmax is the maximum sound level that a person hears during a single event and allows for comparison between individual noise events. However, the Lmax does not provide information on how long or how often the event occurs. For example, a single dog bark may be somewhat annoying but hardly compares with the neighbor's dog barking all night.

Equivalent Sound Level, Leq – Leq is a measure of sound energy during a specified time period, typically for 1 hour. Leq is called the equivalent sound level because it is equivalent to the level of a steady sound which, during a referenced duration and location, has the same sound energy as the fluctuating sound.

Sound Exposure Level, SEL – This is a measure of the sound energy of a single event, such as a single train pass-by, where the total sound energy of the event is mathematically squeezed into a 1-second duration. SEL is used to calculate the peak-hour Leq and Ldn noise levels from light rail operations.

Day-Night Equivalent Sound Level, Ldn – The Ldn is a 24-hour Leq with a 10-dB "penalty" assessed for noise events occurring at night (defined as 10 p.m. to 7 a.m.). The effect of this penalty is that any event occurring during the nighttime hours is equivalent to 10 events occurring during the daytime hours. This strongly weights Ldn toward nighttime noise to reflect that most people are more easily annoyed during the nighttime hours when typical background noise is lower and most people are sleeping. Studies of community response to a wide variety of noises indicate that Ldn is a good measure of the noise environment. Figure 1 illustrates typical community noise levels in terms of Ldn.

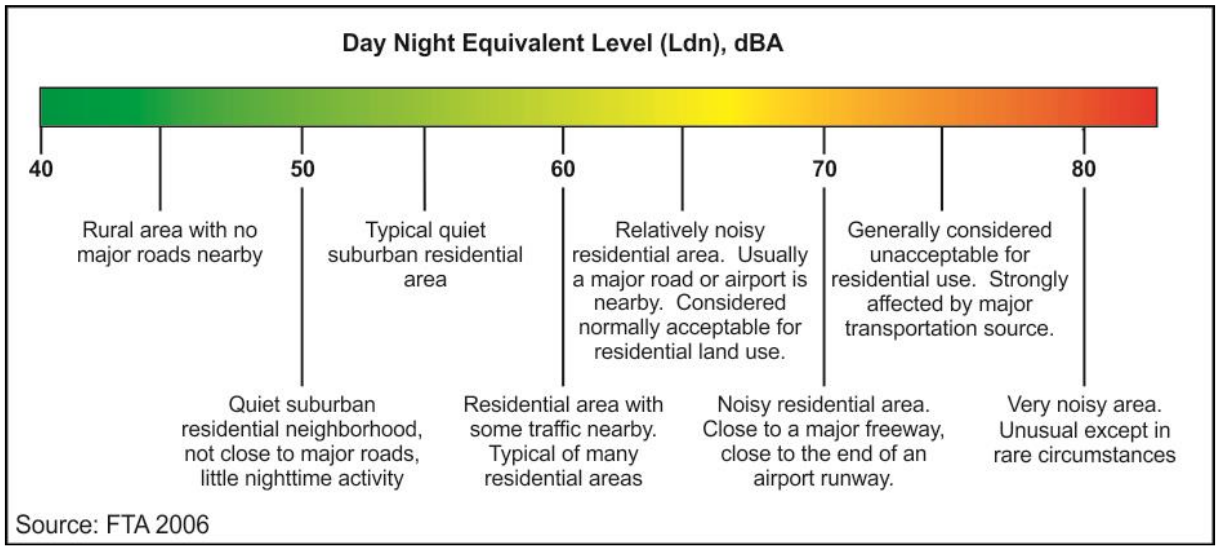


Figure 1. Typical Ldn Values for Residential Communities

Typical Ldn noise levels vary with proximity to major noise sources, such as arterial roadways, highways, airports, or commercial and industrial facilities with nighttime activities. For example, receptors located adjacent to Interstate 5 could have noise levels approaching or exceeding 70 dBA Ldn. An Ldn of 70 dBA is usually unacceptable for residential land use without special measures taken to enhance outdoor/indoor sound insulation. Areas with some shielding from major highways, or near minor arterials, typically have Ldn noise levels in the range of 60 to 70 dBA. Residential neighborhoods that are not near major sound sources will usually be in the range of Ldn 55 to 65 dBA. Urban residential areas will typically have noise levels ranging from 50 to 60 dBA Ldn, while rural areas, far from any major noise source, could have noise levels ranging from 45 to 55 dBA Ldn.

The following list contains some general rules for noise measurements:

- Outside of carefully controlled conditions, such as an audiology test, a change of 1 dB is generally not perceptible.
- A 3-dB change is the minimum most people will notice in most environments.
- A 5-dB change is clearly perceptible.
- A 10-dB increase in sound level is generally perceived as an approximate doubling of the loudness of the sound. Similarly, a reduction of 10 dB is considered half as loud and a notable reduction in noise.
- Under free-field conditions where there are no reflections or additional attenuations, the noise level generated by a point source in free space decreases at a rate of 6 dB for each doubling of distance as a result of the inverse square law. For example, a sound level of 70 dB at a distance of 100 feet would decrease to 64 dB at 200 feet. However, for line sources over a reflective plane, such as free-flowing traffic on a roadway or a light rail system, the reduction is closer to 3 dB per doubling of distance, but can vary depending on the ground cover between the source and receiver.
- Sounds such as sirens, bells, and horns are more noticeable and more annoying than normal noise because of the high frequency content.
- Noise control measures that provide less than a 5-dB noise reduction are usually considered ineffective because the reduction is not clearly perceptible.
- Because noise is measured on a decibel scale, combining two noises is not simple addition. For example, combining two noises of 60 dBA does not give 120 dBA (which is near the pain threshold), but gives 63 dBA, which is lower than the volume at which most people listen to their televisions.

Ldn is the designated metric of choice for many federal agencies, including the Department of Housing and Urban Development, FTA, and the Federal Aviation Administration (FAA). The noise impact criteria applicable to residential areas included in the FTA manual use Ldn to characterize community noise for land uses with nighttime noise sensitivity and Leq for noise-sensitive land uses where the main use is during daytime hours, such as schools and libraries.

Sound Transmission Characteristics

Several factors determine how sound levels decrease over distance. As previously described, under ideal conditions, a point noise source in free space will attenuate at a rate of 6 dB per doubling of distance and a line source (such as constant flowing traffic on a busy highway)

reduces at a rate of approximately 3 dB per doubling of distance. Under real-life conditions, however, interactions of the sound waves with the ground often results in attenuation that is slightly higher than the ideal reduction factors given above. Other factors that affect the attenuation of sound with distance include existing structures, topography, foliage, ground cover, and atmospheric conditions such as wind, temperature, and relative humidity. The following list provides general information on the potential effects each of these factors may have on sound propagation:

- **Existing Structures.** Existing structures can have a substantial effect on noise levels in any given area. Structures can reduce noise by physically blocking the sound transmission and, under special circumstances, may cause an increase in noise levels if the sound is reflected off the structure and transmitted to a nearby receiver location. Measurements have shown that a single-story house has the potential, through shielding, to reduce noise levels by up to 10 dB. The actual noise reduction will depend greatly on the geometry of the noise source, receiver, and location of the structure. Increases in noise caused by reflection are normally 3 dB or less, which is the minimum change in noise levels that can be noticed by the human ear.
- **Topography.** Topography includes existing hills, berms, and other surface features between the noise source and receiver location. As with structures, topography has the potential to reduce or increase sound depending on the geometry of the area. Hills and berms between the noise source and receiver can have an effect on noise levels. In some situations, berms provide noise mitigation by physically blocking the noise source from the receiver location. In rare instances, however, the topography can result in an overall increase in sound levels by either reflecting or channeling the noise towards a sensitive receiver location.
- **Foliage.** Foliage, if dense, can provide slight reductions in noise levels. One hundred feet of dense evergreen foliage can provide up to a 3- to 5-dBA noise reduction. Because foliage varies in the study area, no reduction for foliage will be used in the analysis, which results in a conservative approach for predicting noise impacts.
- **Ground Cover.** The ground cover between the receiver and the noise source can have an effect on noise transmission. For example, sound will travel very well across reflective surfaces such as water and pavement, but it can be attenuated when the ground cover is field grass, lawns, or even loose soil. Detailed information related to sound transmission in the study area will be compiled through a combination of onsite monitoring, noise modeling, and published information.
- **Atmospheric Conditions.** Atmospheric conditions that can have an effect on the transmission of noise include wind, temperature, humidity, and precipitation. Wind can increase sound levels if it is blowing from the noise source to the receiver; conversely, it can reduce noise levels if blowing in the opposite direction. Noise propagation can also be affected when the temperature gradient is such that an inversion is formed. Other atmospheric conditions, such as humidity and precipitation, are rarely severe enough to result in substantive changes in noise level propagation. The effects of atmospheric conditions increase with the distance sound travels and generally are negligible within the relatively shorter distances within the study area (100 to 500 feet).

Vibration

Ground-borne vibration is the oscillatory motion of the ground from a state of equilibrium (or its common state). Ground-borne vibration can be described in terms of displacement, velocity, or acceleration. Displacement is the distance an object moves away from its equilibrium position. Velocity is the rate of change in displacement or the speed of this motion. Acceleration is the change in the velocity of the object over time. Because sensitivity to vibration typically corresponds to a constant level of vibration-velocity amplitude within the low-frequency range that is of most concern for environmental vibration (i.e., roughly 5 to 100 Hz), vibration velocity is used in this analysis as the primary measure to evaluate the impacts of vibration.

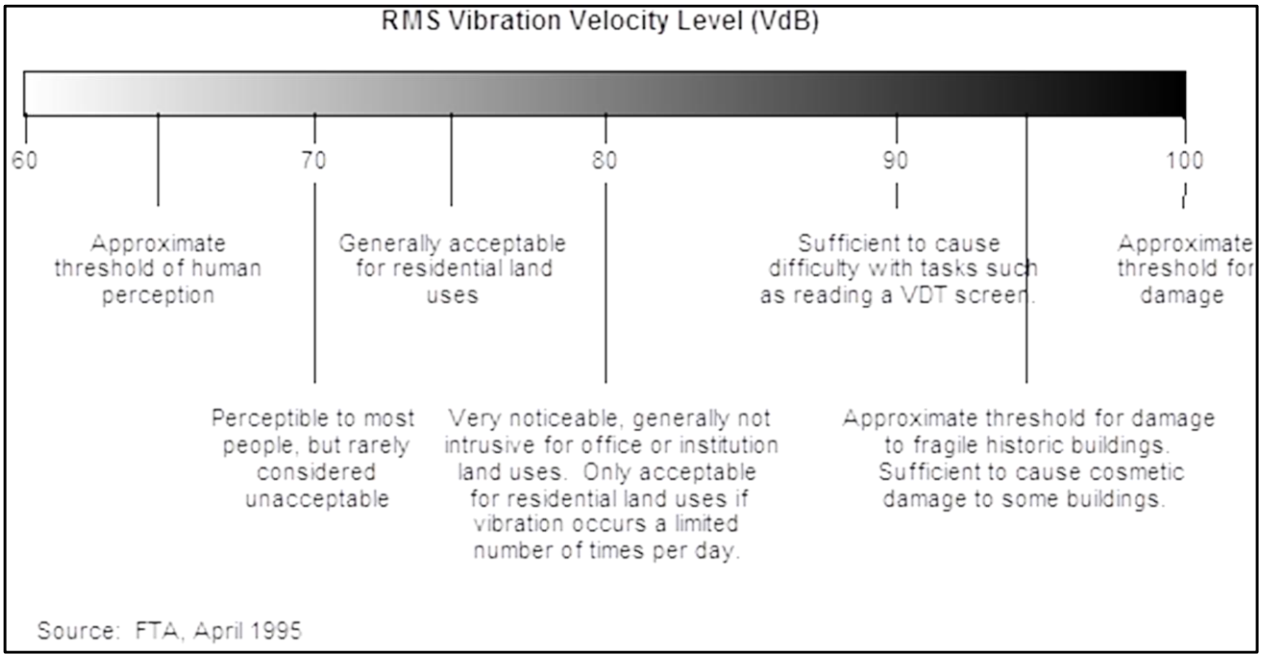


Figure 2. Human Response to Building Vibration

There are several different measures used to quantify vibration amplitude. One of the most common is the peak particle velocity (PPV), defined as the maximum instantaneous positive or negative peak of the vibratory motion. PPV is often used to monitor blasting vibration because it is related to the stresses experienced by building components. Although PPV is appropriate for evaluating the potential for building damage, it is less suitable for evaluating human response, which is better related to an average vibration amplitude. Because the net average of a vibration signal about its equilibrium position is zero, the root mean square (rms) amplitude is often used to describe the "smoothed" vibration amplitude. The rms amplitude is defined as the square root of the average of the squared amplitude of the signal and is typically evaluated over a 1-second period of time. The descriptor used for this assessment of ground-borne vibration is the rms vibration velocity level, Lv, expressed in vibration decibels (VdB) relative to 1 micro-inch per second. Figure 2 illustrates typical ground-borne vibration levels for common sources, as well as human and structural response to ground-borne vibration. As shown, the range of interest is from approximately 50 VdB to 100 VdB (i.e., from imperceptible background vibration to the threshold of damage). Although the threshold of human perception to vibration is approximately 65 VdB, annoyance does not usually occur unless the vibration exceeds 70 VdB.

When ground-borne vibrations propagate from transit vehicles to nearby buildings, the floors and walls of the building structure will respond to the motion and may resonate at natural frequencies. The vibration of the walls and floors may cause perceptible vibration, rattling of items such as windows or dishes on shelves, or a rumbling noise. The rumble is the noise radiated from the motion of the room surfaces. In essence, the room surfaces act like a loudspeaker; this is called ground-borne noise.

The potential annoyance of ground-borne noise is often assessed using the A-weighted sound level, although there are potential problems in using the A-weighted sound level to characterize low-frequency ground-borne noise. Human hearing is non-linear, which causes sounds with substantial low-frequency content to seem louder than broadband sounds that have the same A-weighted level. This is accounted for by setting A-weighted impact criteria limits lower for ground-borne noise than would be the case for broadband noise.

Contacts and Coordination

Agencies and organizations have been notified of the intent to prepare an Environmental Impact Statement (EIS) through the Federal Register and through other project outreach activities. Because the project travels through, or near, several different jurisdictions, all jurisdictions within 500 feet of any potential alignment were reviewed for noise and vibration regulations or ordinances that have applicability to the project. The following agencies were contacted for information, regulations or ordinances:

- State
    1. Oregon Department of Transportation
- County
    1. Clackamas County
    2. Multnomah County
- City
    1. City of Lake Oswego
    2. City of Portland
    3. City of Tigard
    4. City of Tualatin

Study Area

The general study area for the noise analysis will extend out to 350 feet or more on either side of the project alignments, and could extend farther to ensure that all project-related noise impacts are identified. For the vibration analysis, operational vibration impacts rarely occur past 100 to 150 feet from the alignment. The actual study area will be based on the maximum distance from the alignments where the potential for project-related noise or vibration impacts exist based on a review of the light rail vehicle specifications, alignment location and type, proposed operational schedule, land use, and, for noise, the existing noise levels. In general, properties within the study area would likely experience the noise and vibration effects of building and/or operating a

new light rail system. This area exceeds the recommended initial assessment area for a light rail transit project according to the FTA Manual.

Traffic noise will be evaluated in areas with new or modified roadways that result from the project. The study area includes any noise-sensitive property in adjacent areas that could experience a new project-related traffic noise impact, increased severity of an existing traffic noise impact, or a substantial increase in traffic noise levels. This study area could extend several hundred feet from the roadway; the final selection of the traffic study area will be based on noise modeling of future conditions.

Affected Environment

Data Collection

The study area will be inspected for areas where FTA noise and vibration-sensitive land uses have the potential for noise or vibration impacts from light rail operation or construction, including residences, hospitals, and institutional uses such as schools, libraries, and churches. Variables such as the potential for impacts, topography, geology, and type of rail structure (at-grade, retained cut and fills, or elevated trackway) will be considered when selecting receivers for analysis.

Existing noise levels will be measured at noise-sensitive locations along the project alignments and will consist of short-term (typically 15 to 30 minutes) noise measurements and long-term (typically 42 to 48 hours or more) noise measurements along the project corridor. Up to 16 long-term and 12 short-term sites will be monitored and used to establish the existing noise environment along the project corridors. During the final EIS, additional sites may be added to further qualify the noise environment and assist with impact identification and noise mitigation measures.

Locations used for ambient noise monitoring will be selected after performing an onsite review of the existing data, and alternatives. The criteria for noise monitoring location selection will include land use, assumed existing ambient noise, number of sensitive receivers in the area, and level of expected impact. Proposed noise monitoring locations will be reviewed by the project engineers, TriMet, and Metro.

The measured data, along with methods in the FTA Manual, will be used to establish the Ldn and peak-hour Leq for receivers used in the noise analysis. The Ldn is a 24-hour energy average noise level used in determining impacts where nighttime sensitive land use exists, such as residences, hotels and motels, and hospitals. The peak-hour Leq is used to determine noise impacts for institutional land use, such as schools, libraries, or churches. All noise levels will be A-weighted to account for the hearing response of humans and referred to as sound levels in decibels (dBA).

All noise measurement procedures will comply with the methods defined by the FTA, FHWA, and the American National Standards Institute (ANSI) S1.13-1983. All noise measurement equipment will meet the standards for an ANSI Type 1 sound measurement device and be capable of providing complete statistical analysis of the measured data. Photographs will be taken of all microphone placements during measurement periods. Local site characteristics affecting the transmission of noise will also be identified. At a minimum, the recorded values will include second-by-second Leq, Lmin (minimum sound level), and Lmax (maximum sound

level). Special software allows the computation of other noise descriptors using the measured data, including hourly Leq's and the Ldn.

Vibration monitoring is not performed under the FTA General Vibration Assessment. Rather, the general level of assessment uses generalized reference vibration levels to develop a curve of vibration level as a function of distance from the track. For this project, vibration levels at specific buildings will be estimated by using reference force density for TriMet vehicles as measured by ATS and WIA and applying adjustments to account for factors such as track support system, vehicle speed, type of building, and track and wheel condition. All vibration levels will be presented in vibration velocity in decibels, referred to by the FTA as VdB to minimize confusion with sound levels (dBA).During the Final EIS, locations identified with vibration impacts will be re-evaluated. As part of this updated analysis, vibration propagation measurements will be taken at, or near, the affected properties. The vibration analysis will be updated and the propagation measurements will be used to develop final vibration mitigation measures.

Impact Assessment

Noise and vibration impacts from the operation and construction of the alternatives will be determined through noise and vibration modeling using the methods from FTA. The FTA requires the use and consideration of state and local regulations as applicable to the project. Regulatory information applicable to the project is described below for long-term operational and short-term construction noise and vibration.

Long-Term Impacts

Noise and vibration impacts from the operation of the alternatives will be determined through noise and vibration modeling using the methods from FTA and FHWA. Noise and vibration levels will be predicted for any existing, or planned and permitted land use as defined under FTA and FHWA land use categories, as defined below. Details on the modeling methods and criteria for determining impacts are provided in the following sections.

FTA Operational Transit Noise Impact Criteria

The criteria in the FTA Manual are based on research on community reaction to noise. The amount of change in the overall noise environment that the transit project is allowed to make is reduced with increasing levels of existing noise.

The FTA noise impact criteria group noise-sensitive land uses into the following three categories:

- **Category 1:** Tracts of land where quiet is an essential element in their intended purposes. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks with significant outdoor use. Also included are recording studios and concert halls.
- **Category 2:** Residences and buildings where people normally sleep. This category includes residences, hospitals, and hotels where nighttime sensitivity is assumed to be of utmost importance.
- **Category 3:** Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, theaters, and churches where it is important to avoid interference

with such activities as speech, meditation, and concentration on reading material. Places for meditation or study associated with cemeteries, monuments, museums, campgrounds, and recreational facilities can also be considered to be in this category. Certain historical sites and parks are also included.

The Ldn is used to characterize noise exposure for residential areas (Category 2), and the peak 1-hour Leq is used to evaluate effects from other noise-sensitive land uses such as schools, libraries, and other noise-sensitive daytime uses (Categories 1 and 3) during project operation. There are no FTA impact criteria for commercial uses, such as offices, retail, or restaurants.

There are two levels of impact included in the FTA criteria. The interpretations of these two levels of impact are summarized below:

- **Severe:** Severe noise impacts are considered "significant" according to the usage of this term in NEPA and implementing regulations. Noise mitigation will normally be specified for severe impact areas.
- **Impact (Moderate Impact):** In this range, other project-specific factors must be considered to determine the magnitude of the impact and the need for mitigation. These other factors can include the predicted increase over existing noise levels, the types and number of noise-sensitive land uses affected, existing outdoor/indoor sound insulation, and the cost-effectiveness of mitigating noise to more acceptable levels.

The FTA noise impact criteria are summarized in Table 1. The first column shows the existing noise exposure; the remaining columns show at what level the project-related noise is considered to cause noise impacts, based on land use type. Table 1 also provides the criteria levels for moderate and severe impacts for each of the three FTA land use categories.

Noise from project operations, including light rail, bus and supporting facilities, will be modeled using the methods described in the FTA Manual. Input to the model will include:

- Measured reference noise levels for TriMet light rail vehicles on at-grade ballast and tie trackway. The reference noise will be determined through noise measurements or data from the FTA for similar systems.
- Correction factors for different track types as provided by the FTA: +3 dB for embedded trackway and +4 dB for elevated trackway with direct fixation.
- Proposed speed profiles along each of the alternatives and design option routes.
- Light rail operating plan, including the length and number of trains throughout the daytime, evening, and nighttime hours.
- Plan and profile of the alternatives and design options, including the locations of special track work, such as crossovers, where wheel impacts make a clicking noise, and where vibration levels can be increased.
- Reference noise levels for any bells, crossing gates, and train horn/bells used for at-grade crossings. The reference noise will be determined through noise measurements or data from the FTA for similar systems.
- Station locations and park-and-rides.

- Detailed design drawing of roadway modifications performed as part of the project, to include traffic volumes, speeds, and vehicle types (e.g., cars, medium trucks, and heavy trucks).

Table 1. FTA Transit Noise Impact Criteria

Existing Noise Exposure, Leq or Ldn (dBA)[a]	Project Noise Impact Exposure, Leq or Ldn (dBA)[a]					
	Category 1 or 2 Sites			Category 3 Sites		
	No Impact	Moderate Impact	Severe Impact	No Impact	Moderate Impact	Severe Impact
<43	<Ambient + 10	Ambient + 10 to 15	>Ambient + 15	<Ambient + 15	Ambient + 15 to 20	>Ambient + 20
43	<52	52-58	>58	<57	57-63	>63
44	<52	52-58	>58	<57	57-63	>63
45	<52	52-58	>58	<57	57-63	>63
46	<53	53-59	>59	<58	58-64	>64
47	<53	53-59	>59	<58	58-64	>64
48	<53	53-59	>59	<58	58-64	>64
49	<54	54-59	>59	<59	59-64	>64
50	<54	54-59	>59	<59	59-64	>64
51	<54	54-60	>60	<59	59-65	>65
52	<55	55-60	>60	<60	60-65	>65
53	<55	55-60	>60	<60	60-65	>65
54	<55	55-61	>61	<60	60-66	>66
55	<56	56-61	>61	<61	61-66	>66
56	<56	56-62	>62	<61	61-67	>67
57	<57	57-62	>62	<62	62-67	>67
58	<57	57-62	>62	<62	62-67	>67
59	<58	58-63	>63	<63	63-68	>68
60	<58	58-63	>63	<63	63-68	>68
61	<59	59-64	>64	<64	64-69	>69
62	<59	59-64	>64	<64	64-69	>69
63	<60	60-65	>65	<65	65-70	>70

Table 1. FTA Transit Noise Impact Criteria

Existing Noise Exposure, Leq or Ldn (dBA)[a]	Project Noise Impact Exposure, Leq or Ldn (dBA)[a]					
	Category 1 or 2 Sites			Category 3 Sites		
	No Impact	Moderate Impact	Severe Impact	No Impact	Moderate Impact	Severe Impact
64	<61	61-65	>65	<66	66-70	>70
65	<61	61-66	>66	<66	66-71	>71
66	<62	62-67	>67	<67	67-72	>72
67	<63	63-67	>67	<68	68-72	>72
68	<63	63-68	>68	<68	68-73	>73
69	<64	64-69	>69	<69	69-74	>74
70	<65	65-69	>69	<70	70-74	>74
71	<66	66-70	>70	<71	71-75	>75
72	<66	66-71	>71	<71	71-76	>76
73	<66	66-71	>71	<71	71-76	>76
74	<66	66-72	>72	<71	71-77	>77
75	<66	66-73	>73	<71	71-78	>78
76	<66	66-74	>74	<71	71-79	>79
77	<66	66-74	>74	<71	71-79	>79
>77	<66	66-75	>75	<71	71-80	>80

[a] Ldn is used for land use where nighttime sensitivity is a factor; Leq during the hour of maximum transit noise exposure is used for land use involving only daytime activities.

Wheel squeal is possible on curves with a radius of less than 600 to 1,000 feet, depending on the speed and type of trackway. Wheel squeal is not included in the noise model; however, areas where wheel squeal may occur will be identified, and, where mitigation is needed, a method of providing wayside lubricators or manual lubrication will be reviewed with TriMet and proposed for mitigation.

For this analysis, attenuation for the noise-reducing effects of ground coverage will not be included. All front-line receivers will be assumed to have a line-of-sight view of the light rail route unless the route is in a retained cut, which would directly shield the receptor from the tracks. This conservative methodology ensures that all potential noise impacts will be identified. This method is consistent with the FTA Manual. The predicted project-generated noise exposure at each noise-sensitive site will be compared to the FTA noise impact criteria shown in Table 1 corresponding to the existing noise exposure and the current use of each site. This comparison

will identify the locations where moderate and severe noise impacts will be caused by the project and where noise mitigation should be evaluated.

FHWA Traffic Noise Impact Criteria

The traffic noise impact criteria against which the project traffic noise levels will be evaluated are taken from CFR Title 23, Part 772, Procedures for Abatement of Highway Traffic Noise and Construction Noise. The criterion applicable for residences, churches, schools, recreational uses, and similar areas is an exterior hourly equivalent sound level (Leq) that approaches or exceeds 67 dBA. The criterion applicable to other developed lands, such as commercial and industrial uses, is an exterior Leq that approaches or exceeds 72 dBA. FHWA states that a substantial increase in traffic noise levels can also result in a noise impact. Finally, FHWA allows the state departments of transportation to define the terms "approach" and "substantial increase" in their local regulations.

In Oregon, traffic noise impact occurs if projected noise levels approach within 2 dB of the FHWA criteria; therefore, a residential impact occurs at 65 dBA Leq and a commercial impact occurs at 70 dBA Leq. In addition, a 10-dB increase in traffic noise is considered a substantial increase impact. A summary of the FHWA noise regulations is provided in Table 2.

Table 2. Noise Abatement Criteria (NAC) and Noise Abatement Approach Criteria (NAAC) by Land Use Category

Activity Category	Activity Criteria in hourly Leq (dBA)		Evaluation Location	Activity Description
	FHWA NAC	ODOT NAAC		
A	57	55	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need, and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose
B[a]	67	65	Exterior	Residential (single-family and multifamily units)
C[a]	67	65	Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings

Table 2. Noise Abatement Criteria (NAC) and Noise Abatement Approach Criteria (NAAC) by Land Use Category

Activity Category	Activity Criteria in hourly Leq (dBA)		Evaluation Location	Activity Description
	FHWA NAC	ODOT NAAC		
D	52	50	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios
E[a]	72	70	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties, or activities not included in Activity Categories A to D or F
F	--	--	--	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing
G	--	--	--	Undeveloped lands that are not permitted

[a] Includes undeveloped lands permitted for this activity category.

FTA Vibration Impact Criteria

Vibration impacts will be assessed using the FTA General Vibration Assessment. Vibration models developed for the FTA will be used to predict vibration levels at vibration-sensitive land uses during light rail operations and construction. As with the criteria for noise, the impact thresholds for ground-borne noise and vibration reflect the sensitivity of various types of land uses, including residences, businesses, and places where equipment or other activities have lower tolerances for vibration. The same models will be used to predict ground-borne noise levels for noise-sensitive land uses and for special cases, if existing, such as indoor performance spaces or entertainment media studios.

The FTA vibration propagation curve will be combined with operational conditions to develop a vibration model to predict project-related vibration and ground-borne noise levels for nearby sensitive receptors, including residential uses and high-sensitivity uses, such as hospitals and institutional uses. The predicted vibration and ground-borne noise levels will be compared to the FTA criteria to determine locations where vibration or ground-borne noise impacts occur. Where vibration or ground-borne noise impacts are identified, mitigation measures will be examined.

The FTA ground-borne vibration impact criteria are based on land use and train frequency. Because the project will have frequent train service throughout the corridor, only the criteria for frequent train operations are presented. These criteria for common land uses are shown in Table 3. The FTA vibration criteria are applied primarily to residential (including hotels and other places where people sleep) and institutional land uses. Commercial land uses are considered only when they contain vibration-sensitive uses, such as medical offices or sensitive manufacturing equipment. The criterion applied to these locations is dependent on the sensitivity of the use. Some buildings, such as concert halls, recording studios, and theaters, can be particularly sensitive to vibration but do not fit into any of the three categories listed in Table 3. Because of their sensitivity, these buildings usually warrant special attention during the impact assessment. Table 4 gives criteria for acceptable levels of ground-borne vibration for various types of special buildings.

Table 3. Ground-borne Vibration and Noise Impact Criteria for Frequent Events

Land Use Category	Ground-borne Vibration Impact for Frequent Events[a] (VdB re 1 micro-inch/second)	Ground-borne Noise Impact for Frequent Events[a] (dB re 20 micro-Pascals) [d]
Category 1: Buildings where low ambient vibration is essential for interior operations	65 VdB[b]	N/A[c]
Category 2: Residences and buildings where people normally sleep	72 VdB	35 dBA
Category 3: Institutional land uses with primarily daytime use	75 VdB	40 dBA

[a] "Frequent Events" are defined as more than 70 vibration events of the same source per day; most rapid transit projects fall into this category.

[b] This criterion limit is based on levels that are acceptable for most moderately sensitive equipment, such as optical microscopes. Vibration-sensitive manufacturing or research requires detailed evaluation to define the acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the heating, ventilation, and air conditioning systems and stiffened floors.

[c] N/A = not applicable. Vibration-sensitive equipment is generally not sensitive to ground-borne noise.

[d] A measure of pressure used in vibration analysis

Table 4. Ground-borne Vibration and Noise Impact Criteria for Special Buildings

Type of Building or Room[a]	Ground-borne Vibration Impact Levels for Frequent Events[b] (VdB re 1 micro-inch/sec)	Ground-borne Noise Impact Levels for Frequent Events[b] (dB re 20 micro-Pascals)
Concert Halls	65 VdB	25 dBA
TV Studios	65 VdB	25 dBA

Table 4. Ground-borne Vibration and Noise Impact Criteria for Special Buildings		
Type of Building or Room[a]	**Ground-borne Vibration Impact Levels for Frequent Events[b] (VdB re 1 micro-inch/sec)**	**Ground-borne Noise Impact Levels for Frequent Events[b] (dB re 20 micro-Pascals)**
Recording Studios	65 VdB	25 dBA
Auditoriums	72 VdB	30 dBA
Theaters	72 VdB	35 dBA

[a] If the building will rarely be occupied when trains are operating, then there is no need to consider impact. For example, consider locating a commuter rail line next to a concert hall; if no commuter trains will operate after 7 p.m., then trains would rarely interfere with the use of the hall if concerts are after 7 p.m.

[b] "Frequent Events" are defined as more than 70 vibration events per day; most transit projects fall into this category.

Maintenance Facilities, and Ancillary Facilities

Noise from other project-related ancillary facilities such as power stations and maintenance bases is evaluated using both the FTA criteria and the local noise control ordinance, as applicable. Applicable local noise ordinances include ordinances from the Cities of Lake Oswego, Portland, Tigard and Tualatin. Also, for noise-sensitive uses in the unincorporated areas of Clackamas and Multnomah Counties, county and Oregon State Department of Environmental Quality (DEQ) ordinances and regulation are also included and used as appropriate.

State of Oregon Regulations

The Oregon DEQ regulations are found in Oregon Administrative Rule (OAR) 340 Division 35 Noise Control Regulations. Under OAR 340-035-0035 (Noise Control Regulations for Industry and Commerce), industrial or commercial noise sources are subject to the limits specified in Table 5 below. The statistical noise levels L01, L10, and L50 refer to the sound pressure levels that occur for 1 percent (0.6 minutes), 10 percent (6 minutes), and 50 percent (30 minutes) in any one-hour period. The DEQ regulations are not applicable to construction noise.

Table 5. DEQ Maximum Allowable Noise Levels from New Industrial and Commercial Source		
Source of Noise	**Daytime Limits[a] (7 a.m. to 10 p.m.)**	**Nighttime Limits[a] (10 p.m. to 7 a.m.)**
L_{50}	55 dBA	50 dBA
L_{10}	60 dBA	55 dBA
L_{01}	75 dBA	60 dBA

[a] Between 10:00 p.m. and 7:00 a.m., the maximum levels given above are reduced by 5 dBA.

City of Lake Oswego Noise Control Ordinance

There are several parcels within 350 feet of the corridor, located along the east side of I-5, south of Highway 217, and north of the project terminus, that are within the City of Lake Oswego or unincorporated Clackamas County. For the locations in the City of Lake Oswego, ancillary facilities would need to meet applicable ordinances for those areas.

Sections 537 and 539 of Article 34.10 of the Lake Oswego code are specific to noise from ancillary operations. The code restricts noise levels by the time of the day, and also restricts any loud, disturbing, or unnecessary noise, but does not provide any specific decibel levels, making identification of impact difficult to quantify. However, because the nearest parts of the corridor are across I-5 at distances of 250 to 350 feet or more from the City of Lake Oswego, it is not likely that noise from any ancillary operations would be noticeable by any Lake Oswego residents.

City of Portland Noise Control Ordinance

Because the project is located in Portland, Oregon, the local noise control ordinance is applicable to the operation of other project-related ancillary facilities. The City of Portland noise control ordinance can be found in Chapter 18 of the Code of the City of Portland. The City of Portland Noise Control Ordinance defines three classes of property usage and the maximum noise levels allowable for each. For example, the noise caused by a commercial property must be less than 60 dBA at the closest residential property line. The City of Portland Noise Control Ordinance is summarized in Table 6.

Table 6. City of Portland Noise Control Ordinance

	Maximum Allowable Sound Level (dBA)		
Source of Noise	**Residential Receiver**	**Commercial Receiver**	**Industrial Receiver**
Residential	55	60	65
Commercial	60	70	70
Industrial	65	70	75

Between 10 p.m. and 7 a.m., the maximum levels given in Table 6 are reduced by 5 dBA. For pure tone and steady-state noise, such as constantly running fans, the maximum allowable noise levels in Table 6 are also reduced by 5 dBA during daytime hours and 10 dBA during nighttime hours.

City of Tigard

Article V in Title 6 of the Tigard Municipal Code contains a noise nuisance ordinance with maximum noise levels that can be produced by project facilities, such as maintenance bases and power substations, during different times of the day. For example, the noise caused by a project facility at the boundary of a property with a noise-sensitive use must be less than 40 dBA during the nighttime hours of between 10 p.m. and 7 a.m., and less than 50 dBA during the daytime

hours of between 7 a.m. and 10 p.m. For receiving properties that are not noise-sensitive, the noise must be less than 60 dBA during the nighttime hours and less than 75 dBA during the same daytime hours. In addition, the noise caused by a project facility cannot be plainly audible within a noise-sensitive building during the nighttime hours of between 10 p.m. and 7 a.m.

Under Section 6.02.450 of the Tigard Municipal Code, sounds caused by regular vehicular traffic upon premises open to the public in compliance with state law are exempt from the ordinance. As a result, the City of Tigard ordinance will not apply to project park-and-rides. The ordinance also does not apply to construction projects for public facilities within rights-of-way pursuant to a noise mitigation plan approved by the city manager.

City of Tualatin

The City of Tualatin adopted a noise control ordinance as part of the municipal code in 2013. The noise ordinance found in Chapter 6-14 is a nuisance ordinance with maximum noise levels that can be produced by project facilities, such as maintenance bases and power substations, during different times of the day. For noise-sensitive properties, such as residences, the code limits noise levels to 50 dBA from 10:00 p.m. to 7:00 a.m. and 70 dBA from 7:00 a.m. to 10:00 p.m. For non-noise-sensitive properties, the levels are 10 dB higher: 60 dBA from 10:00 p.m. to 7:00 a.m. and 80 dBA from 7:00 a.m. to 10:00 p.m.

Under Sections 6-14-060 (5) and (7), noise from facilities that are regulated by federal noise regulations and general traffic on public roadways is exempt from the noise limits provided above. Therefore, noise on public roadways and noise from public transit are exempt from the city noise ordinance. However, noise from maintenance bases and power substations would be required to meet the location regulations as required by the FTA.

Short-Term

A general assessment of construction noise and vibration levels will be performed as described in Chapter 12, Noise and Vibration during Construction, of the FTA Manual. Applicable regulations and ordinances from state, counties, and cities for construction are the same as provided above under the Maintenance Facilities and Ancillary Facilities from long-term operations. General exemptions for construction during daytime hours are:

- 7 a.m. to 6 p.m. in Lake Oswego
- 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

The alternatives and the areas surrounding staging areas and stations will be investigated for noise- and vibration-sensitive land uses. Potential noise and vibration levels from commonly used construction equipment will be predicted and compared to local regulations, ordinances, and guidelines governing construction noise and vibration. The noise and vibration prediction methods will follow the general assessment methods for construction analysis given in the FTA Manual.

Indirect Impacts

Indirect impacts in both noise and vibration could occur from other developments in station areas or if these developments are related to the light rail project. Most typical sources for noise or vibration would be addressed through the direct long-term or construction impacts analysis, but the indirect impact assessment would consider other activities that may occur. Examples of these activities include station area transit-oriented developments or street/transit system improvements that others may undertake in support of the light rail project.

Cumulative Impacts

For noise, the long-term impact analysis includes several elements that are already cumulative in nature because it considers the existing noise levels of surrounding facilities, such as highways or local streets, as well as factors for future traffic growth as part of predicting noise levels with and without the alternatives. The development of other projects, including future transportation facilities or services independent of the proposed light rail project, would have the potential to alter cumulative noise levels. As a result, the noise analysis will examine other potential projects occurring in the vicinity of the proposed project to qualitatively evaluate the potential for cumulative long-term noise impacts. Where cumulative impacts are identified, the analysis will suggest mitigation measures to help avoid or minimize effects.

Cumulative construction noise impacts could also occur if the light rail project and other construction projects occur simultaneously or in close sequence. The analysis will identify other projects that could result in additional construction noise impacts (this will be a qualitative evaluation) and describe potential mitigation measures.

For vibration, if existing vibration levels are negligible, cumulative impacts are expected to be represented by the direct impact of light rail project operation. There are likely few opportunities for other projects or activities to result in a cumulative effect of higher vibration levels. However, the analysis will qualitatively discuss and evaluate the possibility of cumulative impacts.

Mitigation Measures

For locations where potential noise or vibration impacts are identified, mitigation measures will be considered and reviewed with project engineers, Metro, TriMet and FTA, and will also be reviewed by cooperating and participating agencies. The public will also have the opportunity to review and comment on impacts and proposed mitigation as part of the EIS process. Mitigation measures at the source will be the preferred means of mitigation. After the implementation of source treatment measures, the use of path measures (between the source and receiver) will be the preferred method of mitigating noise impacts (e.g., noise walls and berms). Receiver mitigation will be the final method implemented. Mitigation measures will be considered for all noise and vibration impacts, and those found to be reasonable and feasible will be recommended for inclusion with project.

Mitigation will be considered for all impacts identified. General specifications for each of the recommended mitigation measures will be included in the Draft EIS Noise and Vibration section and the Noise and Vibration Results Report, and the resulting reduction in noise or vibration levels will be predicted.

It is also important to note that as the project design is modified during final design, all of the impacts and mitigation measures will be reviewed to verify projections. If at that time it is discovered that mitigation can be achieved by a less costly means through more detailed testing, or that the noise impact at the location would not occur even without mitigation, then the mitigation measure may be eliminated.

Mitigation measures for addressing noise and vibration impacts from project construction will also be described.

Documentation

Existing noise and vibration conditions, impacts and potential mitigation will be discussed in a Noise and Vibration Results Report and summarized in a Noise and Vibration section of the EIS. The EIS section will be summary-level, focused primarily on impacts but still identifying the long-term and short-term/construction period impacts of the project. The Noise and Vibration Results Report will include background information, existing conditions information, and details of the analysis. The results report will include projected noise and vibration levels, noise from ancillary facilities, and an assessment of traffic noise related to the project. Project-related construction noise and vibration will also be discussed.

References

City of Lake Oswego. Noise Ordinance, Section 537 and 539 of Article 34.10, Lake Oswego Municipal Code. June 2006

City of Portland. Noise Ordinance. Title 18, Noise Control, Code of the City of Portland. May 17, 2016.

City of Tigard. Noise Ordinance. Title 6, Noise Nuisances, City of Tigard Municipal Code. April 2013.

City of Tualatin. Noise Ordinance. Chapter 6-14, Noise Ordinance, City of Tualatin Municipal Code, June, 2013

FTA (Federal Transit Administration). 2006. Transit Noise and Vibration Impact Assessment (FTA Manual). FTA-VA-90-1003-06. Office of Planning and Environment. May 2006.

Oregon Department of Transportation. ODOT Noise Manual, July 2011.

State of Oregon. Noise Control Regulations for Industry and Commerce. OAR 340-0035. June 11, 2004.

PARKS AND RECREATIONAL RESOURCES ANALYSIS METHODS

Introduction

This report describes the methods that will be used to collect data and evaluate impacts to parks and recreational resources for the Southwest Corridor Light Rail Project. This analysis will be developed to comply with the National Environmental Policy Act (NEPA); local and state policies, standards, and regulations; and to respond to comments from environmental scoping.

For the purposes of this methods report, parks and recreational resources include publicly owned parks, greenspaces, recreation areas and trails, and wildlife lands. This report identifies laws and regulations applicable to parks and recreational resources, describes methods for data collection, and outlines how impact analysis will be conducted.

Related Laws and Regulations

State and Local Agencies

Parkland and recreation facilities in the project area are owned and managed by several local, regional, and state agencies. This includes the City of Portland Parks and Recreation, City of Tigard Parks and Recreation department, and Metro. Metro owns and manages public parks and open spaces throughout the Portland Metro area. The City of Tualatin owns and manages parks and recreation areas near the project area, but all are anticipated to be outside of the project area. The Cities of Portland and Tigard continue to maintain general parks goals and policies within their comprehensive plans, parks master plans, and strategic plans. Oregon's Department of Land Conservation and Development (DLCD) also has specific planning goals that local jurisdictions must address in their comprehensive plans. In particular, Oregon Statewide Planning Goal 8 addresses recreational needs of citizens and visitors and provides for the siting of necessary recreational facilities.

The analysis of park and recreational resources will consider the applicable comprehensive plan goals and policies and statewide planning goals, and will consider both existing and future planned parks.

Land and Water Conservation Funds – Section 6(f)

State and local governments often obtain grants through the Land and Water Conservation Fund Act of 1965 (LWCF) to acquire or make improvements to parks and recreation areas. Section 6(f) of the LWCF Act prohibits the conversion of property acquired or developed with these funds to a non-recreational purpose without the approval of the National Park Service. If there is an indication that recreation lands subject to LWCF requirements may be impacted by the project, those properties must go through a Section 6(f) clearance process. The first step in the clearance process includes evaluation of how LWCF funds apply to a site (e.g., for property purchase, site upgrades) and what portion or portions of a site are affected by the funds. Next, efforts to minimize any impacts to the site need to be considered, and finally, if there are any unavoidable impacts, mitigation is necessary. Mitigation for impacts to Section 6(f) properties can only be accomplished through the provision of a replacement property of equal value and reasonably equivalent usefulness.

Section 4(f)

Section 4(f) is a USDOT regulation protecting publicly owned parks, recreation, and wildlife preserve lands from impacts from federal transportation projects. Section 4(f) requirements and methods are described in the Section 4(f) Analysis Methods report.

Contacts and Coordination

Parks and recreational resources will be evaluated to determine their essential characteristics and facilities as determined through coordination with the agencies responsible for the establishment and management of each resource. Coordination will include identifying the type or types of recreational uses at each location and potentially the frequency, intensity, and accessibility of each type of use. The analysis will also consider environmental or other protections, special use permits, or special seasonal uses.

For Section 6(f) properties and for other properties that were funded through programs that may have special conditions or restrictions on impacts or conversions of park or recreation properties, close coordination with the Oregon Parks and Recreation Department (OPRD) LWCF program will be necessary to identify potentially affected sites, evaluate potential impacts, and identify and negotiate mitigation if necessary.

Agencies that could be contacted include the following:

Federal Agencies

- U.S. Fish and Wildlife Service (USFWS)
- National Marine Fisheries Service (NMFS)
- U.S. Department of Interior (USDOI)
- USDOI National Park Service (NPS)

State Agencies

- Oregon Parks and Recreation Department (OPRD)
- Oregon Department of Land Conservation and Development (DLCD)
- Oregon Department of Fish and Wildlife (ODFW)
- Oregon Department of State Lands (ODSL)
- Oregon Department of Transportation (ODOT)

Local Jurisdictions and Agencies

- Metro Regional Parks and Nature
- Portland Parks and Recreation Bureau
- City of Portland
- City of Tigard
- City of Tualatin
- Portland Public Schools

Data Collection

Existing Conditions Inventory

Parks and recreational resources, including any subject to Section 4(f) or Section 6(f), will be identified through review of Metro's regional property database and local jurisdiction park district mapping. Verification of mapping information will be confirmed through interviews with affected agencies and site visits where necessary.

Affected Environment

Identified park resources located within 150 feet of the edge of construction will be inventoried and mapped. The inventory will describe the type and size of the resource, types and levels of uses, access to the resource, any unusual or significant characteristics, and whether any LWCF monies were involved in the site.

Parklands located in the vicinity of the project that have been previously identified and that may be affected are listed below. Additional resources may be identified during the technical studies.

In the City of Portland:

- Ash Creek Natural Area
- Burlingame Park
- Duniway Park
- Front & Curry Community Garden
- Fulton Park and Community Garden
- George Himes Park
- Heritage Tree Park
- Holly Farm Park
- Lair Hill Park
- Lesser City Park
- Markham Elementary School
- Marquam Nature Park
- Portland Community College Sylvania Campus
- Spring Garden Park
- SW Terwilliger Boulevard Parkway
- Sylvania Natural Area park
- Water & Gibbs Community Garden
- Woods Memorial Natural Area

In the City of Tigard:

- Brown Natural Area

- Fanno Creek Park
- Knez Wetland Area
- Potso Dog Park

Impact Assessment

Long-Term Impacts

All identified public parks and recreation areas will be evaluated for potential impacts. Conceptual engineering information developed by TriMet, along with property boundary maps for the identified resources, will be used to determine potential physical impacts. Coordination with other disciplines, including visual, noise and vibration, and transportation, will be used to assess indirect impacts. The analysis will be coordinated with the parkland property owners.

If there is an indication that recreation lands subject to LWCF requirements might be impacted by the project, those properties will be evaluated for the Section 6(f) clearance process, including coordination with OPRD's LWCF program and with the National Parks Service. This coordination will identify the extent of the site affected by LWCF monies, whether there is a way to reduce or avoid the impact, and will facilitate negotiation of any mitigation.

Short-Term Impacts

For parks and trails near construction activities, access could be affected by detours and street or lane closures, and by increased congestion caused by construction traffic. Some parks that are adjacent to the alignment or that have portions directly impacted by the project could also have areas that could be temporarily affected, and in some cases parking, trees, or other vegetation could be affected by construction. Visual impacts, light, glare, dust, and noise could also affect users in some of the parks and trails. This analysis will describe the general impacts that may occur to parks and recreation resources during construction.

Indirect Impacts

Potential indirect impacts resulting from the project may include changes to surrounding areas or environmental conditions, but are unlikely to affect the resource directly. Potential indirect effects could include changes to the land uses near the resources, such as through station area redevelopments that could affect activity levels for a resource, or changes to travel demand or parking, which could indirectly alter accessibility.

Cumulative Impacts

This analysis will review potential cumulative effects on parks and recreational resources resulting from other past, present, or reasonably foreseeable future actions that could impact the resources, either directly or indirectly. This could include other transportation projects, as well as other planned developments or land use changes occurring in the area.

Mitigation Measures

If a conversion of Section 6(f) lands is required, the land must be replaced with other recreational properties of at least equal fair market value and with reasonable equivalent usefulness and location. Other regulations may also apply to the mitigation measures as described in the

Section 4(f) methods. Many of the mitigation measures defined for parks impacts will require the written agreement of the parties with jurisdiction over the resources.

Documentation

Existing park and recreational resources and impacts, including Section 6(f) and Section 4(f) resources, will be discussed in the park and recreation section of the EIS. The EIS section will be summary-level, focused primarily on identifying the long-term and short-term/construction period impacts to park and recreational resources. Background information, existing conditions information, and details of the analysis will be included in a technical memorandum available for review through Metro, and will be included in cooperating agency reviews of the Preliminary Draft EIS.

PUBLIC SERVICES ANALYSIS METHODS

Introduction

This report describes the methods that will be used to collect data and evaluate impacts to public services for the Southwest Corridor Light Rail Project. This analysis will be developed to comply with applicable state policy legislation; local and state policies, standards, and regulations; and to respond to environmental scoping comments.

Public services include law enforcement, fire and emergency medical services (including hospitals), solid waste collection and disposal, federal post office services, and public school transportation. Public transit, which is also a public service, will be discussed in the Transportation Results Report.

Related Laws and Regulations

Federal

No federal laws or regulations specifically address the questions to be considered in this technical analysis.

State

- Oregon Administrative Rule (OAR) 660-015-0000(11), Oregon Statewide Planning Goal 11 (2010) Public Facilities and Services.

  This regulation requires Oregon local jurisdictions to develop community and public facilities plans. It primarily pertains to water and sewer provisions, but it also requires plans for police and solid waste facilities. This regulation does not specifically pertain to the analysis questions and is provided for information only.

- Oregon Revised Statutes (ORS) Chapter 459 (2015), Municipal Solid Waste Management.

  This regulation establishes the relationship and authorities of state and local governments with respect to solid waste management in Oregon, and defines landfill permitting rules. This information will be used to help identify whether the project impacts the future demand (need for increased police presence) or facilities for public services.

- ORS 327.043 (2015), When district required to provide transportation; waiver.

  This regulation defines the requirement for public school districts to provide student transportation from their homes to public schools in Oregon. It will be used to evaluate potential impacts to school districts due to a change in public services facility location.

Contacts and Coordination

Coordination with public service agencies, including potential interviews with public service agency representatives, will be conducted primarily by telephone and electronic communication.

Study Area

Public services within 0.5 mile of the light rail alternatives will be evaluated. The study area is larger for public services than for some other environmental topics because it is important to evaluate access to

and from locations along the project corridor in addition to evaluating the ability for emergency services to conduct their operations across and along the corridor. The study area can be adjusted based on information gathered from coordination with the public service agencies. For example, there may be access routes that are outside of the 0.5-mile radius that are impacted by the alternatives.

Data Collection

Data for public service providers will be gathered and analyzed for facilities or key routes located within the public services study area

Because there are no regulatory guidelines to frame this impacts assessment, it will be based on public service provider industry standards or adopted strategic plans and goals. In order to understand the standards plans or goals, information will be gathered from the following:

- Existing facility and operations reports
- Available maps for route information
- Targeted interviews with representatives from public service providers

Existing reports and maps will provide the basic understanding of how public services function within the study area. Interviews with limited public service representatives will facilitate answering the key questions posed above. Any additional information that is produced and updated by public services will be used for this analysis.

If specific roadway or intersection forecast analysis is deemed necessary, this analysis will rely on data provided in the transportation analysis.

The project team expects to collect data from many sources, including the following documents:

Metro

- Metro Council, 2040 Growth Concept, 1995, updated December 2014.

City of Portland

- City of Portland, Bureau of Planning (2016), 2035 Comprehensive Plan Goals and Policies.
- City of Portland, Bureau of Planning (2016), Central City 2035 Comprehensive Plan Goals and Policies.
- City of Portland, Portland Fire and Rescue (2015), Fiscal Year 2015-2020 Strategic Plan. This plan establishes long-range operating goals and service standards that will be used to evaluate impacts to facilities and response times.
- City of Portland, Planning and Sustainability (2016), City Wide Systems Plan, Chapter 10.
- City of Portland, Portland Bureau of Transportation, Transportation System Plan 2007.

City of Tigard

- City of Tigard (2007), Comprehensive Plan 2027.

City of Tualatin

- City of Tualatin Development Code.

Affected Environment
Fire stations, police stations, medical centers, schools, and other public services are located within the project area. These service providers depend on the local and highway transportation networks to respond to emergencies and allow access to their facilities. Typically, mobile service providers designate critical access routes they rely on to provide emergency response. Modifications in the transportation infrastructure can impact these operations. Additionally, schools are stationary, but students rely on safe and efficient transportation facilities to reach them.

Impact Assessment
The degree to which the alternatives affect the provision of public services will be evaluated. The evaluation will consider both long-term (operational) and short-term (temporary construction) impacts. Generally, the three key questions to be answered for all public services are:

- Will the long-term use and operation of the Southwest Corridor Light Rail Project affect the facilities or provision of services provided by public services? For instance, will the project affect the response time for fire and emergency medical response teams to reach victims?
- Will the construction activities of the Southwest Corridor Light Rail Project affect the facilities or provision of services provided by public services? For instance, will detours or increased traffic due to construction prevent the use of critical access routes such that service is detrimentally delayed?
- What is the largest design vehicle utilized along emergency access routes?

This evaluation will qualitatively evaluate impacts to the specific public services listed below. The Safety and Security Analysis Methods report will address the issues listed below:

- Fire and emergency medical services and law enforcement, including infrastructure, response times and access routes
- School transportation, including infrastructure, bus routes and safe routes to school
- Postal services and solid waste, including infrastructure, transportation and distribution

Long-Term Impacts
Alternatives will be evaluated to determine long-term impacts on the movement and efficiency of public services, such as those impacts listed below:

- Displacement of facilities.
- Notable traffic movement restrictions or changes in transportation service levels (e.g., closed roads, turning restrictions, one-way designations, new median barriers, or traffic congestion levels) that would permanently alter the routes used to provide public services.

Beneficial effects associated with the alternatives, including improved access, reduced delays, and improved safety, will also be discussed based on the results of the transportation impact analysis.

Short-Term Impacts

The short-term impacts analysis will discuss how construction could impact public services. Past experience with major transportation development projects indicates that close coordination with fire, emergency, law enforcement, the postal service, and school transportation providers is necessary during construction design and in the development of construction management plans.

Indirect Impacts

Indirect impacts for public services could occur from other developments around station areas related to the light rail project. Most impacts to public services would be addressed through the direct long-term or short-term impacts analysis, but the indirect impact assessment would consider other activities that may occur. Examples of these other activities include station area transit-oriented developments or street/transit system improvements that parties other than FTA and TriMet may undertake in support of the light rail project.

Cumulative Impacts

Based on the list of foreseeable transportation and other development projects that are anticipated to occur in the study area within the same time frame, a qualitative analysis of potential cumulative effects will be conducted for public services. It is assumed that the list of foreseeable projects for this analysis will be based on information provided in the transportation and land use analyses. It is also assumed that the cumulative effects will be prepared for all elements of the environment based on this same list of foreseeable projects.

Mitigation Measures

If mitigation is necessary, the Environmental Impact Statement (EIS) will include potential options that would adequately reduce the impacts on public services.

Documentation

Existing public services and impacts will be discussed in the Public Services section of the EIS. The EIS section will focus on long-term and short-term/construction period impacts common to all alternatives, but will also identify impacts specific to individual alternatives when appropriate. Background information, existing conditions information, and details of the analysis will be included in a technical memorandum available for review through Metro, and will be included in cooperating agency reviews of the Preliminary Draft EIS.

SAFETY AND SECURITY ANALYSIS METHODS

Introduction

This report describes the methods that will be used to collect data and evaluate impacts to public safety and security for the Southwest Corridor Light Rail Project. This analysis will be developed to comply with the National Environmental Policy Act (NEPA); local and state policies, standards, and regulations; and to respond to community concerns raised through environmental scoping.

The safety and security section of the Environmental Impact Statement (EIS) will document potential public safety impacts and the project's design, operational, and mitigation measures to minimize transit-related impacts to public safety and security. Public safety and security will include potential damage or loss of property, as well as potential harm or injury to members of the public, arising through the construction and operation of the light rail system and its facilities. Some of the issues that will be considered in this analysis will also be discussed in other sections of the EIS, including public services and traffic. For instance, the public services analysis will identify potential impacts to emergency services facilities and operations in the corridor, including police, fire, and medical emergency response. The public safety analysis, by contrast, will discuss transit-related crime and other incidents, such as how determining facility locations, based on the area's crime statistics, accident rates, or other public safety issues, might change public safety conditions.

The Safety and Security section of the EIS is also intended to describe the programs that are already in place and assumed to be part of the project, but which might not be readily understood by the general public. For instance, TriMet has developed and adopted a systemwide Transit Security Plan that applies community policing goals and techniques to transit security. Elements of the plan would be incorporated into the design and operation of the Southwest Corridor Light Rail Project. These elements would likely include:

- In-house training of transit district employees to increase awareness of and prevent criminal activities
- Coordination with local law enforcement agencies and personnel
- Facility design and operations standards, principles, and guidelines that would improve visibility at transit stations, reduce conditions that could encourage crime, and facilitate effective security enforcement
- Tracking and surveillance technology

Related Laws and Regulations

This section describes laws, regulations, and other guidance that could guide data collection and the criteria for gauging potential project impacts on safety and security.

Federal

- National Environmental Policy Act (NEPA 1969); as implemented through 40 Code of Federal Regulations (CFR) 1508. Environmental concerns identified during project scoping should be addressed in the Draft EIS.

Local

- City of Portland, Bureau of Planning. 2016. Comprehensive Plan Goals and Policies. Portland, Oregon.
- City of Portland, Portland Fire and Rescue. 2015. Fiscal Year 2015–2020 Strategic Plan. Portland, Oregon. This plan establishes long-range operating goals and service standards that will be used to evaluate impacts to facilities and response times.
- Tualatin Valley Fire and Rescue 2013–2015 Strategic Plan. Washington County.
- City of Portland, Portland Police Bureau. 2007. 2007–2012 Community Policing Strategic Plan. Portland, Oregon. This plan establishes long-range goals, strategies, and service standards that will be used to evaluate programs and approaches to minimize public safety concerns.

Contacts and Coordination

This study will include data obtained from or coordination with facility staff or service district representatives from the following fire and emergency medical services and law enforcement providers:

- Washington County Sheriff's office
- City of Portland Police Bureau
- Portland Fire and Rescue
- Tigard Police Department
- Tualatin Police Department
- Tualatin Valley Fire and Rescue
- Oregon State Police

Additionally, agencies and organizations have been notified of the intent to publish a Draft EIS through the Federal Register and through other project outreach activities. Interested organizations will have the opportunity to review and comment on the safety and security analysis throughout the course of the project.

Data Collection

The project team will collect information from the following:

- The Federal Transit Administration's National Transit Database (NTD) reporting program for transit-related crime and public safety incidents
- TriMet, including a transit police division that is specifically dedicated to policing transportation
- Transportation Security Administration (TSA), which administers grants and programs under the Department of Homeland Security
- The Cities of Portland, Tigard, and Tualatin, and Washington County (statistical information on crime occurrence in the study area), and TriMet (information on crime incidence and security measures in the study area and on the existing light rail system)

This study will also rely on information gathered from other technical analyses, such as accident location reporting in the Transportation section of the Draft EIS and analysis of potential impacts to emergency response times, which will be discussed in the Public Services section of the Draft EIS.

Affected Environment

The affected environment profile for this safety and security analysis will identify the locations of existing public safety service areas, which could include the following fire and emergency medical services and law enforcement information:

- Location of service providers
- Type of service or services provided
- Area served
- Population served
- Critical access routes and response times collected locally by neighborhood and precinct, to provide an overlay of existing conditions along the project corridor.

Impact Assessment

The safety and security analysis will address whether safety and security conditions would be negatively affected by construction activities or the long-term operation of the project. The analysis will be coordinated with the public involvement work element for the project.

*Long-Ter*m *Impacts*

The project team will evaluate the degree to which project alternatives might affect public safety and security conditions. The analysis will also respond to comments and concerns raised by the public. Will the project introduce features or facilities that could increase the potential for crime or emergencies? For example, will park-and-ride facilities be located in areas with high incidence of crime, such as car thefts, robbery, or assault?

Short-term Impacts

Traffic rerouting, lane closures, and construction traffic may affect emergency response times and the travel routes for pedestrians and bicycles during construction periods, especially at stations or construction sites. This could also require emergency responders to alter their response routes or it could increase their response times. The analysis will include an evaluation of how these construction activities may impact safety and security in the project area.

Indirect Impacts

Indirect impacts for safety and security could occur from other developments around station areas related to the project. Most impacts for safety and security would be addressed through the direct long-term or short-term impacts analysis, but the indirect impact assessment would consider other activities that may occur. Examples of these other activities include station area transit-oriented development or street/transit system improvements that parties besides FTA and TriMet may undertake in support of the project.

Cumulative Impacts

Based on the list of foreseeable transportation and other development projects that are anticipated to occur in the study area within the same time frame, a qualitative analysis of potential cumulative effects will be conducted for safety and security impacts. The list of foreseeable projects for this analysis will be based on information provided in the transportation and land use analysis. It is also assumed that the cumulative effects will be prepared for all elements of the environment based on this same list of foreseeable projects.

Mitigation Measures

TriMet's programs for fire/life/safety and its standard design procedures will be referenced as potential impact mitigation/minimization measures. TriMet will perform a preliminary hazard analysis and threat and vulnerability assessment early in design to ensure all identified hazards and threats are mitigated to the lowest practical level.

Documentation

Existing conditions and impacts to safety and security will be discussed in the Safety and Security section of the EIS. The EIS section will be summary-level, focused primarily on impacts but still identifying the long-term and short-term/construction period impacts to safety and security.

SECTION 4(F) RESOURCES ANALYSIS METHODS

Introduction

This report describes the methods that will be used to collect data, conduct agency coordination and public outreach, and evaluate impacts to Section 4(f) resources for the Southwest Corridor Light Rail Project. This analysis will be developed to comply with Section 4(f) federal regulations.

This report describes the Section 4(f) regulation and outlines how the analysis will be conducted. For the purposes of this analysis, Section 4(f) resources include the following:

1. Parks and recreational areas of national, state, or local significance that are both publicly owned and open to the public
2. Publicly owned wildlife and waterfowl refuges of national, state, or local significance that are open to the public to the extent that public access does not interfere with the primary purpose of the refuge
3. Historic sites of national, state, or local significance in public or private ownership regardless of whether they are open to the public

Related Laws and Regulations

Federal requirements protecting publicly owned parks, greenspaces, recreation area and trails, wildlife and waterfowl refuges, and public or private historic sites apply to all transportation projects that utilize federal funding. These requirements, known as Section 4(f), are originally from Section 4(f) of the U.S. Department of Transportation Act of 1966 (USDOT Act), which was recodified in 1983 as 49 United States Code (USC) 303 policy on lands, wildlife and waterfowl refuges, and historic sites.

The Section 4(f) evaluation and results report will use information and coordination conducted for the Parks and Recreational Resources impact analysis and the Historic, Archaeological and Cultural Results report, focusing on those properties that meet requirements to be considered Section 4(f) resources. USDOT regulations define significant historic, archaeological, and cultural resources as those that are listed in or meet criteria for listing in the National Register of Historic Places, per Section 106 of the National Historic Preservation Act and related regulations.

Section 4(f)

Section 4(f) prohibits the use of Section 4(f) resources for transportation projects except under certain defined circumstances. USDOT agencies, including FTA:

> …may approve a transportation program or project (other than any project for a park road or parkway under section 204 [1] of title 23) requiring the use of publicly owned land of a public park, recreation area, or wildlife and waterfowl refuge of national, State, or local significance, or land of an historic site of national, State, or local significance (as determined by the Federal, State, or local officials having jurisdiction over the park, area, refuge, or site) only if—
>
> (1) there is no prudent and feasible alternative to using that land; and

> (2) the program or project includes all possible planning to minimize harm to the park, recreation area, wildlife and waterfowl refuge, or historic site resulting from the use.

A "Use" can be permanent, temporary adverse, or constructive, as defined below.

Permanent use includes acquisition and incorporation of the resource into the transportation facility. It includes fee simple and permanent easements use.

Temporary use occurs when a transportation project temporarily occupies any portion of the resource and results in an adverse condition. In order for a temporary use of Section 4(f) land not to be considered adverse, it must meet the following conditions:

- The duration of the occupancy must be less than the time needed for the construction of the project, and there must not be a change in ownership.
- Both the nature and magnitude of the changes to Section 4(f) resources are minimal.
- There are no anticipated permanent adverse physical changes or interference with activities or purposes of the resource on a temporary or permanent basis.
- The land is restored to the same or better condition.
- There is a documented agreement of the appropriate federal, state, or local officials having jurisdiction over the resource, regarding the above condition.

A constructive or indirect use occurs when the proximity effects of the transportation project are so great that the use of the property is substantially impaired. Examples of such use include the following:

- The projected noise level increase from the project substantially interferes with the use and enjoyment of a resource that is protected by Section 4(f), such as enjoyment of a historic site where a quiet setting is a generally recognized feature or attribute of the site's significance.
- The proximity of the proposed project impairs the aesthetic quality of a resource, where aesthetic qualities are considered important contributing elements to the value of a resource, such as impairment to visual or aesthetic qualities that obstructs or eliminates the primary views of an architecturally significant historic building.
- The project results in a restriction of access to the Section 4(f) resource, which substantially diminishes the utility of the resource.
- A vibration impact from the operation of a project substantially impairs the use of a Section 4(f) resource, such as projected vibration levels from a rail transit project great enough to affect the structural integrity of a historic building.
- The ecological intrusion of the project substantially diminishes the value of wildlife habitat in a wildlife or waterfowl refuge adjacent to the project or substantially interferes with the access to a wildlife or waterfowl refuge.

FAST Act, SAFETEA-LU, MAP-21, and Section 4(f)

Section 6009(a) of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), Pub. L. 109-59, amended existing Section 4(f) legislation at Section 138 of Title 23 and

Section 303 of Title 49, United States Code, to simplify the processing and approval of projects that have only *de minimis* impacts on lands protected by Section 4(f). SAFETEA-LU was the first substantive revision of Section 4(f) legislation since passage of the USDOT Act of 1966. The SAFETEA-LU revision provides that once the USDOT and the Federal Transit Administration (FTA) determine that a transportation use of Section 4(f) property (after consideration of any impact avoidance, minimization, and mitigation or enhancement measures) results in a *de minimis* impact on that property, an analysis of avoidance alternatives is not required. Coordination with the official with jurisdiction over the 4(f) resource and public outreach about any *de minimis* finding is required before FTA can make a final determination. This coordination and determination is regulated by 23 CFR 774.5.

In 2012, an exception to Section 4(f) was enacted as part of the federal transportation legislation Moving Ahead for Progress in the 21st Century (MAP-21). Section 1119(c)(2) of MAP-21 modifies 23 USC 138(a), effectively exempting projects on federal lands transportation facilities from Section 4(f) provisions. The exemption includes facilities owned and maintained by the National Park Service, U.S. Fish and Wildlife Service, U.S. Department of Agriculture Forest Service, U.S. Army Corps of Engineers, or the Bureau of Land Management.

In 2015, the FAST (Fixing America's Surface Transportation) Act added additional environmental streamlining measures requiring federal agencies to align NEPA, Section 106, and Section 4(f) processes.

Contacts and Coordination

There are several agencies that have jurisdiction over lands that could be subject to Section 4(f):

Federal Agencies

- U.S. Fish and Wildlife Service (USFWS)
- National Marine Fisheries Service (NMFS)
- U.S. Department of Interior (USDOI)
- National Park Service (NPS)
- Federal Transit Administration (FTA)

State Agencies

- Oregon Parks and Recreation Department (OPRD)
- Oregon State Historic Preservation Office
- Oregon Department of Land Conservation and Development (DLCD)
- Oregon Department of Fish and Wildlife (ODFW)
- Oregon Department of State Lands (ODSL)
- Oregon Department of Transportation (ODOT)

Local Jurisdictions and Agencies

- Metro Regional Parks and Greenspaces
- City of Tualatin

- City of Portland
- City of Tigard
- Washington County
- Portland Public Schools

Existing 4(f) Resources

The study area for publicly owned parks, greenspaces, recreation resources, and trails extends 150 feet from the edge of the alternatives. The Area of Potential Effect (APE) for historic, archaeological, and cultural resources is defined as 50 feet from the edge of the alternatives.

Methods to identify the presence of parks and recreational resources, including any subject to Section 4(f), are provided in the Parks and Recreational Resources Analysis Methods report. Each identified resource subject to Section 4(f) will be evaluated to determine the characteristics and significance of the recreational use. Uses will be characterized through coordination with the agencies responsible for the establishment and management of each resource and any associated Native American Tribes. Coordination will include identifying the type or types of recreational uses at each location and potentially the frequency, intensity, and accessibility of each type of use. The analysis will also investigate considerations including, but not limited to, environmental or other protections, special use permits, or special seasonal uses.

The Section 4(f) analysis will also draw from the results of the historic, archaeological, and cultural analysis to define resources that could be regulated under Section 4(f). If properties on (or eligible for listing on) the National Register of Historic Places would be used or adversely affected by the any of the project alternatives, the analysis of impacts would be coordinated with the Section 4(f) evaluation. Eligibility is determined through concurrence by the State Historic Preservation Office (SHPO).

Impact Assessment

All identified Section 4(f) resources will be evaluated to determine whether any of the project alternatives would be a "use" of the resource. There are no wildlife and waterfowl refuges in the study area. Impacts to historic and cultural resources will be evaluated in conjunction with the Determinations of Effect prepared for the Section 106 analysis. Similarly, the parks and recreational resources analysis will assist in determining impacts that could be considered a Section 4(f) use. The analysis described in the Draft EIS will identify the alternatives that involve a use of a Section 4(f) property, and which alternatives, if any, would avoid or reduce the use. If none of the Draft EIS alternatives appears to avoid the use, the Draft EIS will discuss the factors being considered to determine if an avoidance alternative exists, and if none is available, it will also review the factors that would be considered to determine a least harm alternative. While all of these steps in the analysis involve coordination with the agencies with jurisdiction over Section 4(f) resources, substantially more planning, coordination, and written documentation are needed to meet the requirements for FTA to approve a project with a Section 4(f) use, as described further below.

Conceptual engineering information by TriMet, in conjunction with property boundary and acquisition maps for the identified resources, will be used to determine where the project might convert all or part of a Section 4(f) property into a transportation facility. To determine whether there would be a

constructive use, the Section 4(f) analysis will be coordinated with the analyses of noise and vibration, traffic, parking, access, and nonmotorized use, as well as visual impacts. If a use or constructive use of an identified Section 4(f) resource would be required with any of the project alternatives, potential avoidance opportunities would be identified.

If uses or impacts to a Section 4(f) resource are anticipated, the agency with jurisdiction over that resource will be identified and contacted. The project team will arrange a meeting with the official who has jurisdiction over the property to discuss the significance of the property and probable effects. If the official determines that a site is not significant, documentation to that effect will be requested and included in the Section 4(f) results report. Further consideration under Section 4(f) is not required for insignificant sites. For sites that are defined as significant, the Section 4(f) evaluation will be completed.

Avoidance and Measures to Minimize Harm

When a project's Section 4(f) impact would be greater than *de minimis*, FTA must consider whether there are feasible and prudent alternatives that would avoid the impact. As defined in the Section 4(f) regulation, an alternative is feasible if it can be built as a matter of sound engineering judgment. An alternative is prudent if all the following requirements are met:

- It meets the project purpose and need and does not compromise the project to a degree that makes it unreasonable to proceed in light of its stated purpose and need.
- It does not cause extraordinary operational or safety problems.
- It causes no other unique problems or severe economic or environmental impacts.
- It would not cause extraordinary community disruption.
- It does not have construction costs of an extraordinary magnitude.
- There are no other factors that collectively have adverse impacts that present unique problems or reach extraordinary magnitudes.

If FTA finds that an alternative is not feasible and prudent, that alternative may be removed from consideration as a way to avoid a Section 4(f) use. If there are no prudent and feasible alternatives that can avoid all Section 4(f) resources, then FTA must determine which alternative results in the least overall harm, after considering the following factors:

- The ability to mitigate adverse impacts to each Section 4(f) property (including mitigation measures that result in benefits to the property)
- The relative severity of the remaining harm, after mitigation, to the protected activities, attributes, or features of the Section 4(f) property
- The relative significance of each Section 4(f) property
- The views of the official(s) with jurisdiction over each Section 4(f) property
- The degree to which each alternative meets the purpose and need for the project
- After reasonable mitigation, the magnitude of any adverse impacts to resources not protected by Section 4(f)
- Substantial differences in costs among the alternatives

Documentation

For the Draft EIS, a Section 4(f) evaluation will be prepared that compares the potential Section 4(f) impacts of the each alternative. The Final EIS will contain a more detailed evaluation of the Preferred Alternative, along with documentation of the consultations with officials with jurisdiction over any affected Section 4(f) properties.

TRANSPORTATION ANALYSIS METHODS

Traffic, Pedestrians, Bicycles, Freight, Parking

Introduction

This report describes the methods that will be used to collect data and conduct transportation analysis for people traveling in the Southwest Corridor in motor vehicles, by foot, and on bicycles, for goods moving in freight trucks and on railroads, and for motor vehicle parking for the Southwest Corridor Light Rail Project Draft Environmental Impact Statement (Draft EIS). This analysis will be developed to comply with the National Environmental Policy Act (NEPA); local and state policies, standards, and regulations; and to respond to community concerns raised through environmental scoping.

Planning for high capacity transit (HCT) improvements in the Southwest Corridor has been underway since 2009. The evaluation and refinement of HCT options in the corridor have included considerable technical analysis of traffic operations associated with the HCT options. The *Final SW Corridor Traffic Analysis and Operations Memorandum, July 2014*, prepared by DKS Associates, used Synchro traffic models to analyze the PM and AM peak hour operations at key intersections with HCT operating through the corridor.

That memo was followed by the *SW Corridor Supplemental Refinement Traffic Impact Analysis Executive Summary Traffic Report, March 2016*, also prepared by DKS Associates. This refinement memo focused on more detailed technical analysis in three target areas: SW Barbur Boulevard between SW 69th and SW Brier Place, SW Barbur Boulevard between SW Hamilton and SW Naito Parkway, and in the Interstate 5 (I-5)/Lower Boones Ferry Interchange area. This refinement analysis was used to test detailed design options and provide input into the preparation of light rail designs that are the basis for the Southwest Corridor Light Rail Project Environmental Impact Statement (EIS) analysis.

The models and analysis prepared for these memos will be used, as appropriate, in the traffic operations and impacts analysis for the EIS. The Draft EIS and Final EIS traffic analyses will be consistent with these methods. The Final EIS will include a more detailed analysis focused on the Preferred Alternative.

The Oregon Department of Transportation (ODOT) and the City of Portland are currently negotiating a potential jurisdictional transfer of the portions of SW Naito Parkway and SW Barbur Boulevard within the Portland city limits that are currently part of the state highway system designated as OR 99W. ODOT issued a letter to Metro and TriMet in January 2017 which clarified its expectations with regard to the acceptable forecast year for the traffic analysis for these portions of roadway in the Draft EIS. The letter clarifies that ODOT will accept 2035 forecast year analysis for SW Barbur Boulevard and SW Naito Parkway except for locations at freeway interchanges. ODOT further clarifies that if the jurisdictional transfer agreement is not concluded, that additional analysis using a 2045 forecast year for those state highway segments may be required.

Transportation methods range from system-wide measures developed through regional travel forecasts to focused analysis of intersection operations. Metro will analyze system-wide transportation impacts, but micro-level traffic impacts analysis will focus on identifying localized impacts. The local traffic analysis will identify and evaluate the long-term impacts of the project on the following:

- Volume-to-capacity (v/c) ratios or level of service (LOS) at study intersections affected by the alternatives and options
- Signal progression
- 95th percentile queueing at freeway off-ramps and mainline approaches for study intersections in Vissim model areas
- Property access and local traffic-flow changes caused by intersection reconfiguration, street closures and/or driveway consolidation, the addition of new traffic signals, and by at-grade rail crossings created by the proposed transit improvements
- Truck freight movement within the corridor, including loading dock access
- On-street parking impacts attributable to the alternatives and options
- Bicycle and pedestrian access and circulation
- Safety including high injury locations

Short-term impacts to vehicular, bicycle and pedestrian traffic resulting from construction activities will also be identified and evaluated.

Related Laws and Regulations

The following relevant laws, regulations, and policy direction established in the numerous transportation plans and policy documents adopted by jurisdictions within the corridor will be considered in the transportation analysis.

Federal

- National Environmental Policy Act of 1969
- Code of Federal Regulations (CFR), Title 49, Transportation - Part 213 Track Safety Standards
- CFR, Title 49, Transportation - Part 236 Rules, Standards and Instructions: Signal Systems

State

- Oregon Transportation Planning Rule (Oregon Administrative Rules [OAR] Chapter 660, Division 12) with its provisions for bicycle parking, and bicycle and pedestrian access to stations, and performance standard guidance
- OAR 340.20.129(1)(c) and OAR 340.20.129(1)(e) relating to the evaluation of park-and-ride lots as required by the Oregon Department of Environmental Quality (DEQ)
- OAR 734-020 and OAR 734-051 relating to traffic control and access spacing as required by the Oregon Highway Plan
- *Oregon Transportation Plan*, Oregon Department of Transportation (ODOT) (adopted September 20, 2006)
- *Oregon Highway Plan*, ODOT (1999, amended May 2015)

Local

- *Regional Transportation Plan*, Metro (2014)
- City and County Transportation System Plans (City of Portland, City of Tigard, City of Tualatin, City of Lake Oswego, and Washington County)
- Transportation impact study guidelines (City of Portland, City of Tigard, City of Tualatin, and Washington County)

Contacts and Coordination

Previous planning efforts in the Southwest Corridor have been coordinated by Metro and managed by a project Steering Committee that is chaired by two Metro Councilors, and has elected and appointed representatives from TriMet, ODOT, Washington County, and the cities of Portland, Tigard, Tualatin, Durham, King City, Beaverton, and Sherwood. A description of this planning process and resulting documentation can be found on Metro's website at http://www.oregonmetro.gov/public-projects/southwest-corridor-plan. Each of these agencies and jurisdictions is represented at the Southwest Corridor Project Technical Advisory Committee (TAC), which is composed of technical staff from each jurisdiction and agency. The transportation analysis team will report to the TAC as needed and as directed by the Metro project manager.

The jurisdictions and agencies listed below will be contacted as appropriate to provide information to assist with the transportation analysis. Typical thresholds or standards of significance used by these agencies (as documented later in this section) will be utilized, and any standard mitigation measures that would apply to the project are identified, including improvements already identified through prior planning in the corridor.

State Agencies

- ODOT: *Oregon Transportation Plan* (adopted September 20, 2006), *Oregon Highway Plan* (1999, amended May 2015), *Oregon Bicycle and Pedestrian Plan* (adopted May 19, 2016), and relevant policies related to access management and highway design/operation. ODOT is a full partner in the EIS and has responsibility over certain major transportation facilities in the corridor including I-5 (and exit and entrance ramps), OR 99W, Ross Island Bridge, OR 141 (SW Hall Boulevard), I-405, and OR 217. ODOT also has responsibility for roadways within interchange areas as well as for rail crossing safety, compliance with Federal Railroad Administration policies, regulating railroad clearances, and safety oversight of rail transit systems.
- DEQ: DEQ has responsibility for air and water quality and is included here due to its role in monitoring air quality impacts related to motor vehicle operations.

Regional Agencies

- Metro: *Urban Growth Management Functional Plan* (January 2016), the Congestion Management System, and the *Regional Transportation Plan* (2014). Metro is the project manager for the EIS, and is responsible for land use and transportation planning at a regional level.
- Tri-County Metropolitan Transportation District of Oregon (TriMet): TriMet is responsible for the design, construction, and operation of HCT facilities in its service area which includes

most of the urbanized areas of Washington County, Multnomah County and Clackamas County.

Counties

- Washington County: *Transportation System Plan (*November 2015). Washington County operates and maintains several roadways in the study area, and those facilities will be subject to county performance measures.

Cities

- City of Portland: *Transportation System Plan Update Stage 1 of the Comprehensive Plan* (adopted June 2016), the Transportation System Plan (adopted 2002, updated 2007), the Central City 2035 Proposed Draft (June 2016), and the Central City Transportation Management Plan (Adopted 1995).
- City of Tigard: *Transportation System Plan* (November 2010).
- City of Tualatin: *Transportation System Plan* (March 2014).
- City of Lake Oswego: *Transportation System Plan* (September 2014).

Data Collection

Study Area

The study area was defined during previous study phases. TriMet has developed conceptual designs illustrating the project alternatives, which are organized into three segments and serve as the basis for the EIS technical analysis. The results of the technical transportation analysis will be reported by segment, listed below, and will provide the basis for comparison among alignment options within each segment.

- Segment A – Inner Portland (SW Lincoln to SW Brier Place)
- Segment B – Outer Portland (SW Brier Place to SW 68th)
- Segment C – Tigard/Tualatin (SW 68th to Bridgeport Village)

The first two segments fall completely within the Portland City Limits, and the third segment includes two sub-areas that fall within the Cities of Tigard and Tualatin. There are four primary jurisdictions in the study area where the local traffic impacts within corridors are managed (Washington County, City of Portland, City of Tigard, and City of Tualatin), as well as the ODOT jurisdiction.

Overview of the Transportation Analysis Process

The following discussion provides an overview of the process for collecting data, analyzing existing conditions, preparing forecast volumes, preparing intersection analyses, assessing performance, and identifying mitigation. Further detail describing specific methodology and analysis is presented in subsequent sections of this report.

Affected Environment

Understanding the transportation-affected environment for the project requires collecting data on the existing transportation system and its performance for various modes of travel. The locations

and type of data to be collected are described in the Affected Environment section of this report. The traffic count program described provides the basis for determining existing traffic volumes in the corridor.

The transportation analysis will focus on transportation operations at study area intersections and roadways using the *2010 Highway Capacity Manual* methodologies for unsignalized intersections and the *HCM 2000* methodology for signalized intersections (Transportation Research Board 2010). The analytical tools used to evaluate traffic operations at study area intersections will be Synchro, SimTraffic, and/or Vissim. The Affected Environment section will summarize data collected on pedestrian activity, bicycle activity, transit usage, on-street parking usage, freight truck activity, and safety data.

Future Traffic Volumes

After data for the affected environment has been summarized, forecasts for future volumes will be developed based on post-processing forecasts provided by Metro. The No-Build Alternative horizon year is 2035 (and 2045 for freeway ramp terminals). In addition to developing future volumes for the No-Build Alternative, future volumes will be developed for the build alternatives and alignment options for comparative purposes. These forecasts take into account future regional land uses including park-and-ride land uses, when applicable.

Impact Assessment – System-wide Analysis

Metro will prepare the system-wide analysis that will use the regional travel demand model to determine if the light rail project and associated facilities would cause changes in motor vehicle circulation or traffic patterns, including the potential for diversion of traffic through neighborhoods. This analysis will include quantification of link volumes from the travel demand model at key screenline locations (i.e., South Portland, mid-Barbur, Tigard), and comparison of link volumes across No-Build and build alternatives. Traffic diverted to regional through routes, such as freeways or other limited-access facilities, will be quantified using the regional travel demand model as a part of the system-wide traffic impact analysis. Volume difference plots will be produced to document changes in traffic patterns throughout the regional system.

Impact Assessment – Intersection Analysis

The tools utilized for future transportation operational analysis will focus on macroscopic (regional) and microscopic (intersection and corridor) levels of detail. The macroscopic analysis will be prepared by Metro utilizing its regional travel demand model. The microscopic analysis will be prepared by the consultant team and will focus on intersection/corridor performance using Vissim, SimTraffic, and the *Highway Capacity Manual* methodologies in Synchro. Vissim simulation will be utilized at three locations (SW 4th Avenue/I-405 interchange area, Ross Island Bridgehead, and the SW Terwilliger/Bertha/I-5 interchange area) identified at a traffic analysis methodology workshop with all participating project partner agencies. Microsimulation at these locations was determined to be necessary in order to fully understand the effects of oversaturated conditions and dynamic elements such as ramp queue dump operations, transit signal priority and pre-emption, and upstream/downstream effects of congestion.

Performance Measures and Mitigation

The final step in the transportation analysis process is to compare the alternatives, including the No-Build Alternative, to determine impacts to the transportation system resulting from the implementation of the proposed project. Potential mitigation measures will be developed at locations that do not meet specific performance standards and/or performance criteria thresholds (all of which are identified in more detail later in this report).

Background and Definitions

Travel Demand Modeling

Existing and projected population and employment are key factors in how the transportation system operates and how many vehicle trips are on the transportation network. Metro prepares population and employment estimates for the base year (2015) and for a range of forecast years. This study will use the base year and both a 2035 and a 2045 forecast year. Projected population and employment were developed for all areas within the study area consistent with the local jurisdiction comprehensive plans. These forecasts are consistent with the adopted Regional Transportation Plan (RTP). For purposes of the EIS analysis, Metro will prepare a 2035 forecast consistent with the RTP population and employment forecasts and a factoring approach to a 2045 forecast. Complete data sets will be developed for the following conditions:

- Existing base 2015
- Year 2035 forecast (AM and PM)[1]
- Year 2045 (PM only) forecast (for freeway ramp terminals only, factored from 2035).

The forecast year AM and PM peak-hour travel forecasts for each alternative and alignment option will be generated by Metro using the regional travel model. Regional travel demand forecasts will include hourly data and peak spreading.

The output from the regional travel models will be used to develop AM and PM peak-hour directional roadway volumes and intersection turning movements. These volumes will be derived using methodologies outlined in National Cooperative Highway Research Program Report 765, *Highway Traffic Data for Urbanized Area Project Planning and Design*. A post-processing application will facilitate the derivation of the forecast year AM and PM peak-hour turning movement volumes from actual count and model increment (growth) data.

Forecasting the amount of future traffic at the signalized and unsignalized intersections will be done by incorporating existing counts, base case travel demand model data (2015), and future travel demand model data (2035 and 2045). The growth rate in volumes will be determined between the base year model and the future year model, and the growth rate will be applied to the existing volume counts for 2015. This methodology minimizes the effects of model error by adding the increment of growth projected by the travel demand model to actual count data. Therefore, intersection approach and departure volumes used in the LOS calculations will reflect growth, but will not exactly match raw model volumes produced from the travel demand model.

[1] Use of 2035 forecast year for analysis of OR 99W portions of SW Barbur Boulevard and SW Naito Parkway is dependent on the successful completion of proposed jurisdictional transfer between ODOT and the City of Portland.

Intersections

Traffic operations on surface streets are generally controlled by the intersections along any given route. For the purposes of the project's local traffic impact analyses, surface street intersections have been categorized into three basic groups: (1) signalized intersections, (2) unsignalized intersections and ramp merges, and (3) at-grade crossings of surface streets by light rail or railroad tracks. Some locations combine two of these elements; for instance, a signalized intersection with light rail tracks passing through the intersection. Through prior planning, EIS scoping, and the review of these methods, local agencies and ODOT have provided input into the intersections to be evaluated.

Measurement of Motor Vehicle Performance at Intersections

This section discusses the intersection operations for motor vehicles in the study area. LOS and the v/c ratio are two commonly used performance measures that provide a gauge of intersection operations. Agencies often incorporate these performance measures into their mobility standards. These performance measures are defined as follows:

- Level of Service (LOS): A "report card" rating (A through F) based on the average delay (seconds per vehicle) experienced by vehicles at the intersection. LOS A, B, and C indicate conditions where traffic moves without significant delays over periods of peak-hour travel demand. LOS D and E are progressively worse operating conditions. LOS F represents conditions where average vehicle delay has become excessive and demand is near or over capacity; this condition is typically evident in long vehicle queues.
- Volume-to-capacity (v/c) ratio: A decimal representation (typically between 0.00 and 1.00) of the proportion of capacity that is being used. The v/c ratio is determined by dividing the peak-hour traffic volumes by the hourly capacity of a given facility. A lower ratio indicates smooth operations and minimal delays. As the ratio approaches 1.00, congestion increases and performance is reduced. Above 1.00, demand is greater than capacity and the facility is oversaturated, resulting in longer queues and delays.

Highway Capacity Manual methods will be used to determine LOS and v/c ratio at signalized intersections. The LOS at signalized intersections is defined in terms of average delay. Capacity, delay, LOS, and v/c ratio are calculated for each traffic movement or group of traffic movements at an intersection. The weighted average delay across all traffic movements determines the overall LOS for a signalized intersection. Refined analysis in subsequent phases of the project may be necessary to account for the effects of transit priority measures, as measured in terms of additional delay that would be experienced by motorists.

LOS at an unsignalized intersection is also defined in terms of delay. Average total delay, or the total elapsed time from when a vehicle stops at the end of the queue until the vehicle enters the intersection from the stop-controlled or yield-controlled approach, is the controlling measure. While the analysis methodology is completely different for unsignalized intersections than for signalized intersections, the measures of effectiveness are similar (LOS delay). LOS definitions for signalized and unsignalized intersections are in Table 1.

Table 1. Level-of-Service Definitions

LOS	Signalized Intersection Stopped Delay per Vehicle (seconds per vehicle)	Unsignalized Intersection Average Total Delay (seconds per vehicle)
A	≤10.0	≤10.0
B	>10.1 and ≤20.0	>10.1 and ≤15.0
C	>20.1 and ≤35.0	>15.1 and ≤25.0
D	>35.1 and ≤55.0	>25.1 and ≤35.0
E	>55.1 and ≤80.0	>35.1 and ≤50.0
F	>80.0	>50.0

Source: Transportation Research Board – 2010 Highway Capacity Manual, Special Report 209, Fourth Edition.

In order to objectively evaluate roadways in Segment A with free-flow movements, metered movements, and ramp merges where v/c ratios and LOS cannot be measured, queuing, delay, throughput, and travel time will be measured for these locations. These are not specific mitigation criteria, but will be reported to provide complete information on the benefits and impacts of proposed changes to the roadway network.

Signal Timing Optimization

Often at intersections, motor vehicle, pedestrian, and bicycle movements are controlled by a traffic signal. The operation of traffic signals has an overall time allocated for all of the movements at the intersection (referred to as the cycle length), as well as an individual time within the cycle length given to movements (typically referred to as splits in the cycle). As volumes of users of all modes at an intersection grow over time, it is usually necessary to reallocate the existing cycle length time or develop a new cycle length time and allocation of time within that cycle, to better serve those movements.

Signal Progression Bandwidth

Signalized intersections are often coordinated along a corridor/roadway for maximizing operations of throughput on that corridor. The ability to coordinate these signals is predicated on the amount of green time given to the major through movement on the corridor, and the timing between the signals to progress users along the corridor. The “green time” (amount of time allocated to a movement at an intersection that is green) creates a band of time for users to travel along a corridor. This band of time is also referred to as a bandwidth for users. Signal progression takes into account this bandwidth of green time on a corridor and can try to optimize the ability for users to progress on a corridor.

Queuing

Queuing is when a line of vehicles is waiting to be served by a signalized or unsignalized intersection. The speed of vehicles serviced within the queue is determined by the rate of flow at the front of the queue. The queue (or backup) of traffic can affect the design of facilities to properly account for this storage activity. *Highway Capacity Manual* methodologies are limited in their ability to capture the effects of oversaturated conditions, queue spillback between intersections, storage bay spillback, or starvation. As such, simulation-based analysis will be performed using SimTraffic and/or Vissim to capture these effects. SimTraffic analysis will be

performed according to ODOT's Analysis Procedures Manual, and Vissim analysis will be performed according to ODOT Vissim Protocol. For future year analysis, a peak-hour factor of 1.00 and an ideal saturation flow of 1,900 vehicles per hour per lane may be used to reflect realistic traffic patterns under highly congested conditions. The simulation analysis will report the 50th and 95th percentile queue lengths. The 95th percentile queue estimates that for any given cycle at a signalized intersection, the queue length calculated is representative of 95 percent of the peak 15-minute vehicular queues during the peak hour at that intersection.

Safety

Intersections will be identified based on their inclusion on local jurisdiction listings of high injury locations (or other collision reference). The local jurisdictions and ODOT will be asked to provide their prioritization and designations of high injury locations. Fatal and severe injury crashes (serious crashes) occurring in the most recent 5 years of data within 500 feet of the project alignment options will be documented. The locations of serious crashes will be identified and reviewed for apparent risk factors and compared to available documentation, such as the Barbur Road Safety Audit.

Evaluation Criteria for Traffic Operations

The methods used in the analysis of local traffic impacts will be consistently applied throughout the study area. However, because multiple agencies and jurisdictions are involved, there will be some differences in methodologies and impact thresholds depending upon the location within the corridor, the complexity of the issues, and the applicable laws and regulations.

In addition to the performance measures listed in Table 3, there are two special considerations for the City of Portland. The Portland Central City planning area has been designated a Multimodal Mixed-Use Area (MMA) by the city with concurrence from ODOT in June 2016. The MMA designation means that the City will not need to consider ODOT mobility standards when approving Comprehensive Plan or Zoning Map Amendments within the Central City portions of the corridor (north of I-405). The second consideration is a City policy that established a hierarchy for transportation modes that prioritizes pedestrian, bicycle, transit, freight and HOV/carshare vehicles over single occupant vehicles. While these policies do not directly affect the performance measures listed in Table 3, they will be considered during the evaluation of potential mitigation measures.

Local Jurisdiction Criteria

It is recognized that because multiple agencies and jurisdictions make up the study area, there will be some differences in performance measures depending upon the location of an intersection within the study area. The specific LOS threshold criteria for the supervising jurisdiction will be used at the study area intersections that fall within that jurisdiction and are summarized in Table 3.

Table 3. Acceptable Operating Standards / Performance Measures

Jurisdiction	Location	AM/PM Peak Two-Hour Period	
		First Hour	Second Hour
Oregon Department of Transportation [A]	Barbur Boulevard (outside of Centers) Naito Parkway (outside of Centers)	0.99	0.99
	Ramp Terminals (signalized intersections at end of freeway off-ramps)	0.85	0.85
	Regional/Town Centers	1.1	0.99
Washington County [B]	Regional Centers Town Centers Main Streets Station Communities	0.99	0.99
	Other Urban Areas	0.99	0.9
City of Portland [C]	Central City Gateway Town Centers Neighborhood Centers Station Areas	1.1	0.99
	Barbur Boulevard and Other Principal Arterials	0.99	0.99
City of Tualatin [D]	Washington County facilities ODOT facilities	0.99	0.99
	Downtown Tualatin (Metro-designated Town Center)	1.1	0.99
	City facilities	LOS D or E	
City of Tigard	City of Tigard facilities	1.0	1.0
City of Lake Oswego	City of Lake Oswego facilities	LOS E	

Sources: A. Oregon Highway Plan (1999); B. Washington County Transportation System Plan (November 2015); C. City of Portland Comprehensive Plan, Transportation System Plan update (June 2016); D. Tualatin Transportation System Plan (February 2013).

Note: ODOT and the City of Portland are currently negotiating a possible jurisdictional transfer (JT) of the OR 99W portions of SW Naito Parkway and SW Barbur Boulevard. The Draft EIS will use ODOT criteria for those facilities to determine potential mitigation. It is anticipated that the JT issue will be resolved in 2017 and the Final EIS will use the appropriate jurisdictional criteria for determining final mitigation.

Affected Environment

Understanding the affected transportation environment requires gathering data on the existing transportation system and its performance for all modes of travel. The following discussion describes the collection of intersection count data that will capture the number and direction of bicyclists, pedestrians, and motor vehicles traveling through study area intersections. Counts are focused on signalized intersections and other locations where the project would change operation or geometry of the intersection. Figures 2-1 through 2-5 show the study area intersections and modeled intersections. Study area intersections are locations where performance measures will be reported. Modeled intersections are used to distribute traffic and to properly capture traffic operations at study intersections. Performance measures will not be reported at modeled intersections. This data includes the following:

- AM peak hour (7 to 9 AM) vehicle turn movement counts at up to 74 intersections. These counts will include the collection of pedestrian, bicycle, bus, and truck (medium/heavy) crossing counts at each intersection.
- PM peak hour (4 to 6 PM) vehicle turn movement counts at up to 105 intersections. These counts will include the collection of pedestrian, bicycle, bus, and truck (medium/heavy) crossing counts at each intersection.
- 24-hour bidirectional vehicle volume, speed, and classification counts at up to 8 locations (locations to be determined during field observations).
- AM and PM peak-hour one-hour driveway counts at up to 24 locations (locations to be determined during field observations).
- Video data collection at up to six locations (locations to be determined during field observations).
- Motor vehicle travel time surveys (using the floating car method) will be collected along up to four different routes in Segment A during the AM and PM peak hour (routes to be determined during field observations). It is assumed that survey data will be collected over two different days by two different vehicles.
- Vehicle queue length measurements at up 20 locations during both the AM and PM peak hours (locations to be determined during field observations).
- Lane utilization measurements at up to 10 different locations (locations to be determined during field observations) during both the AM and PM peak hours
- Survey of the existing physical characteristics of the existing street network, including travel lanes, lane geometry at intersections, signal timing and phasing at study area intersections, presence of sidewalks, presence of bike lanes, presence of crosswalks, presence of bus stops and/or bus zones.
- An on-street parking inventory will be collected for the entire project corridor to determine number of stalls impacted by the project.
- To supplement the number of stalls impacted by the project, parking occupancy counts will be collected on an hourly basis over an 8-hour period on up to 10 block faces in downtown Tigard.
- Crowd-sourced travel time data (i.e., TomTom, HERE, or similar) will be collected for segment A to support simulation model calibration.

Figure 2-1. Segment A Study Intersections

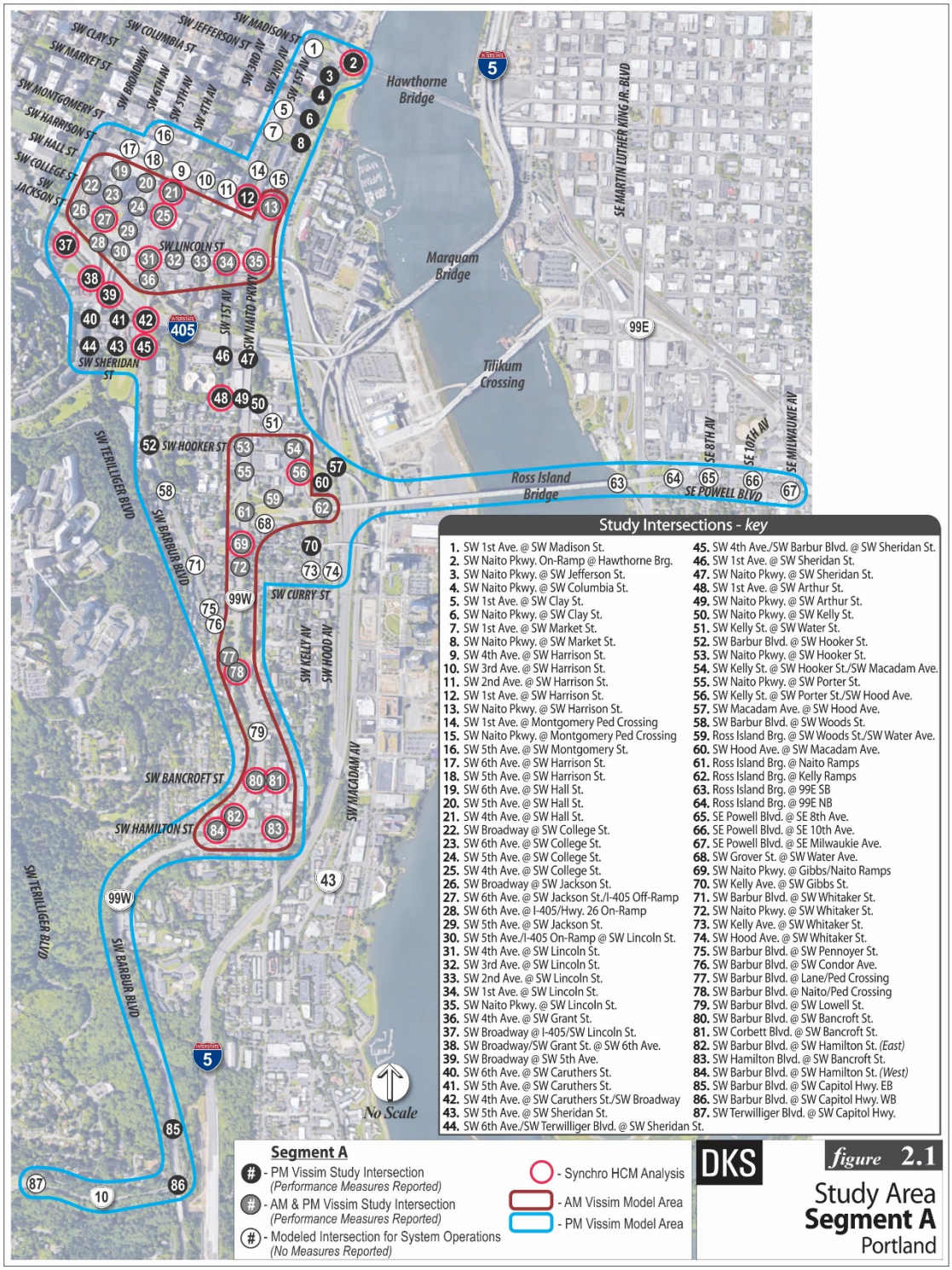


Figure 2-2. Segment B Study Intersections

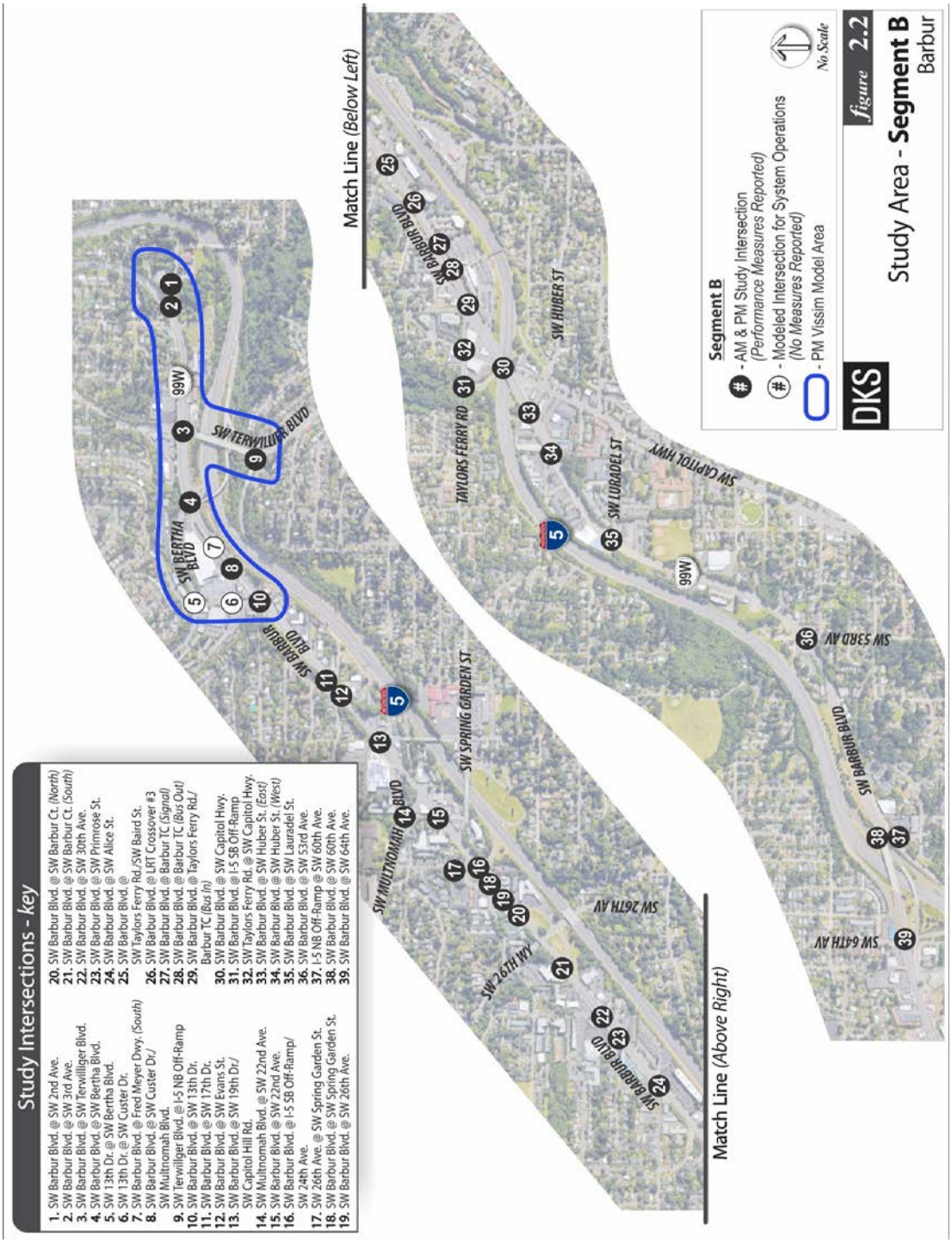


Figure 2-3. Segment C Study Intersections – Tigard

Study Intersections - *key*

2. 99W @ SW Hall Blvd.
3. 99W @ SW Greenburg Rd./SW Main St.
4. SW Hall Blvd. @ Clinton
5. SW Hall Blvd. @ Ash/Knoll
6. SW Main St. @ SW Commercial St.
7. SW Main St. @ SW Scoffins St.
8. SW Commercial St. @ Magno Humphries Driveway
9. SW Hall Blvd. @ SW Hunziker St./SW Scoffins St.
10. SW Hall Blvd. @ SW Commercial St.
11. SW Hall Blvd. @ SW Burnham St.
12. SW Hunziker St. @ Beveland Bridge/Wall St.
13. SW 72nd Ave. @ SW Dartmouth St.
14. SW 72nd Ave. @ SW Baylor St.
15. SW 72nd Ave. @ SW Beveland St.
16. SW 70th Ave. @ SW Beveland St.
17. SW 65th Ave. @ SW Haines St./I-5 NB Ramps
18. SW 68th Pkwy. @ SW Atlanta St.
19. SW 68th Pkwy. @ SW Dartmouth St./I-5 SB Ramps
20. SW Hall Blvd. @ Rail Crossing

Segment C

(#) - PM Study Intersection *(Performance Measures Reported)*

(#) - Modeled Intersection for System Operations *(No Measures Reported)*

No Scale

DKS

figure 2-3

Study Area - **Segment C**
Tigard

Figure 2-4. Segment C Study Intersections – Bonita and Carman/Upper Boones Ferry

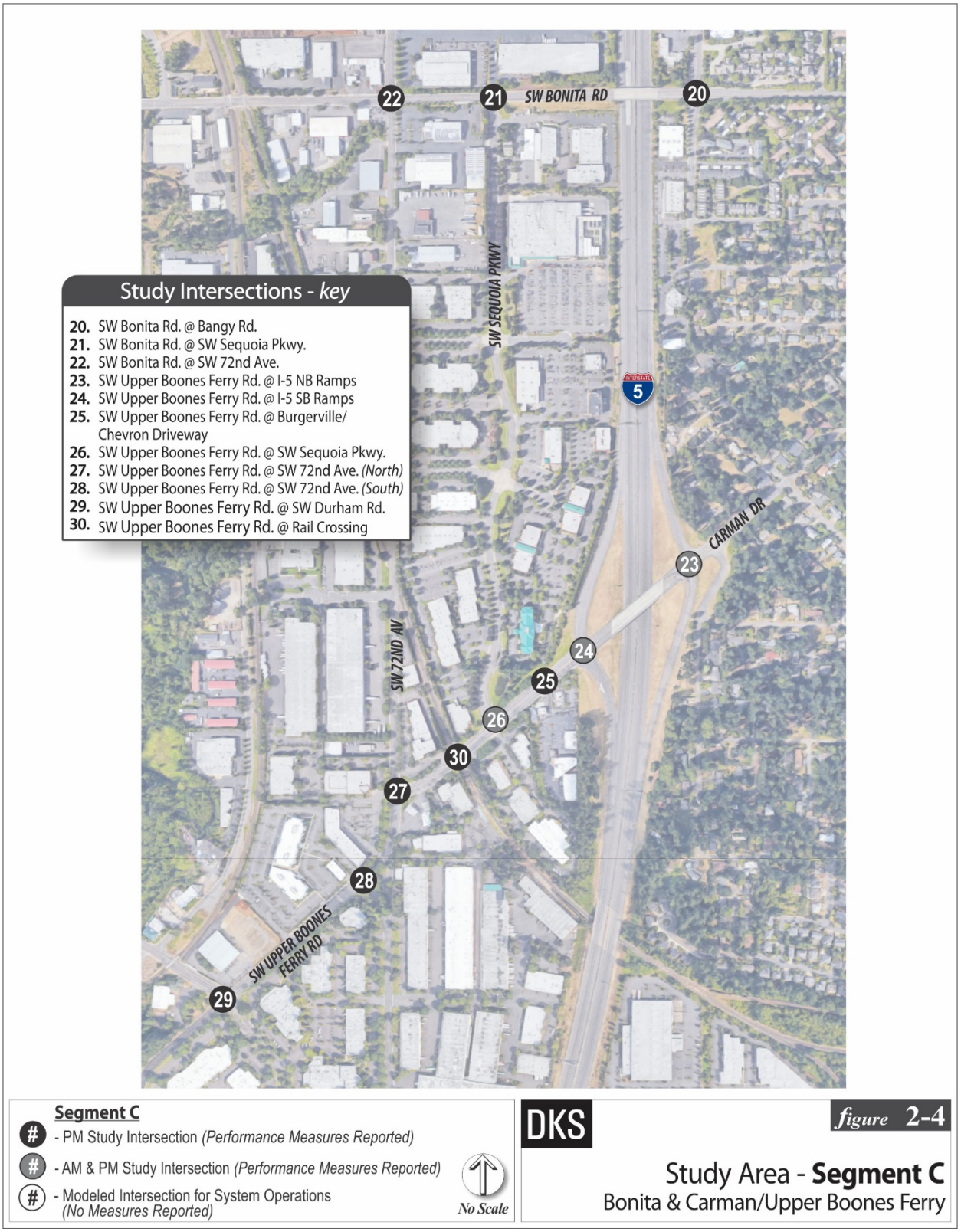
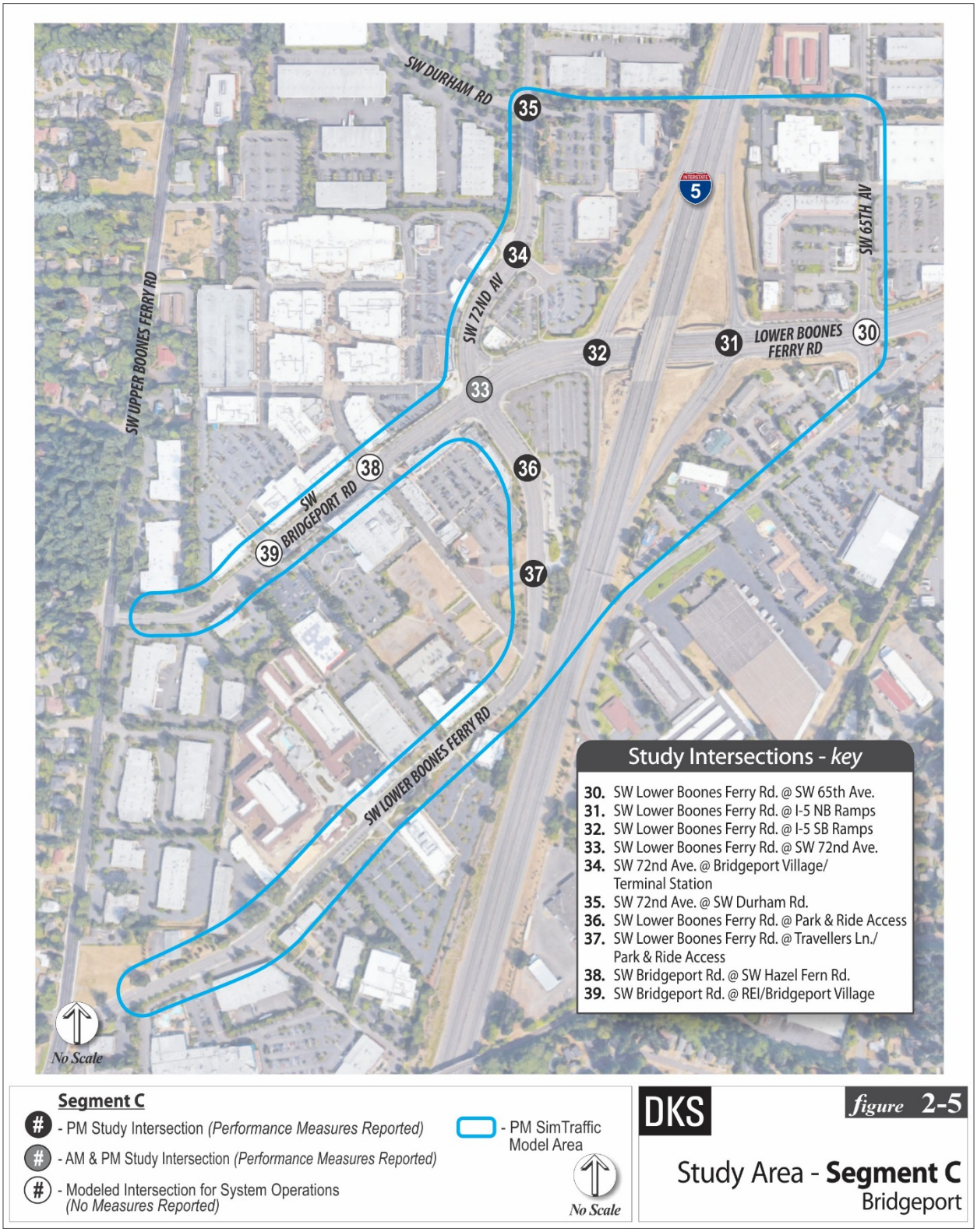


Figure 2-5. Segment C Study Intersections – Bridgeport



Impact Assessment and Mitigation

Long-Term Impacts

The following criteria will be used to evaluate all modes of travel within the study area. Both motorized and non-motorized modes will be evaluated, as well as additional criteria for parking and access.

Intersection Analysis

The evaluation of motor vehicle performance and identification of mitigation requirements for the project will be based on three primary criteria: v/c ratios, queuing, and safety. These three criteria will be compiled across all project alternatives (no build and build). To provide consistent evaluation criteria across the entire study area, project-based standards that have been mutually agreed upon by the partner agencies will be used. The project-based standards have been developed based on input from jurisdictional standards, but may or may not conform to these standards exactly. Each criterion will be evaluated separately to determine whether performance measures are met or not met when compared to the No-Build Alternative.

It is important to note that an alternative may not require mitigation using one performance measure, but may require mitigation using another performance measure. For example, a ramp terminal intersection may meet an intersection v/c mobility standard, but the 95th percentile queue on the ramp may exceed the safe stopping distance from back of queue to the freeway, thus requiring mitigation. Therefore, all performance measures will be applied, as appropriate, to study area intersections. These performance measures will be developed to help promote mobility and provide a safe and efficient transportation network. Figure 2-6 summarizes the overall process for evaluating impacts on study area intersections using the following performance measures.

The Draft EIS will include a preliminary signal warrant analysis at locations where the project includes installation of a traffic signal or where the project substantially impacts an unsignalized intersection. A full MUTCD traffic signal warrant analysis will be conducted during a future project phase.

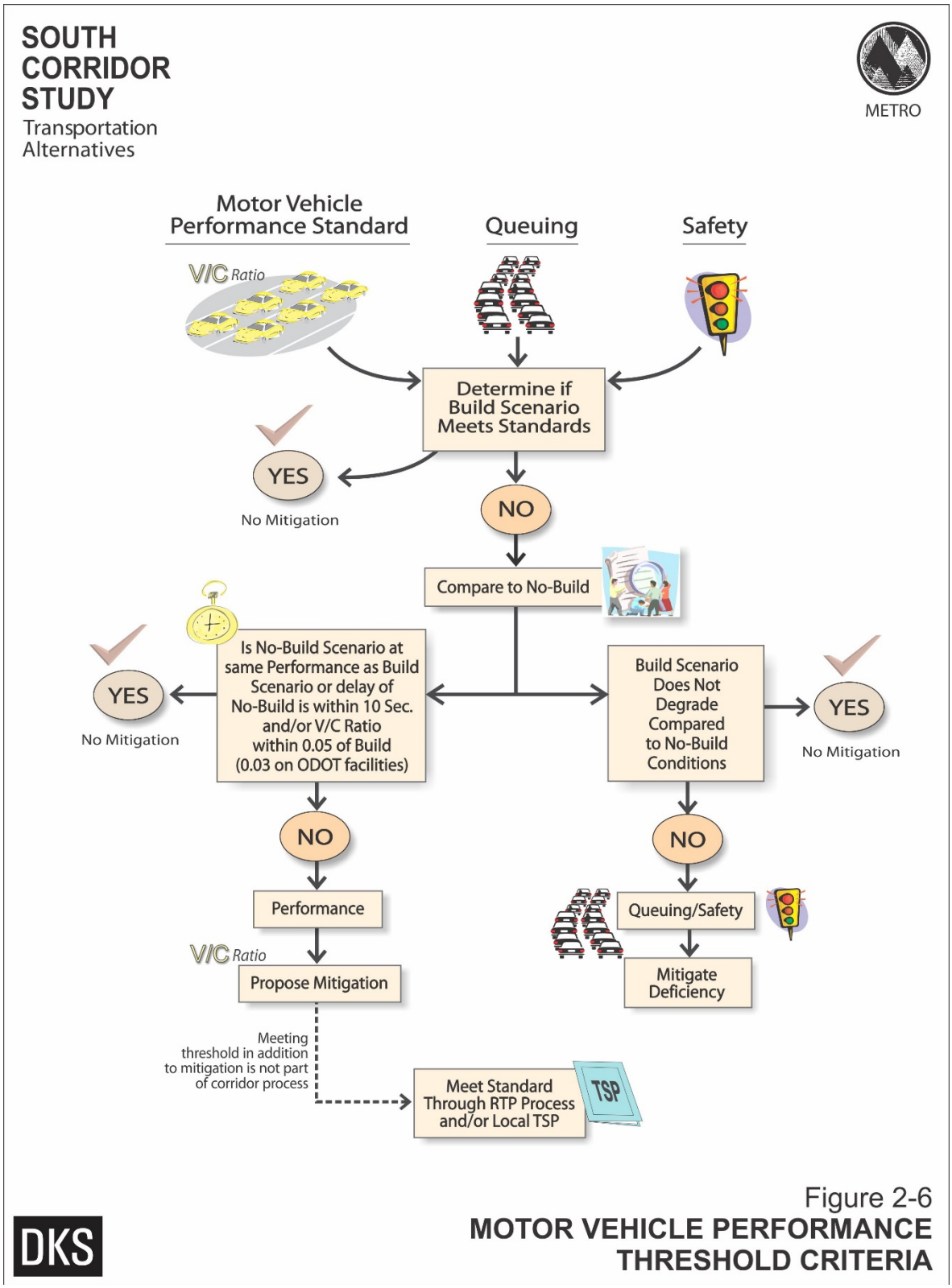
Intersection Performance Measures

The first performance measure is the v/c ratio. The build alternatives will be compared to the No-Build Alternative, which will lead to one of four different performance measure scenarios. The following is a list of the various performance measure scenarios for comparing alternatives; these performance measures apply to both unsignalized and signalized intersections.

Scenario 1: The No-Build Alternative and the build alternatives, with or without alignment/design options, **meet** jurisdiction standards. This scenario represents a condition where none of the alternatives create unacceptable traffic operations at study area intersections.

Scenario 2: The No-Build Alternative **meets** jurisdiction standards, and the build alternatives, with or without alignment/design options, **do not meet** jurisdiction standards and operate significantly worse (i.e., greater than 10 seconds of delay or greater than 0.05 v/c [except 0.03 for ODOT facilities]) than the No-Build Alternative. This scenario represents a condition where the build alternatives impact the transportation system and create unacceptable traffic operations.

Figure 2-6. Transportation Mitigation Criteria/Process



Scenario 3: The No-Build Alternative and the build alternatives, with or without alignment/design options, **do not meet** jurisdiction standards, and the build alternatives, with or without alignment/design options, operate either the same as or slightly worse (i.e., no more than 10 seconds of delay or 0.05 v/c [except 0.03 for ODOT facilities] more) than the No-Build Alternative. This scenario represents a preexisting condition where the No-Build Alternative has unacceptable traffic operations.

Scenario 4: The No-Build Alternative and the build alternatives, with or without alignment/design options, **do not meet** jurisdiction standards, and the build alternatives, with or without alignment/design options, operate significantly worse (i.e., greater than 10 seconds of delay or greater than 0.05 v/c [except 0.03 for ODOT facilities]) than the No-Build Alternative. This scenario represents a preexisting condition in which the No-Build Alternative has unacceptable traffic operations which would be worse with the build alternatives.

Each of the scenarios described above will have different mitigation associated with it based on the comparison of its performance to that of the No-Build Alternative. Scenario 1 would require no mitigation, because both the No-Build Alternative and the build alternatives, with or without alignment/design options, meet jurisdiction standards. Scenario 2 would require mitigation of the build alternatives, with or without alignment/design options. Due to the preexisting traffic operations under the No-Build Alternative for Scenarios 3 and 4, the following mitigation criteria was developed to determine when mitigation is necessary for either of these scenarios:

> ***Intersection Traffic Operations Mitigation:*** *No mitigation is necessary if there is less than or equal to 10 seconds of delay difference or 0.05 v/c (0.03 v/c for ODOT facilities) between the No-Build Alternative and the build alternatives. If there is greater than 10 seconds of delay or 0.05 v/c (0.03 v/c for ODOT facilities) between the No-Build Alternative and any of the build alternatives, and the build alternative does not meet the jurisdiction threshold criteria, then the build alternative would be mitigated to approximately the No-Build Alternative conditions (within 10 seconds of delay or 0.05, or 0.03 v/c difference). Use of either delay or v/c criteria is based on the operating standard of the owner of the roadway.*

Under Scenarios 2 and 4, the mitigation requested by the jurisdiction may exceed the minimum needed to achieve No-Build Alternative conditions. When this type of mitigation occurs, it is considered a betterment, and assumed to be the responsibility of the project to pay the proportionate share of the mitigation/betterment required to bring the study area intersection performance to match the no build.

With the mitigation commitments that will be included in the Final EIS, the proportionate share would be based either on the number of new vehicles introduced to the intersection that are related to the build alternatives compared to the total new volume with the No-Build Alternative (levels beyond existing conditions), or the increased delay associated with the build alternative compared to the No-Build Alternative. For mitigating to near No-Build Alternative conditions, the proportionate share approach would not apply as that would be the project's responsibility. The use of modifications to signal timing as mitigation would need to be approved by the managing jurisdiction of the facility.

In addition to the above-mentioned mitigation for Scenarios 2 and 4, additional mitigation may be identified that would be necessary to meet the threshold criteria of local jurisdictions. This betterment beyond the required mitigation would not be part of this project; however, it could be

identified for possible inclusion in updates to the RTP Needs (Preferred or Strategic Plan) and local Transportation System Plans.

Queuing Analysis and Mitigation

The primary concern with queuing is whether or not ramp queues extend into the deceleration portion of the ramp or if turn pockets regularly overflow into the through lanes. Queuing results will be evaluated for the 95th percentile during the peak-hour conditions for both the No-Build Alternative and the build alternatives where indicated in the scope of work. These 95th percentile queues will then be evaluated to determine whether ramp queues extend or if turn pockets regularly overflow into the through lanes.

There are three potential queuing scenarios that could occur during this analysis:

Scenario 1: Neither the No-Build Alternative nor the build alternatives, with or without alignment/design options regularly have turn pockets that overflow into the adjacent through lanes, and/or produce queue spill back from freeway off-ramps to the safe stopping distance. This scenario represents a condition where none of the alternatives create unacceptable queuing.

Scenario 2: The No-Build Alternative queuing **does not regularly have turn pockets overflow** into the adjacent through lanes, and/or **does not produce queue spill back** from freeway off-ramps to the safe stopping distance, but queuing under the build alternatives, with or without alignment/design options, **does regularly have turn pockets overflow** into the adjacent through lanes, or **does produce queue spill back** from freeway off-ramps to the safe stopping distance, and is more than 25 feet longer than the vehicle queuing for the No-Build Alternative . This scenario represents a condition in which the build alternatives create unacceptable queuing impacts to the transportation network.

Scenario 3: Under the No-Build Alternative and the build alternatives, with or without alignment/design options, queuing **does regularly have turn pockets overflow** into the adjacent through lanes, and/or **does produce queue spill back** from freeway off-ramps to the safe stopping distance, and the vehicle queuing for the build alternatives, with or without alignment/design options, is not more than 25 feet longer than the vehicle queuing for the No-Build Alternative. This scenario represents conditions in which future volumes under the build alternatives have a preexisting queuing condition prior to implementation.

Scenario 4: Under the No-Build Alternative and the build alternatives, with or without alignment/design options, queuing **does regularly have turn pockets overflow** into the adjacent through lanes, and/or **does produce queue spill back** from freeway off-ramps to the safe stopping distance, and the vehicle queuing for the build alternatives, with or without alignment/design options, is more than 25 feet longer than the vehicle queuing for the No-Build Alternative. This scenario represents a condition in which the build alternatives create unacceptable queuing impacts to the transportation network.

Each of the scenarios described above has different mitigation associated with it based on the performance of the No-Build Alternative. Scenarios 1 and 3 would require no mitigation, because the build alternatives, with or without alignment/design options, either do not have queuing problems or do not worsen the issue. Both Scenario 2 and Scenario 4 would require mitigation. The following mitigation criteria were developed to address the type of mitigation necessary under these scenarios:

Traffic Queuing Mitigation: *If queuing under the any build alternative, but not under the No-Build Alternative regularly has turn pockets overflow into the adjacent through lanes, or produces queue spill back from freeway off-ramps to the safe stopping distance, and is more than 25 feet longer than the vehicle queuing for the No-Build Alternative, then the build alternative, with or without alignment/design options, would be mitigated to conditions in which these queuing conditions are within 25 feet of the No-Build Alternative or to an appropriate condition. If queuing regularly has turn pockets overflow into the adjacent through lane or spill back from freeway off-ramps to the safe stopping distance under the build alternatives and the queuing is more than 25 feet longer than that of the No-Build Alternative, then potential mitigation strategies would be developed.*

Safety Analysis and Mitigation

Safety will be analyzed using ODOT's critical crash rate analysis method combined with a summary of information from existing crash lists, including ODOT's ARTS program, Washington County SPIS, and City of Portland's High-Crash Corridors.

There are a number of safety threshold criteria to evaluate for the No-Build Alternative and the light rail alternatives to determine if existing safety concerns are addressed by the project or if the project creates new safety concerns. The safety analysis will focus on serious injury and fatal crash history, and crash locations. If the No-Build Alternative does have intersections or other locations that are listed as high crash locations or that are on other preexisting crash lists in locations that may be altered by the light rail alternatives, then the project team will work with the agency with jurisdiction over the existing facility to identify reasonable measures that would likely result in safety conditions that would be the same or better than those of the No-Build Alternative.

Signal Warrant Review

Consultant will review peak one-hour traffic volumes for each intersection at which a new traffic signal is proposed and compare the volumes to a single hour of the 8- and 4-hour warrants from the Manual for Uniform Traffic Control Devices. The intent is not to complete a formal signal warrant analysis, which would be done in a future project phase, but to provide an indication of likelihood of meeting warrants with a future analysis. This comparison will be documented and reported as a percent of warrant met for the one hour considered.

Multimodal Impact Analysis and Mitigation

Transit Impact Analysis

Transit performance will be analyzed using Metro's regional travel demand model. The analysis will use a 2015 base year and 2035 horizon year. Future forecasts will be prepared for the No-Build Alternative and light rail alternatives that are anticipated to yield differentiating results. Most comparisons will be between the No-Build, a full-length through-routed alternative, a full-length branched route alternative, and a minimum-operable segment (MOS) alternative. Additional modeling will be performed to analyze changes to ridership as a result of geographic segment-level alternatives, including:

- Barbur (A1) and Naito (A2) in Segment A
- Barbur (B1), and adjacent to I-5 alternatives (B2, B3, and B4) in Segment B

- Ash (C1 and C5), Clinton (C3 and C4), and Wall (C6) in Segment C
- Adjacent to I-5 (C1 and C3) and Railroad (C2 and C4) in Segment C

Supplemental modeling may be performed to analyze park-and-ride capacity and PCC Sylvania shuttle options.

Performance measures will include:

- Service characteristics
  - Transit vehicle miles traveled
  - Transit vehicle hours traveled
- Travel Time
- Ridership
  - Light rail line ridership
  - System and corridor transit ridership
  - Peak load point
  - Station usage
  - Transit mode share
  - Change in transit productions
- Reliability

Transit Mitigation: *TriMet and Metro will use the technical evaluation to determine if modifications are needed to the design or operation of the planned light rail alternatives or to the supporting bus network.*

Pedestrian Impact Analysis

The primary concerns for pedestrian activity are safety and accessibility to transit stations along the light rail alignments. Previous planning work in the corridor identified a range of pedestrian access projects within a broadly defined study area surrounding the transit corridor. These projects were extensively evaluated and those most supportive of the proposed light rail project were either integrated into the project design or identified as proposed non-integrated station access projects and included as separate items in the back of the plan drawing set.

The Draft Environmental Impact Statement (Draft EIS) analysis of impacts and mitigation will primarily focus on pedestrian safety and access issues. The non-integrated station access projects will be analyzed programmatically by segment. The Draft EIS will reference the development and purpose of the non-integrated projects and provide a qualitative description of impacts associated with potential modal conflicts (e.g., pedestrian/motor vehicle, pedestrian/bicycle, etc.) related to the design of sidewalk, pedestrian bridges, pedestrian crossings and other similar projects.

The Draft EIS will include a *Highway Capacity Manual*-based analysis of link-level Pedestrian Level of Service (PLOS) for roadway segments which would be significantly modified as part of a light rail alignment under any of the build scenarios.

The Draft EIS will include a description and inventory of pedestrian facilities included as integrated elements of the light rail project. Previous analysis identified gaps in the pedestrian network and will be used as a resource for evaluating the quality of pedestrian access to transit stations. The analysis will include an inventory of pedestrian crashes adjacent to the light rail alignment or within 500 feet of stations. The previous analysis and inventory will be used to identify impacts to pedestrian safety issues related to the introduction of the light rail project in the corridor.

> ***Pedestrian Mitigation:*** *Where pedestrian safety or station access impacts are identified including new gaps or barriers for existing or planned pedestrian facilities, potential mitigation measures will be identified. Examples of possible pedestrian safety impacts include locations where the design of the light rail could encourage jaywalking, where a pedestrian crossing or route is made substantially longer, or where light rail would close an existing pedestrian crossing.*

Bicycle Impact Analysis

Bicycle safety and access to transit stations will be evaluated in the Draft EIS. Previous planning work in the corridor identified a range of bicycle projects within a broadly defined study area surrounding the transit corridor. Bicycle projects most supportive of the proposed light rail project were either integrated into the project design or identified as proposed non-integrated station access projects and included as separate items in the back of the plan drawing set.

The Draft EIS analysis of impacts and mitigation will primarily focus on bicycle safety and access issues included in the light rail design sheets including projects that are considered as integrated in the design of the light rail project. The remaining non-integrated projects will be analyzed programmatically by segment. The Draft EIS will reference the development and purpose of the non-integrated projects and provide a qualitative description of impacts associated with potential modal conflicts (e.g. bicycle/motor vehicle, bicycle/pedestrian, etc.) related to the design of sidewalk, pedestrian bridges, pedestrian crossings and other similar projects.

The Draft EIS will include a *Highway Capacity Manual*-based analysis of link-level Bicycle Level of Service (BLOS) for roadway segments which would be significantly modified as part of a light rail alignment under any of the build scenarios.

The Draft EIS will include a description and inventory of bicycle facilities included as integrated elements of the light rail project. Previous analysis that identified gaps in the bicycle network will be used as a resource for evaluating the quality of bicycle access to transit stations. The Draft EIS analysis will include an inventory of bicycle crashes adjacent to the light rail alignment or within 500 feet of stations. The previous analysis and inventory will be used to identify impacts to bicycle safety issues related to the introduction of the light rail project in the corridor.

> ***Bicycle Mitigation:*** *Where bicycle safety or station access impacts are identified including new gaps or barriers for existing or planned bicycle facilities, potential mitigation measures will be identified. An examples of possible bicycle safety impacts include locations where bicycles would cross light rail tracks or are exposed to high conflicting (i.e. turning) vehicle volumes.*

Freight Mobility Impact Analysis

The role of major freight facilities in the study corridor will be characterized and documented with regard to local truck freight access and through travel as well as the role of rail freight operations in the corridor. This analysis will include the impact of the alternatives to truck movement and access adjacent to the alignment, including local truck access to businesses for loading and deliveries. Property access changes required by the build alternative, including consideration of access of heavy truck movements and the risk of truck traffic diverting to neighborhood streets, will be evaluated. Project impacts to rail freight operations will be identified.

> ***Freight Mitigation:*** *Locations where through movement of truck and rail freight is significantly impacted and impacts to specific site access will be identified, and a range of site-specific mitigation treatments will be identified.*

On-Street Parking Impact Analysis

Project plan sheets, on-line mapping tools, aerial mapping and site visits will be used to inventory existing on-street parking immediately adjacent to the light rail alignment. Metro and TriMet will provide the consultant with direction as to the locations where on-street parking spaces would be potentially be impacted by the light rail facility. The Draft EIS will include a summary and characterization of the demand for and the role of the impacted parking spaces.

> ***Parking Mitigation:*** *Based on the parking space inventory and a review of the conceptual drawings for each alternative, the loss of existing parking spaces will be calculated by location and type. The magnitude of any parking loss will be estimated using a simple parking utilization assessment, and mitigation strategies will be developed as appropriate, consistent with local policies.*

Operations and Maintenance (O&M) Facility Impact Analysis

The operation of the Southwest Corridor Light Rail Project would require additional O&M facility capacity. Two locations in Tigard have been identified as potential sites for a new operations and maintenance facilities to support the project: a site on SW Hunziker Street and a site on SW 72nd Avenue with two sub-options (one associated with a through-routed alignment and one with a branched alignment).

Traffic impacts associated with an O&M facility are typically minor and generally associated with employee and contractor access to and from the site. The EIS will determine whether traffic analysis is warranted by comparing the anticipated employment at the O&M facility with the current estimated employment on that site under existing conditions with the current land uses.

Both potential sites assume vehicle access at locations where driveways for vehicle access currently exist. If the employment associated with new O&M facility exceeds the current employment on the sites, the EIS will add the additional PM peak volumes to the analysis of adjacent intersections. If the O&M facility employment is no more than the existing, no adjustments will be made.

> ***O&M Facility Mitigation:*** *If traffic impacts are identified from the operation of the O&M facility, the traffic mitigation will be determined using methods consistent with the Traffic Queuing and Intersection Traffic Operations Measures described above.*

Park-and-Ride Lot Assessment

Areas where park-and-ride lots are proposed will also be evaluated for impacts to the street network. Existing vehicle trip generation data from similarly located and sized TriMet park-and-ride lots with a check using Institute of Transportation Engineers *Trip Generation*, will be utilized to estimate the number of vehicle trips during the peak period for transit park-and-ride lots. Park-and-ride trips already accounted for in the travel demand model results will be subtracted so that these trips are not double-counted in the analysis. The entrance to these lots and adjacent study intersections will be evaluated using the previously mentioned *Highway Capacity Manual* methodology.

The potential for park-and-ride spillover into neighborhoods will be assessed at locations where Metro's park-and-ride analysis indicates that the capacity provided at park-and-ride facilities is at risk for being inadequate. The analysis will consider the park-and-ride overflow risk at nearby commercial parking facilities and neighborhood on-street parking.

> ***Park-and-Ride Traffic Mitigation:*** *If traffic impacts are identified from the operation of the park-and-ride lots, the traffic mitigation will be determined using methods consistent with the Traffic Queuing and Intersection Traffic Operations Measures described in Figure 2-6. The mitigation assessment will also evaluate whether reducing the capacity of the park-and-ride facility would be a feasible strategy to minimize or avoid park-and-ride–related traffic impacts. Should reducing the capacity of a park-and-ride prove desirable, then adjusting capacity at other park-and-ride lots upstream or downstream could be considered as part of the refined project definition during preliminary engineering. Impacts associated with any park-and-ride capacity modifications would be evaluated in the Final EIS.*
>
> *Locations on the existing light rail system where neighborhood spillover park-and-ride activity has been identified, have been addressed on a case by case basis. Treatments implemented have included no-action, signage, enforcement, etc. If high spillover park-and-ride risk is identified, and it is determined that mitigation is desirable, those measures could include signage and active management and enforcement at commercial locations and time restrictions or resident permits at on-street locations.*

Alternatives to Mitigation

It is possible that the analysis will identify an impact for which no feasible or reasonable mitigation is available. In this case, the project team would work with the managing jurisdiction of the facility and the local land use authority to identify the appropriate course of action. The managing jurisdiction(s) could work with the project team to develop alternative mitigation strategies or could agree to accept the impact.

Construction (Short-term) Impacts

Two primary sources of construction impacts on local traffic will be considered from a generally qualitative standpoint:

- Impacts on traffic operations, property access, and parking supply related to potential road, sidewalk, bicycle, or other transportation facility restrictions and/or closures during construction; and
- Impacts of construction-related traffic on traffic operations.

The assessment of construction-related transportation impacts will focus primarily on arterials, on local streets that could be significantly affected by construction, and on I-5 at locations where structures would be built over or adjacent to the freeway or where freeway ramps would be modified. The transportation team will coordinate with Metro and TriMet to identify the construction activities that are likely to be most the most disruptive at locations along the light rail alignment(s).

Construction traffic analysis will consider the following:

- Identification of changes in roadway capacity including potential lane restrictions, parking restrictions, pedestrian or bicycle facility impacts, alignment shifts, areas of construction activity adjacent to travel lanes, or other reductions to capacity due to transit facility construction activity;
- Impacts on transit and emergency services;
- Impacts to transit bus stops and routing;
- Impacts on school transportation services during construction;
- Impacts to postal service routes and access;
- Impacts of construction-related activity on on-street parking supply;
- Identification of potential construction staging areas, including access and impact on roadway operations;
- Impact to freight delivery routes and truck size restrictions;
- Identification of potential construction access and truck routes and the impact of construction-related traffic on these routes, including reductions to overhead clearance; and
- Assessment of potential for neighborhood traffic intrusion related to road closure, detours or other construction related delays.
- Impacts to freight rail service and rail crossing locations;
- Estimation of construction truck traffic;
- Temporary delays or restrictions on truck routes during construction;
- Identification of areas that would require construction coordination between TriMet and other governmental agencies; and
- Development of mitigation measures.

The analysis will be summarized in a tabular format to identify the following:

- Impact location(s).
- Street characteristics.
- Type of construction activity including likely duration of impact.
- Level of construction traffic (characterized as high, moderate, or low).
- Full or partial road closures.
- Availability of detour routes.

- Potential for detoured traffic to affect a residential neighborhood. (This is characterized as high, medium, or low and is related to both potential for road closure and options for traffic detour.)
- Bus route detours and temporary bus stop locations.
- Loss of on-street parking. (This may be characterized as "yes" for parking loss and "no" for no parking loss. Additionally, there may be some temporary loss of off-street parking due to the location and operation of construction staging, as well as construction worker parking.)
- General comments highlighting key issues for each location related to construction traffic activity that do not fall into one of the above categories.

  Construction Mitigation: *A construction traffic management plan will be prepared that will address construction-related issues identified in the EIS analysis. The construction management plan will address potential construction staging locations, construction-related truck routes, motor vehicle, bicycle and pedestrian detours and other accommodations.*

Documentation

Existing transportation conditions, impacts and potential mitigation will be discussed in a Transportation Results Report and summarized in a Transportation section of the EIS. The EIS section will be summary-level, focused primarily on impacts but still identifying the long term and short term/construction period impacts of the project. The Transportation Results Report will include all background information, outputs from the traffic models, and other details of the analysis.

References

Transportation Research Board. 2010. *Highway Capacity Manual*, Special Report 209.

Institute of Transportation Engineers. 2012. *Trip Generation*, 9th Edition.

UTILITIES ANALYSIS METHODS

Introduction

This report describes the methods that will be used to collect data and evaluate impacts to utilities for the Southwest Corridor Light Rail Project. This analysis will be developed to comply with the National Environmental Policy Act (NEPA); local and state policies, standards, and regulations; and to respond to scoping comments.

The purpose of this analysis is to evaluate the potential short- and long-term construction effects on utilities that could result from construction of the Southwest Corridor Light Rail Project. The analysis is not meant to be a comprehensive study of all utility conflicts but rather will highlight areas where extensive utility relocation or protection is anticipated and will identify major utility crossings that could impact the project's scope and schedule or cause other secondary impacts.

Related Laws and Regulations

Federal statutes provide regulations that address displacement and relocation that could occur as a result of the Southwest Corridor Light Rail Project alternatives. Following is a list of the statutes and guidelines that are in effect and would be applied to the project.

- 49 Code of Federal Regulations (CFR) Part 24, the Uniform Relocation Assistance and Real Property Acquisition Regulations for Federal and Federally Assisted Programs, Final Rule and Notice, issued by the U.S. Department of Transportation
- Oregon Revised Statutes – Utility Regulation Generally (ORS) 757 to ORS 952
- Oregon Department of Transportation (ODOT), Right-of-Way Manual, Chapter 10
- City of Portland City Code 17.56.060, Relocation and Discontinuation of Facilities

Contacts and Coordination

Public and private utility companies were contacted during conceptual design development. The information obtained from this initial outreach effort was annotated to the design and is the primary source of information.

Agencies and organizations have been notified of the intent to publish a Draft Environmental Impact Statement (Draft EIS) through the Federal Register and through other project outreach activities. Interested organizations will have the opportunity to review and comment on the utilities analysis throughout the course of the project.

Data Collection

The primary sources of data used to determine potential utility conflicts will be the Southwest Corrior Draft EIS Utility Analysis that was developed during the conceptual design phase, geographic information systems (GIS) utility mapping, utility as-built drawings, and field verifications.

Conceptual Engineering Drawings

Preliminary information on the types of utilities and the affected utility owners will be tabulated, based on the available design information from TriMet. This information includes major utility

corridors, which will be identified and characterized, and shows how the location of tracks, traction power substations, signal and communications buildings, station platforms, park-and-ride lots, and maintenance facilities may conflict with existing utilities.

Affected Environment

The study area for utilities is 20 feet from the edge of construction. Utilities that run parallel to or intersect with the study area will be identified.

The alternatives potentially impact both aerial and underground utilities. Aerial utilities include lighting, other electrical services, and communication facilities. Aerial communication facilities are typically on electricity distribution poles but can also be on their own structures. Belowgrade or underground utilities include water, sanitary facilities, storm facilities, and natural gas. Electrical services and communication facilities can also be located underground. The primary utility providers/owners in the corridor were identified during the conceptual design phase, but the list will be confirmed for the EIS.

Impact Assessment

Long-Term Impacts

The analysis will review the types of potential impacts of the alternatives on the existing locations of utilities, such as electrical lines, water mains, stormwater or sewer lines, natural gas lines, or telecommunication (cable and fiber optic) networks. Long-term impacts occur when the alignment requires placing tracks or other structures where a utility is located. The potential for conflict occurs wherever the alternative alignments and associated features would cross an existing utility. Also, conflicts could occur where utilities are located parallel and in proximity to the alternatives. This discussion will primarily focus on impacts to utilities that occur regardless of what option or alternative is analyzed, but will highlight the major differences in the utility impacts that are unique to an alternative or option.

Short-Term Impacts

Construction impacts could occur when utilities are located along the project footprint (parallel impacts) or where utilities intersect the alignment.

Indirect Impacts

The analysis of potential indirect impact of the project will be qualitative and will primarily consist of other developments in close proximity to the stations, which could be encouraged by the development of the project. These developments could increase the demand for utility services.

Cumulative Impacts

If other recent past, current, or future projects with utility requirements are nearby, or if the project is relocating a utility that has been relocated or altered due to previous projects, cumulative effects may be present. The analysis will review available information about past or current projects and the location of other proposals in the vicinity to determine the potential for cumulative impacts.

Mitigation Measures and Relocation Requirements

Proper coordination with all affected utility companies will minimize disturbance to system users and avoid damage or impacts to existing facilities that do not require relocation. This coordination would occur after the environmental process concludes. Public utility relocation is funded by the project, and private utility relocation is funded by the company who is impacted.

New facilities are installed and then service is switched over, thereby minimizing any disruption of service. With these measures in place, no additional mitigation measures would be required. However, the relocation of utilities can involve its own impacts, including the need to reconstruct or widen existing street right of way, which can result in effects on adjacent properties and, in limited cases, could require acquisition of additional property.

Impacts during construction would be avoided or minimized by permanently or temporarily relocating the affected utilities, by adjusting the alignment during final design, or by protecting utilities from construction damage.

Documentation

Existing utilities and impacts will be discussed in the Utilities section of the EIS. The EIS section will be summary-level, focused primarily on long-term and short-term/construction period impacts to utilities. Background information, existing conditions information, and details of the analysis will be included in a technical memorandum available for review through Metro, and will be included in cooperating agency reviews of the Preliminary Draft EIS.

VISUAL QUALITY AND AESTHETICS ANALYSIS METHODS

Introduction

This report describes the methods that will be used to collect data and evaluate impacts to visual quality and aesthetic conditions for the Southwest Corridor Light Rail Project. This analysis will comply with the National Environmental Policy Act (NEPA), and federal, state and local policies, standards, and regulations

The purpose of the visual quality and aesthetics analysis is to describe the visual and aesthetic environment surrounding the Southwest Corridor Light Rail Project corridor and to identify and evaluate potential significant adverse and beneficial effects of the alternatives. To facilitate analysis of existing conditions and potential effects, the project corridor will be discussed in terms of viewsheds, as well as by topography, distinguishing physical features, and visual characteristics. Existing visual conditions within and from the neighborhoods, descriptions of their visual patterns, and their resulting visual character (the dominant visual features) will be described for the affected environment.

The analysis also describes viewsheds as the areas of the project visible from selected viewpoints along the alternatives' alignments, which helps frame the evaluation of how project elements could change the visual character and settings of affected neighborhoods.

Related Laws and Regulations

This section describes federal, state, and local plans and policies that encourage or require the protection of visual and aesthetic resources, or establish a context for evaluating the potential visual impacts of the project alternatives.

Federal

NEPA states that the:

> Federal Government...use all practicable means consistent with other essential considerations of national policy to improve and coordinate Federal plans, functions, programs and resources to the end that the Nation may fulfill the responsibilities of each generation as trustee of the environment for succeeding generations; assure for all Americans safe, healthful, productive and esthetically and culturally pleasing surroundings; ... preserve important historic, cultural and natural aspects of our national heritage and maintain, wherever possible, an environment which supports diversity and variety of individual choice.

Although the Federal Transit Administration does not have stated visual impact analysis guidelines, the Federal Highway Administration provides *Guidelines for the Visual Impact Assessment of Highway Projects* (ICF International 2013). There are also related regulations, guidance, and advisories where visual impacts of federal transportation projects are to be considered, including for Section 4(f) reviews and for historic property reviews, as described in more detail in the methods reports for those topics.

State of Oregon

The *2016 Oregon Transportation Plan* (OTP) guides the development of a safe, convenient, and efficient transportation system in order to promote economic prosperity and livability across the

state. OTP Strategy 4.3.2 states, "Promote transportation facility design, including context sensitive design, which fits the physical setting, serves and responds to the scenic, aesthetic, historic and environmental resources, and maintains safety and mobility."

Oregon Statewide Planning Goal 5, Open Spaces Scenic and Historic Areas and Natural Resources, requires cities and counties to conserve open space and protect natural and scenic resources. The goal further directs that programs be provided to ensure open space, protect scenic and historic areas and natural resources for future generations, and promote healthy and visually attractive environments in harmony with the natural landscape character.

Oregon Statewide Planning Goal 8, Recreational Needs, requires jurisdictions to satisfy the recreational needs of the citizens of the state and its visitors. Each jurisdiction with responsibility for recreation areas, facilities, and opportunities must meet existing and future needs. Recreation areas and facilities include scenic resources such as open space, scenic landscapes, and scenic roads and corridors, along with recreational lands, history, natural science and archaeology resources, sports and cultural events, camping, picnicking and recreational lodging, tourist facilities and accommodations, trails and waterway use, mineral resources, and sports activities.

Local Plans and Policies

The Southwest Corridor Light Rail Project crosses three cities: Portland, Tigard, and Tualatin. The goals of each city's comprehensive plan represent its basic intents and purposes. Accompanying each goal are objectives, which generally describe how the city intends to achieve that goal.

City of Portland

The *Portland 2035 Comprehensive Plan* will be effective on January 1, 2018, upon acknowledgment by the Oregon Department of Land Conservation and Development Commission. Also considered are the *Terwilliger Parkway Design Guidelines*, *Marquam Hill Design Guidelines*, *South Auditorium Plan*, and the South Portland Historic District.

Chapter 4 of the comprehensive plan contains four Design and Development goals that cover historic and cultural resources, human and environmental health, and urban resilience. Goal 4A, context-sensitive design and development, is particularly applicable to the proposed project:

> New development is designed to respond to and enhance the distinctive physical, historic, and cultural qualities of its location, while accommodating growth and change.

Within the Scenic Resources subsection of Chapter 4, policies 4.41 through 4.45 provide recognition, enhancement, and protection of public views and significant scenic resources, as designated in the Scenic Resources Inventory and Protection Plans.

The land use analysis to be conducted for the EIS will include further discussion of the project's consistency with comprehensive plan goals and policies, scenic overlay, as described in the Land Use Analysis Methods report. It will also address the City's Scenic Resource Protection Plan, including identified viewpoints, corridors, and overlay zones.

Oregon Statewide Planning Goal 5 requires that the local jurisdiction develop an inventory of significant scenic sites and then determine the appropriate protection. Local jurisdictions will be consulted to determine these sites and the protections that are in place. The City of Portland

documented these locations in the *City of Portland's Scenic Views, Sites and Drives Inventory and Scenic Resources Protection Plan*.

Tigard

The City of Tigard Comprehensive Plan policies related to visual resources are contained in the Land Use Planning Element and the Natural Resources and Historic Areas Element, as well as the *Tigard Triangle Strategic Plan,* and *Downtown Tigard Improvement Plan*.

Tualatin

Tualatin's comprehensive plan, the *Tualatin Community Plan*, is integrated into the Tualatin Development Code as Chapters 1 through 30. Chapter 10, Community Design (Section 10.020), establishes the objectives related to aesthetics.

Methods

This methodology was adapted from several established methods for analyzing visual elements in the environment:

- U.S. Department of Transportation, FHWA, Office of Environmental Policy, Visual Impact Assessment for Highway Projects (March 1981).
- U.S. Department of the Interior, Bureau of Land Management, Division of Recreation and Cultural Resources, Visual Resource Management Program (1980).
- Scenic American Technical Information Series, Evaluating Scenic Resources (1996).
- Central City Scenic Resources Protection Plan (Draft), City of Portland Bureau of Development Services (2016).

Contacts and Coordination

The analysis of character for an area and the identification of visual impacts within these areas will be coordinated with other environmental topic reviews being conducted for the EIS, including the analysis of impacts to neighborhoods and communities, land use, parks and recreation, historic resources, and property acquisition.

Data Collection

The following information will be considered:

1. Terrain and land-cover data to identify general visual characteristics of the regional landscape and to map viewsheds associated with the alternatives.
2. Photography to capture existing landscape characteristics and document key viewpoints for simulation of proposed project features and impact analysis of study alternatives.
3. Plan and profile drawings of the alternatives (vertical and horizontal relationships) to determine location and relationship to visual characteristics.
4. Land use policies, regulations, maps, and reports related to scenic resources for the Cities of Tigard, Tualatin, and Portland, and their associated neighborhoods. These materials will help to identify neighborhood goals and the range of existing recommendations and/or requirements needed to maintain or enhance visual quality.

5. Available information from earlier planning efforts for the Southwest Corridor Light Rail Project, as well as from Draft EIS scoping comments, neighborhood meetings, and Metro public involvement and outreach efforts.

Affected Environment

The affected environment will be characterized by the following:

- A summary description of the visual conditions and character of each area that is analyzed for the EIS.
- A summary of features that are visually dominant in the segment or that are formally identified as a scenic resource in the City of Portland's Scenic Views, Sites and Drives Inventory and Scenic Resources Protection Plan, the Central City Scenic Resources Protection Plan, or within a Scenic Resources Overlay zone.
- A description of the visual conditions and character in the area crossed by the alignment of an alternative.
- A general description of viewers, including residents, motorists, and recreationalists.

Identification and Description of Viewsheds

Viewsheds will be recorded using visual and aesthetic terminology noted in the next section to describe their type, condition, pattern, and overall character. Visual patterns generally include street layout, development, building mass and scale, and the form, scale, and character of the land, water, and vegetation. Other recorded information is listed below:

- Existing development and open space within viewshed.
- Areas with distinctive form, scale, or visual condition.
- Individual buildings, landmarks or clusters of development that are listed as a historic resource (National Register of Historic Places, Portland landmark, or Historic Resources Inventory).
- Community-identified features, key views or sites, especially those identified in neighborhood plans, formal inventories, or other studies (e.g., formal viewpoints).
- Panoramas, gateways, and views of special features (e.g., mountains, bridges) from the City of Portland's Scenic Resource Inventory and Protection Plan.

Opportunities for aesthetic or view enhancement, and constraints that might require future special treatment will also be recorded.

Terms and Definitions

The pattern and characteristics of land, vegetation, water, structures, and other human-made features in a neighborhood unit will be described using the following terms. The terms and their definitions are established vocabulary in the field of visual analysis. They reflect the general nature of the visual analysis units (neighborhoods and viewsheds) for the Southwest Corridor Light Rail Project.

Dominant and Recognized Visual Feature – A visual feature will be determined to be dominant within a neighborhood unit based on the following aspects of the visual feature:

- Visibility relative to the alignment alternatives
- Scale relative to other similar features
- Distinctiveness, such as if it is a one-of-a-kind feature, or because it clearly represents an existing spatial pattern or image

A recognized visual feature can also be one that is known to be important to the neighborhood, or if it is designated in state, county, or city comprehensive or other adopted plans.

Edge – Linear elements or boundaries between two places such as shorelines, railroad cuts, edges of development, walls, etc., that distinguish one place from another; the edges may be seams or lines along which two places are joined. They are often considered to be important organizing features (Lynch 1960). The visual quality analysis may use the terms *strong* or *weak* to distinguish the character of edges.

Pattern – An arrangement of parts, elements or details that suggests orderly distribution (Smardon 1986). The analysis will use *repetitive* or *continuous*, *complex* or *simple*, *loosely knit* or *closely knit*, *disrupted*, *interrupted* or *broken* to describe the distribution, or lack of distribution, of houses, trees, blocks, and other elements within a neighborhood unit. The analysis will also use *small* or *large grid*, *diagonal*, or *perpendicular pattern* to describe the arrangement of streets.

Rural – An area that is physically and culturally distinct from urban, suburban, and wilderness areas. Rural generally describes the patterns and activities associated with agriculture, small towns or the countryside (American College Dictionary 1964). The analysis uses *rural* to describe views of agricultural, natural, or undeveloped areas and portions of neighborhood units that illustrate the small scale, fine texture, and close-knit development pattern typical of small rural communities.

Scale – The visual relationships of size and scale of landscape features and surrounding areas. The analysis will use the following building gradation to characterize relative scales of residential, commercial, and industrial uses in neighborhood units:

- Small scale – One- to two-story, residential or single-family on a typical single-family lot.
- Moderate scale – Two- to three-story, fills more than a single lot and as much as half a block.
- Large scale – More than two stories, fills the block or creates a new size of block.

Space – The distance, interval, or area between or within things (Webster 1960). The analysis will use the terms *open* or *enclosed* to describe types of spaces.

Urban Form – In this corridor, the urban form varies from the downtown Portland area to areas along a forest-lined arterial to areas adjacent to the interstate and surrounding large-scale, auto-oriented commercial, industrial, and residential developments. The analysis will describe the scale and patterns associated with these land uses as they occur in neighborhood units.

Texture – The visual arrangement or constituent parts of something—the structure or composition (Webster 1960); the analysis will use the terms *fine* or *coarse* and *loose-knit* or *close-knit* to describe building and street arrangements and land uses.

Transition – The passing from one place to another, especially without abruptness (Smardon 1986).

Views – A broad landscape or panorama that is looked toward or kept in sight (USFS 1977). The analysis describes several types of views based on their spatial character:

- Panorama – A continuous series of scenes (Yeomans 1983).
- Open – A series of scenes that is framed but not as tightly as an enclosed view.
- Enclosed – Surrounded, bounded, or covered (USFS 1973).
- Focused – Placed at a focus; a focal point (Webster 1960).
- Filtered – Scenes or landscape features seen through other landscape features such as trees.

The visual distance of views in the study will be described as follows:

- Foreground – 0 to 0.25 mile
- Middleground – 0.25 mile to 3 miles
- Background – Beyond 3 miles

Visual Character – The visual character of a landscape is formed by the order of the patterns composing it. The elements of these patterns are the form, line, color. and texture of the landscape's visual resources. Their interrelationships can be objectively described (Jones et al. 1977); the overall impression created by a landscape's unique combination of land, vegetation, water, and structures can be seen in terms of form, line, color, and texture (USFS 1973). The analysis uses *strong*, *weak*, *clear*, *confusing*, or *cluttered* to describe degrees of order and types of impressions.

Visual Contrast – The difference in appearance between two or more features and/or a feature and its background (ACE 1984). The analysis generally describes existing or proposed project features that possess strong contrast.

Description of Viewers

The affected environment will also include a description of viewers.

- The *type* of viewers that see and respond to the affected environment, including viewer groups with a view of the proposed project, and based on the types of land uses that are prevalent. Viewers include neighborhood residents, business people, students, pedestrians, recreationists, and viewers using main streets and roads.
- The *degree* to which viewers experience a view from a physical location and the duration of their view. The report will describe *high*, *moderate* or *low* numbers of viewers and *long-* or *short-duration* views.

Impact Assessment

The visual and aesthetic impact assessment will describe and evaluate both long-term/permanent and short-term/construction effects, considering: (1) the degree of visual change to character and pattern or, in some neighborhoods (if viewsheds align with neighborhood jurisdictional boundaries), to specific features, and (2) viewer sensitivity in terms of viewer numbers, activities, position, and duration of exposure to visual resources. The assessment will apply established guidelines for assessing viewer expectations in urban environments, consistent with FHWA guidance. For instance, areas that involve parks, residences, open space, unique or noted

natural or built landmarks, or established viewpoints are more likely to be considered sensitive, while industrial areas are less likely to be considered sensitive.

Long-Term Impacts

The resulting level of visual impact will be based on the combination of the degree of visual change and viewer sensitivity. The impacts will also consider the conceptual engineering definitions of the alternatives to describe changes in terms of scale or size, particularly where elevated structures would be present. In select locations where visual impacts are considered high, simulations will be considered to illustrate selected elements of the alternatives.

The reporting of visual impacts will include the following descriptions:

- Alignment alternatives and design options within each viewshed, including vertical elements and project footprint (on-the-ground configuration)
- Kind and amount of visual resource change that could result from proposed alternatives, and the resulting degree of potential visual resource change
- Viewer sensitivity to the visual changes being proposed
- Impacts to designated Scenic Viewpoints, Scenic Drives, or Scenic Overlay zones

The reporting will also include a determination of the visual resource impact that could result from the combination of the degree of visual resource change and viewer sensitivity.

Degree of Change

The change in visual character of each viewshed will be characterized in terms of land, water, vegetation, structures, spatial pattern, recognized views, and other valued visual features. Viewer characteristics will be included in each description. Actions that could change the character of these features from their existing condition and affect viewers' responses to them could become visual impacts. The degree of these visual changes coupled with viewer sensitivity would define the severity of the visual impact. In most cases, greater contrast and incompatibility with existing character and pattern, along with the higher levels of viewer sensitivity, would increase visual impact levels. The attributes of visual features that usually determine degree of change are listed below:

- Topography – The visibility and scale of cut or fill relative to existing grades.
- Vegetation – The degree of removal of existing vegetation and the relationship between remaining vegetation and location of proposed project elements.
- Water – The physical or visual removal of a water feature and the design or structural compatibility of new elements over or adjacent to it.
- Structures – Color, scale, and type of project elements compared to the scale and type of existing structures and to existing topography.
- Visual pattern – An increase or decrease in the size of the existing development or a change in the arrangement and distribution of existing buildings, streets, land uses, and other neighborhood features.
- Blocked or altered views.

The analysis will characterize the degree of visual resource change as *high*, *moderate* or *low*, as described in Table 1.

Table 1. Visual Resource Change Categories

	High Visual Change	Moderate Visual Change	Low Visual Change
Topography	Highly visible, deep cut and fill slopes or extensive changes in existing grades.	Cut and fill slopes exceed the grades of representative land forms.	Changes to existing grades maintain or are compatible with existing topography.
Vegetation	Complete removal of existing trees, shrubs and grass.	Removal of highly visible or important tree or shrub species, riparian vegetation or large amounts of grass.	Retains existing vegetation or removes a very limited quantity of trees, shrubs or grass while maintaining the existing vegetation pattern.
Water	Complete removal or destruction of banks and channel form; the introduction of elements such as bridges and abutments whose scale is too large compared to the scale of the water feature.	Modifications to existing banks, channel, or visual setting.	Retains or protects existing water resources.
Structures	Extreme contrast in scale and relationship to street and open space, including the removal of buildings or the introduction of new buildings and structures.	Extensive changes in type, scale, and relationship to street and open space.	Maintains the existing scale and location of structures relative to the street and to open space.
Pattern	A significant increase or decrease or contrast to the scale of development, including the removal or alteration of development or street patterns.	Significant enough disruption to existing visual pattern and scale to weaken its character in specific areas or in general.	Maintains or reinforces the continuity of the existing scale, diversity, and arrangement of roads, structures, and other features.
Views	Total view blockage or complete removal of dominant visual feature; a direct conflict with existing policy or ordinance.	Some blockage or change to the context of the identified visual resource.	Maintains existing views; creates new views of comparable extent.

Viewer Sensitivity

Viewer sensitivity reflects the preferences, values, and opinions of different groups of viewers. It also includes several factors that affect viewer responses:

- Length of time project elements are seen (Are views long or short term/transitory?)
- Distance of the viewer from a project (Do viewers see project elements in the foreground, middle ground or background from important and typical viewpoints?)
- Activities viewers are engaged in relative to land uses (residential and recreational uses are considered more sensitive than commercial or industrial uses; drivers or passengers in vehicles are typically less sensitive than other viewers)
- Numbers of viewers (How many people see the project elements?)

- Position of viewers (Are viewers level with, above, or below project elements?)
- Visual resource significance (Are the visual features being affected formally identified or designated as important, or in areas such as parks or nature trails where visual or aesthetic elements are integral to the land use?)
- Visual resource policy (Are the resources being affected protected in any existing policies, regulations, etc.?)

The analysis will characterize viewer sensitivity as *high*, *moderate*, or *low*.

Short-Term Impacts

Construction impacts will be described qualitatively with particular focus on temporary disruption of elements of the environment, staging areas, and other areas that will not be occupied by permanent facilities.

Indirect Impacts

Indirect impacts will be assessed qualitatively and will include non-project-related changes in visual quality that may result directly from implementation of the project. This will include any local jurisdiction land use plans that propose transit-oriented development in the vicinity of stations and may include other elements identified during EIS scoping. Elements of the project used during construction or acquired but not used for permanent facilities will be discussed in terms of likely future development opportunities.

Cumulative Impacts

Based on the list of foreseeable transportation and other development projects that are anticipated to occur in the study area within the same time frame, a qualitative analysis of potential cumulative effects will be conducted for visual impacts. It is assumed that the list of foreseeable projects for this analysis will be based on information provided in the transportation and land use analyses. It is also assumed that the cumulative effects will be prepared for all elements of the environment based on this same list of foreseeable projects.

Mitigation Measures

Mitigation measures could reduce the amount of change to visual character and the effects on viewer sensitivity caused by project elements. Potential mitigation measures will be identified to minimize or reduce visual impacts. Examples include screening, adjustment of vertical and horizontal alignments, landscaping, or design approaches to improve the fit and scale of the project with lands adjacent to the alternatives. Additionally, TriMet and PBOT's *Guide to Standard Light Rail Transit Improvements in Public Streets* will be followed.

Documentation

Existing visual conditions, existing visual character, and potential visual impacts will be discussed in the Visual Quality and Aesthetics section of the EIS. The EIS section will be summary-level, focused on identifying expected long-term and short-term/construction period impacts by viewshed for each alternative, as well as providing potential mitigation measures. More detailed discussions of the background information used, existing conditions information,

and details of the analysis by neighborhood and/or viewshed will be provided. The information that will be included is described below:

- Photos of existing conditions
- Simulations of proposed project elements at selected sites for the alternatives, primarily for areas considered to have high levels of viewer sensitivity and high impacts; these locations will be determined based on the initial impacts analysis and in consultation with local agencies
- Annotated maps of the alternatives, indicating the locations where high visual impacts are identified

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City of Tigard Community Development Department. 2008 (June 3; adopted amendments effective date). 2027 Comprehensive Plan. Available online at: http://www.tigard-or.gov/city_hall/comprehensive_plan.php.

City of Tigard. 2016 (December 13; adopted by the City of Tigard). Tigard Triangle Urban Renewal Plan and Report Accompanying the Urban Renewal Plan.

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_____. 2012 (November 21, effective). Map 9-5: Special Commercial Setback & Commercial Services Overlay.

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WATER RESOURCES ANALYSIS METHODS

Introduction

This report describes the methods that will be used to collect data and evaluate impacts to public water resources for the Southwest Corridor Light Rail Project. This analysis will be developed to comply with the National Environmental Policy Act (NEPA); local and state policies, standards, and regulations; and to respond to community concerns raised through environmental scoping.

The following water resources will be included in this analysis:

- Surface waters – The natural environment, such as streams, rivers, and lakes.
- Drainage system – The built environment, such as drainage subbasins, existing stormwater management facilities, and stormwater outfall locations.
- Groundwater – Critical aquifer recharge areas, sole source aquifers, and wellhead protection areas.
- Floodplains – The surface area within a 100-year flood event.

Analysis of the potential effects of the alternatives on wetlands, aquatic species, and aquatic habitats are addressed in the Ecosystem Analysis Methods report.

Related Laws and Guidance

The analysis will include review of federal, state, and local regulations that provide the legal requirements applicable to water resources in the study area, as well as a review of local plans, policies, and manuals that provide additional guidance. A general list of these documents is presented below. If a regulation, plan, policy, or manual is updated to a newer version than that listed below, the most recent version that is legally applicable to the project will be referenced for the environmental analysis. A summary of requirements of the regulations will be documented in the water resources analysis report.

Federal

- National Environmental Policy Act (NEPA), 42 United States Code (USC) Section 4321
- Clean Water Act, 33 USC 1251 et seq., which includes the following sections:
  - 401 – Water Quality Certification
  - 402 – National Pollutant Discharge Elimination System (NPDES)
  - 404 – Permits for Dredge or Fill
- Safe Drinking Water Act, 42 USC 300 *et seq.*, Chapter 6A
- Endangered Species Act , 16 USC 1531 *et seq.*, and guidance such as that as outlined in Section 7 Biological Opinion for Revised Standard Local Operating Procedures (SLOPES V) for Stormwater, Transportation, or Utilities
- Floodplain Management Presidential Executive Order 11988
- National Flood Insurance Act of 1968 and Flood Disaster Protection Act of 1973, 42 USC 4001 *et seq.*

State

- Oregon Administrative Rules (OAR) 340-040 – Groundwater Quality Protection
- OAR 340-041 – Water Quality Standards
- OAR 340-045 – NPDES and Water Pollution Control Facility (WPCF) Permits
- Oregon Revised Statutes (ORS) 468B – Water Quality
- ORS Title 45 – Water Resources, Irrigation, Drainage, Flood Control, Reclamation
- Oregon Senate Bill 10 of 1969 and Oregon's Statewide Planning Goals and Guidelines (2010)
- Oregon Department of Transportation (ODOT) Hydraulics Design Manual (2014)

Regional and Local

- City of Portland Code
  - Title 10 – Erosion and Sediment Control
  - Title 33 – Planning and Zoning Chapter 430 Environmental Zones
- City of Portland Fanno Creek and Tributaries Conservation Plan (1994)
- City of Portland Fanno and Tryon Creeks Watershed Management Plan (2005)
- City of Portland Fanno/Tryon Water Quality and TMDL CIP Pre-Design Report (2008)
- City of Portland NPDES MS4 Phase I Permit (Effective January 2011, Expired January 2016, administratively extended by DEQ)
- City of Portland Southwest Hills Resource Protection Plan (1992)
- City of Portland Stormwater Management Manual (2016)
- City of Portland Post-2011 Combined Sewer Overflow Facilities Plan (2010)
- City of Tigard Municipal Code
  - Chapter 12.02 – Sanitary Sewer and Surface Water Management
  - Chapter 18.775 – Sensitive Lands
  - Chapter 18.810 – Street and Utility Improvement Standards
- City of Tigard Stormwater Master Plan (pending, expected summer 2017);
- City of Tualatin Municipal Code Chapter 03-05 – Soil Erosion, Surface Water Management, Water Quality Facilities, and Building and Sewers
- Clean Water Services Healthy Streams Plan (2005)
- Clean Water Services NPDES MS4 Phase I Permit (Effective May 2016, Expires May 2021)
- Clean Water Services Design and Construction Standards for Sanitary Sewer and Surface Water Management (2017)
- Metro Code Section 3.07 - Urban Growth Management Functional Plan
  - Title 3 – Water Quality and Flood Management
  - Title 13 – Nature in Neighborhoods

- ODOT NPDES MS4 Phase I Permit (Effective June 2000, Expire May 2005, reissue pending)
- TriMet Design Criteria Revision 10.2 (2010)
- Washington County groundwater protection information relevant to:
  - Cooper-Bull Mountain Critical Ground Water Area
  - Sherwood-Dammasch-Wilsonville Limited Ground Water Area

Contacts and Coordination

Agencies and organizations that provide information sources used in the analysis are listed below. The project's coordination plan, including the interagency reviews of preliminary drafts of the water resources analysis documents, the Draft EIS review period, and the use of the project's Technical Advisory Committee, as well as direct contacts with agencies, will support further coordination with these parties.

- Federal agencies – U.S. Environmental Protection Agency (EPA), U.S. Army Corps of Engineers (USACE), U.S. Geological Survey (USGS), Natural Resources Conservation Service (NRCS), U.S. Coast Guard, and the Federal Emergency Management Agency (FEMA)
- State agencies – Oregon Department of Environmental Quality (DEQ), Oregon Department of Fish and Wildlife (ODFW), Oregon Water Resources Department (OWRD), Oregon Department of Land Conservation and Development (DLCD) Natural Flood Hazards Program, Oregon Department of State Lands (DSL), and Oregon Department of Transportation (ODOT)
- Local agencies – City of Portland Bureau of Environmental Services (BES), City of Portland Bureau of Transportation (PBOT), City of Tigard, City of Tualatin, Clean Water Services, Oregon Department of Transportation (ODOT), Washington County, TriMet, and Metro

The water resources discipline overlaps with other disciplines, such as ecosystems. This analysis will be coordinated with these disciplines' analyses.

Data Collection

Study Area

The study area for water resources is delineated based on drainage basins where the project will be located, water resources and off-site land areas within those basins, and downstream receiving waters. The study area will be determined by reviewing existing aerial photography, geographic information system (GIS) data, and technical reports pertaining to the project vicinity from federal, state, county, and local sources.

General

Available data, maps, GIS layers, and other information from jurisdictional agencies and organizations applicable to water resources in the study area will be collected and reviewed to identify the affected environment and evaluate potential impacts. Field reconnaissance will confirm available information and document any new features for the existing conditions of the

study area. Coordination with other related disciplines will ensure that necessary information is shared.

Additional data resources are listed below.

Stormwater

- TriMet SW Corridor DEIS Conceptual and Technical Plan Development Services, 14.2 Stormwater Impact Analysis – Conceptual Stormwater Management Approach (Tech Memo from Paul Fendt and Julie Brandt, Parametrix, to David Evans and Associates. December 30, 2016)

Surface Water

- NPDES water quality data, annual reports, and other supporting documentation for project receiving waters, as available
- EPA STORET database
- USGS
  - National Water Information System
  - StreamStats web interface
- DEQ Clean Water Act Section 303(d) and Section 305(b) water quality reports
- NRCS Soil Surveys
- Stream inventories and water quality reports from local jurisdictions
- Pacific States Marine Fisheries Commission StreamNet data
- Publicly available GIS aerial mapping
- GIS data and aerial photographs available from local jurisdictions
- ODOT, county, and local municipality maps of stormwater drainage subbasins, existing stormwater management facilities, and stormwater outfalls (locations and sizes)

Groundwater

- Groundwater maps from EPA, county health departments, and local municipalities that show wellhead protection areas, critical aquifer recharge areas, and sole source aquifers
- Available reports and studies from local jurisdictions that pertain to groundwater, well, and hydrogeologic conditions

Floodplains

Floodplain boundaries and elevations from existing FEMA Flood Insurance documents that have been designated by FEMA as currently Effective (authorized by law to be used in making determinations under the National Flood Insurance Program) or Pending Effective by the end of 2017 will be identified. Where no floodplain or floodway has been designated by agencies, no potential impacts will be assessed above the channel banks.

Affected Environment

The affected environment will be characterized by identifying and qualitatively evaluating existing water resources and land cover through field surveys, literature review, available GIS data, and other environmental data. Field observations will be conducted from publicly accessible roads and right of way and will include sites for proposed crossings, park-and-rides, operation and maintenance (O&M) facilities, and roadway improvements associated with the alternatives. The affected environment will be described in a narrative and shown on figures in the analysis report. Dimensions of mapped water resources and land cover will be approximated.

Impact Assessment

The analysis will review potential beneficial and adverse impacts from the project compared to existing conditions, based on concept-level design approximations of the primary factors affecting water quality, water quantity, floodplain, stream/surface water bodies, and groundwater for the alternatives. At the conceptual design stage of project development, the water resources analysis will be focused on defining the changes common to all alternatives and comparing the magnitude of impacts. Potential mitigation measures will also be provided, including permits, conditions, and best management practices (BMPs) the project is expected to incorporate into its development.

The alternatives will be compared according to their potential respective levels of impact to water resources. Impacts will be identified based on regulatory guidance and similar past projects. The impact analysis will assume that project design will meet applicable guidance from ODOT, Washington County, Clean Water Services, and the Cities of Portland, Tigard, and Tualatin. Impacts will be evaluated in the context of project development and implementation of required management plans, including BMPs for avoiding or minimizing impacts on water resources. Potential impacts will be narratively summarized and compared.

This analysis anticipates more detailed design and permitting information that will be developed as the project advances, and therefore will not attempt to specify the details of management facilities by location, calculate potential pollutant loads, or quantify detailed elements of future facilities. Also, based on observations of existing light rail facilities in Seattle and in Portland, the risk of oil and grease spills is assumed to be negligible, and operation of the light rail trains on rail and ballast will be considered non-pollution-generating. Raised bicycle and pedestrian facilities will also be considered non-pollution-generating.

Short-Term Impacts

Potential short-term construction impacts will be evaluated based on the project's potential for erosion and sediment transport, concrete work, material handling and transport, hazardous material storage and use, trenching, dewatering, and other construction-related activities applicable to water resources. Potential direct impacts from construction activities will be qualitatively assessed based on the proximity of activities to surface water bodies and local drainage systems.

Long-Term Impacts

Potential long-term impacts on water resources from project operation will be evaluated through the methods described below.

Surface Water – Operational impacts will be identified by comparing baseline conditions against conceptual changes in land cover, including changes in pollution-generating impervious surfaces, resulting from each alternative. Potential impacts from flow and pollutant amounts on drainage systems (flow only) and receiving waters will be characterized qualitatively.

Groundwater – Potential impacts on the groundwater supply will be evaluated based on estimated changes in land cover. Impacts on groundwater quality will be identified based on the potential for project-related pollutant discharges that could infiltrate into the ground.

Floodplains – The alternatives will be evaluated for the amount of fill that might be placed in the floodplain and/or that would alter existing crossings in a manner that would cause flood storage volume displacements within the affected reach. In addition, proposed fill or encroachment into the regulatory floodway would be identified if they occur in conceptual design plans, and avoidance or minimization options would be proposed.

Indirect Impacts

Indirect impacts are potential effects that could be caused by the alternatives at a later time or a farther distance, but are still reasonably foreseeable. Indirect impacts to receiving waters will be qualitatively evaluated through consideration of each alternative's potential changes to land use and/or pollutant source. For example, if the proposed project were expected to decrease vehicle use, then an indirect impact would be a potential reduction in traffic-related pollutants in the watershed. Other indirect effects could include station area development by others (such as projects to improve access or connections to stations, or redevelopment by others to increase density in station areas).

Cumulative Impacts

Based on the list of foreseeable transportation and other development projects that are anticipated to occur in the study area within the same time frame, a qualitative analysis of potential cumulative effects will be conducted for water resource impacts. The list of foreseeable projects for this analysis will be based on information provided in the transportation and land use analysis. It is also assumed that the cumulative effects will be prepared for all elements of the environment based on this same list of foreseeable projects. The analysis of potential cumulative water resource impacts will be examined for both near-term construction effects as well as long-term operational impacts.

Mitigation Measures

Measures to mitigate potential adverse impacts within the study area will be evaluated. Examples of adverse impacts include downstream hydrologic impacts resulting from uncontrolled increases in flows, floodplain encroachment at stream crossings, or the cumulative impacts of multiple construction projects occurring in an area simultaneously. For situations where potential impacts from the project would be expected to be avoided or minimized by required BMPs, no mitigation will be identified.

Mitigation strategies would consider local regulatory requirements and innovative treatment techniques. The potential on- and off-site mitigation options that are identified would be evaluated by considering several factors, including proximity to the potential impact, constructability, effectiveness, and opportunity for multiple benefits (i.e., provide both wetland

restoration or enhancement and floodplain storage). Additionally, there may be an opportunity to develop a regional stormwater mitigation strategy that is based on integrated watershed management concepts.

Documentation

The EIS Water Resources section will summarize existing conditions and disclose long-term and short-term impacts by alternative (including indirect as well as cumulative impacts). Maps and summary-level tables covering the alternatives will be provided, and supporting discussions of the above information will be included in an appendix. More detailed information and background will be contained in a technical memorandum available to reviewing agencies and at Metro, but is not proposed to be published as part of the EIS documents.