Lake Oswego to Portland TRANSIT PROJECT

Lake Oswego to Portland Transit Project

Technical Analysis Methods Report

For Development of the
Draft Environmental Impact Statement (DEIS)

Agency Review Draft

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METRO

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TABLE OF CONTENTS

List of Tables

List of Figures

Introduction

This report describes the technical analysis methods to be used for identifying and assessing impacts of the Lake Oswego to Portland Transit Project (LOPT) on the natural and human environment, and for identifying potential measures to minimize harm if adverse impacts are identified. A Draft Environmental Impact Statement (DEIS) will be prepared, based on these technical analysis methods, to summarize the topically specific technical analyses described herein. A series of technical memorandum will be prepared to support the analysis and findings in the DEIS.

The technical analysis methods defined in this report were developed to be consistent with the requirements of the National Environmental Policy Act (NEPA) and other applicable federal, state and local laws, regulations and guidance. These analysis methods have been developed in part from previous analysis methods developed for other regional transit studies. The previous analysis methods have been reviewed, revised and updated to be focused on issues within the Lake Oswego to Portland corridor and changes in legislation and guidance.

Opportunity for review of these technical analysis methods will be/has been provided to a variety of local, state and federal agencies, in accordance with the *Lake Oswego to Portland Transit Project Section 6002 Coordination Plan (Draft September 16, 2009)*. Comments from these reviewers will be/have been incorporated into the final draft of the report. In addition, after the analyses for the corridor are completed, the individual topic-specific analyses may update these analysis methods in recognition of the actual analyses completed for the project. The updated versions of the technical analysis methods, if applicable, will reflect changes that occurred during the various analyses.

Following is the list of expected technical analysis topic areas. The DEIS will be prepared based on these analyses. A series of technical memorandum will be prepared as backup documentation, as appropriate, for the analyses. Where additional detail is necessary beyond the detail contained in the DEIS, it will be documented in Technical Memorandum authored by the task leaders for each of the following specific topic areas:

1. Land use and planning analysis
2. Economic activity analysis
3. Community impact analysis (including community impacts, environmental justice, displacements, and public services)
4. Visual quality and aesthetics analysis (including visual analysis and visual simulations)
5. Historic, archaeological and cultural resources analysis
6. Parklands, recreation areas, wildlife and waterfowl refuge impacts analysis (including Section 4(f) and Section 6(f))
7. Geology, soils and earthquakes analysis
8. Ecosystems analysis (including wetlands, terrestrial, and aquatic resources)
9. Hydrology and water quality analysis
10. Noise and vibration analysis
11. Air quality analysis (including greenhouse gases and global warming)
12. Energy analysis
13. Hazardous materials analysis
14. Transportation and traffic analysis
15. Public safety and security analysis
16. Utility analysis

Although each chapter of this technical analysis methods report is unique to the specific topic area, generally each chapter was developed based on the following outline, and includes sections discussing the following topics:

1.1 Introduction
1.2 Related Laws and Regulations
- Federal
- State
- Local

1.3 Contacts, Coordination and Consultation
1.4 Data Collection
1.5 Affected Environment Profile
1.6 Impact Assessment Analysis Methods
- Direct
- Indirect
- Cumulative

1.7 Potential Mitigation Measures
1.8 Documentation

At the time of preparation of this draft of the technical analysis methods report, the set of alternatives that will be examined in the individual topic analyses and documented in the DEIS is still being finalized. The development of the definition of alternatives report has begun, and at the current time the alternatives are anticipated to include the following list:

1. No-Build Alternative
2. Enhanced Bus Alternative
3. Streetcar Full Length Alternative
   a. Segment 1 – South Portal Segment
      i. Willamette Shore Line Design Option
      ii. South Portal Design Option
   b. Segment 2 – Johns Landing Segment
      i. Willamette Shore Line Design Option
      ii. Macadam In-Street Design Option
      iii. Macadam Additional Lane Design Option
   c. Segment 3 – Sellwood Bridge Segment
      i. Willamette Shore Line Design Option
      ii. Sellwood Bridge Design Option
   d. Segment 4 – Dunthorpe Segment
      i. Willamette Shore Line Design Option
      ii. Riverwood Design Option
   e. Segment 3 – Lake Oswego Segment
      i. Willamette Shore Line Design Option
      ii. West of Railroad Design Option
4. Streetcar Sellwood Bridge Terminus Alternative)

Completion of the definition of alternatives report will finalize the list of alternatives and design options to be studied in the DEIS. The final alternatives and design options will be documented in the

definition of alternatives report and summarized in chapter 2 of the DEIS. If the list of alternatives and design options includes a broader set than is currently envisioned, revisions to the technical analysis methods may be required.

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1. LAND USE AND PLANNING ANALYSIS METHODS

1.1 Introduction

The land use and planning analysis will address the direct, indirect, and cumulative land use impacts of the Portland to Lake Oswego Transit Project study alternatives. Land use impacts are defined as changes in the use of land. Direct land use impacts are conversions of the use of land to transportation from another use that results from the placement of project improvements on the land. Indirect land use impacts are conversions of the use of land that result from changes in access to the land that result from a project. Cumulative impacts are direct and indirect impacts that result from a combination of the project and other projects, actions, and trends.

1.2 Applicable Laws and Regulations

The land use and planning technical analysis will be prepared as part of compliance with the National Environmental Policy Act of 1969[1] the Federal Transit Administration's (FTA's) implementing regulations,[2] and applicable regulations of the Council on Environmental Quality.[3] The statutes and administrative rules that comprise the Oregon Statewide Planning Program apply to the sponsors of the Lake Oswego to Portland Transit Project (LOTP) and to the jurisdictions within which it would be built. A build alternative would need to be included in Metro's regional transportation plan (RTP), the transportation system plans (TSPs) of Lake Oswego, Portland, Clackamas County, and Multnomah County, and TriMet's Transit Investment Plan. The Transportation Planning Rule,[4] part of the Statewide Planning Program, applies to these plans. Specifically:

- TPR Section 660-012-0015(2)(c) states, "Metropolitan service districts shall adopt a regional TSP for areas within their jurisdiction." Metro is a metropolitan services district.

- Regarding cities and counties, which includes Lake Oswego, Portland, Clackamas County, and Multnomah County, TPR Section 660-012-0015(3) states:

  > Cities and counties shall prepare, adopt and amend local TSPs for lands within their planning jurisdiction in compliance with this division:
  >
  > (a) Local TSPs shall establish a system of transportation facilities and services adequate to meet identified local transportation needs and shall be consistent with regional TSPs and adopted elements of the state TSP;
  >
  > (b) Where the regional TSP or elements of the state TSP have not been adopted, the city or county shall coordinate the preparation of the local TSP with the regional transportation planning body and ODOT to assure that regional and state transportation needs are accommodated.

- Regarding mass transit districts, which includes TriMet, TPR Section 660-012-0015(6) states:

[1] 42 U.S.C. 4321 et seq.
[2] Environmental Impact and Related Procedures, 23 CFR part 771.
[3] Regulations for Implementing NEPA, Part 1506.
[4] Oregon Administrative Rules Chapter 660, Division 12.

Mass transit, transportation, airport and port districts shall participate in the development of TSPs for those transportation facilities and services they provide. These districts shall prepare and adopt plans for transportation facilities and services they provide. Such plans shall be consistent with and adequate to carry out relevant portions of applicable regional and local TSPs.

1.3 Coordination Requirements

There are no specific, legal requirements for coordination in the preparation of the land use and planning technical report. There are coordination requirements that will apply if it is necessary to amend the RTP or TSPs referenced above to include a LOTP build alternative. TPR Section 660-012-0015(5) states, "The preparation of TSPs shall be coordinated with affected state and federal agencies, local governments, special districts, and private providers of transportation services." This applies to the amendment of TSPs.

1.4 Data Needs and Sources

A. Mapped Data

The report will require the following geographic information system (GIS) data for the area of potential impact (API):

1. existing land use
2. comprehensive plan designation
3. zoning
4. assessed value of land
5. assessed value of improvements
6. allowed floor area
7. existing floor area

Items 1 through 5 will come from Metro's Regional Land Information System (RLIS). Metro is now compiling items 6 and 7. Whether items 6 and 7 for the project area will be available in time is uncertain.

B. Applicable Policies

The report will require compiling the applicable adopted policies and plans from:

1. Metro's 2004 Regional Transportation Plan
2. The TSPs of Lake Oswego, Portland, Clackamas County, and Multnomah County
3. Any other adopted components, such as neighborhood plans and Lake Oswego, Portland, Clackamas County, and Multnomah County comprehensive plans that contain policies on the transportation system in the project area.
4. Any other urban design, streetscape, land use or other relevant plans in current process.

Copies will be obtained from each of these jurisdictions. Where planning processes are underway that may change these plans, they will be noted.

1.5 Identification and Documentation of the Affected Environment

The method will be to:

1. Define the API for land use impacts and divide it into analysis areas (e.g., Johns Landing, park, unincorporated shoreline, Lake Oswego waterfront, Lake Oswego downtown).
2. Produce tables and maps of existing land use, comprehensive plan designations, and zoning in the API using data from RLIS.
3. Produce tables of allowed, existing, and unused floor area within a half mile of proposed streetcar stops and map the percentage of unused allowed floor area in the same areas. This step is contingent on the availability of the needed data, as referenced above.
4. Produce tables of the ratio of the value of improvements to value of land within one half mile of proposed streetcar stops and map the information.

1.6 Impact Assessment Methods (Direct, Indirect and Cumulative)

A. Direct Impacts

The method will be to use GIS to measure the land area the build alternatives and options would convert to transportation use from non-transportation use by existing use, comprehensive plan designation, and zoning and to tabulate the results by analysis area.

B. Indirect Impacts

The method will be to:

1. Review the literature on the effects of streetcar lines on land development.
2. Identify land development interventions local governments may take in conjunction with the build alternatives, such as the use of their urban renewal authority. This will be done by interviewing planning and community development officials of the Cities of Portland and Lake Oswego.
3. Evaluate the indirect impacts on land use in each analysis areas by reference to the literature on the effects of streetcar lines on land development; the effects of other, similar projects; possible land development interventions by local governments; the tables and maps of allowed and unused floor area ratio referenced above; and the tables and maps of the ratio of the value of improvements to value of land referenced above.
4. Discuss the land use impacts of the project construction process.

C. Cumulative Impacts

The method will be to:

1. Identify other projects, actions, and trends related to land use by interviewing planning and community development officials of the Cities of Portland and Lake Oswego.
2. Consult a list of projects, actions, and trends compiled from other project team members.
3. Evaluate how these other projects, actions, and trends could interact with the land use impacts of the alternatives with results that differ from the land use impacts of the alternatives alone.

D. Compliance with Applicable Policies and Regulations

The method will be to:

1. Identify and compile the policies applicable to project alternatives from the RTP and the TSPs of the City of Portland, City of Lake Oswego, Multnomah County, and Clackamas County.
2. Analyze the consistency of the alternatives with the policies.
3. Identify the land use permits each jurisdiction would require for the build alternatives and instances where the zoning code treatment of project improvements is unclear.

1.7 Mitigation Measures

The purpose is to identify potential mitigation measures and when mitigation is required. The method will be to identify opportunities to amplify land use impacts that achieve public policy objectives by coordinating the alternatives with other public policy actions. This is because projects in Oregon normally do not have adverse land use impacts because land use plans prevail over project impacts in the use of land.

1.8 Documentation

The land use and planning analysis will be summarized in the Lake Oswego to Portland Transit Project DEIS.A technical memorandum will be prepared to document additional details of the land use and planning existing conditions, including the analysis, impacts identified, consultation, and potential mitigation. The technical memorandum will include a list of reference documents and persons contacted during report preparation and list them in an appendix along with other appendices as appropriate.

2. ECONOMIC ACTIVITY ANALYSIS METHODS

2.1 Introduction

The purpose of the economics analysis is to provide information on the economic conditions in the region and the expected direct, indirect and cumulative effects of the Lake Oswego to Portland Transit Project study alternatives. The analysis will be conducted within the context of the overall land use and transportation planning in the region.

One component that an environmental analysis must address is the economic impacts of the proposed project. Most transportation projects provide the mobility necessary for economic activity in an area, but most have a relatively small direct impact on economic conditions. Direct effects are defined for this technical memorandum as jobs or spending caused by the project. Indirect effects are defined as jobs or spending that the project may cause or contribute to causing, by changing the level of access and mobility.

2.2 Related Laws and Regulations

Federal laws, regulations and federal agency guidance will be considered in the analysis of economic impacts. The National Environmental Policy Act (NEPA), Council of Environmental Quality Guidance, Federal Transit Administration (FTA), and Federal Highway Administration (FHWA) environmental guidance on preparing NEPA documents will be considered, and the criteria for Section 5309 New Starts projects will be discussed.

2.3 Contacts and Coordination

Coordination with Metro's Data Resource Center (DRC) staff may be necessary for the application of Metro's forecast of population, households, and employment. These forecasts are disaggregated geographically and have already been used for other long-range planning purposes. Other coordination outside the project team will include information on business tax revenue which will be requested from the City of Portland Revenue Bureau and property tax rate information from the Oregon Department of Revenue. These property tax rates will be used in conjunction with assessor data available in Metro's Regional Land Information System (RLIS) database to estimate property tax impacts of the proposed alternatives. Within the project team, the Areas of Potential Impact (APIs) will be defined in coordination with the land use and community impacts analyses in order to describe each area consistently across the three disciplines. Information on displacements will also be provided by other members of the project team: The community impacts report will provide information on residential property displacements, the land use report will identify displacements of nonresidential property, and the traffic report will identify displacements of on-street parking. Capital costs will be provided by URS's Conceptual Design team and TriMet will provide estimates of operating costs.

2.4 Economic Analysis Methods

The economic impact analysis will support of the Draft Environmental Impact Statement (DEIS) for the Lake Oswego to Portland Transit Project (LOPT). The economic impact analysis will be completed in four phases:

1) collection of data;
2) profile of the affected environment at the regional and study-area levels;
3) assessment of potential impacts; and
4) identification of potential mitigation measures.

The analysis will consider the effects of developing the transit project alternatives on the pattern of growth in the region. The analysis of effects is based on data on historic and projected households, population, and employment in the region, and includes the effects of long-term operations impacts and short-term construction impacts.

The economic impact analysis will rely on the evaluation of land use patterns, plans, and development trends at the regional level, at the corridor level and for various project subsections in the land use and community impacts analyses. The analysis will include areas within one-half mile of transit improvements associated with the various alternatives. The analysis reflects the experiences of TriMet, Metro, and local jurisdictions as they have developed other streetcar and light rail projects in the region.

2.5 Data Collection

The primary source of data will be Metro's estimates and forecast of population, households, and employment, prepared by Metro's Data Resource Center staff. These data will be supplemented with historical information from the U.S. Census Bureau's decennial census, employment data from the Oregon Employment Department, and land use information from the land use technical report, which will rely heavily on RLIS, Metro's geographic information system (GIS), supplemented by field observation. Information on future economic conditions, including population and employment by area, will be based on 2030 forecasts developed by Metro in cooperation with local jurisdictions, and allocated by Transportation Analysis Zones. 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.

Information on construction and operation costs, construction phasing, operation details and right-of-way impacts will be used to evaluate impacts to economic activity. These data include the number of residences and businesses displaced and the effects of this major construction project on the regional economy. Assessed value by parcel and property tax rates will be used to estimate impacts to property tax revenue, license information from the Portland Revenue Bureau will be used to estimate the impact of displaced business on license revenue, and an inventory of displaced on-street parking and meter rates will be used to estimate the impact of displaced parking on parking revenue.

Construction impacts will be calculated using the IMPLAN model's data for the four-county economy, based on capital cost estimates for the transit project. IMPLAN is a static equilibrium input-output model first developed in 1979 by the U.S. Forest Service in cooperation with the Federal Emergency Management Agency and the U.S. Bureau of Land Management to assist the Forest Service in land and resource planning and management. The program has been updated and improved over subsequent years and is now one of the most commonly-used economic modeling tools for measuring the economic impacts of development projects. This analysis will employ data for Multnomah, Washington, and Clackamas counties in Oregon, and Clark County, Washington from 2007, which is the latest year for which data are available. Operations and maintenance (O&M) cost estimates will be used to generate long-term employment estimates.

Regional factors consistent with previously completed studies will be used (for example, the Portland to Milwaukie LRT Project DEIS), basing the forecasts on the cost estimates provided by Tri-Met and Metro. Information will be gathered on the real estate market by major market classification (office-commercial, industrial, retail-commercial) and on adopted plans and ordinances that address parking policies (maximum parking ratios); increased development density (minimum densities and floor area ratios); and transit-oriented design (minimum setbacks, building orientation, pedestrian connections, etc.). Additionally, information will be gathered on other tools and actions to promote transit-oriented development, such as urban renewal districts and tax abatement legislation.

2.6 Affected Environment Profile

A profile of the affected environment will be prepared, including tabular representations of the regional population, households, and employment; profile of the regional real-estate market; and station-area and/or corridor profiles (of population, households and employment within each station area and the corridor by segment. The data review for the station areas and/or corridors will focus on factors relevant to the impacts analysis such as the population, households, and employment within one-quarter mile of study alternatives. Vacant and underutilized or re-developable lands will be identified and examined with respect to opportunities related to the various alternatives.

2.7 Impact Assessment Analysis Methods

The impact assessment will focus on a comparison of the alternatives and design options. At the regional level, the potential effect of each alternative on the pattern of growth in the metropolitan area will be evaluated with respect to its compatibility with the statewide planning goals and guidelines, the Region 2040 Growth Concept, the Regional Transportation Plan and the local jurisdiction comprehensive plans.

The analysis will evaluate the effectiveness of the project alternatives in serving existing and future activity centers and various economic activities within the corridor. The analysis of impacts will include employment and other direct impacts, indirect impacts including tax base impacts (such as the impact of displacements on property and business tax revenue), parking revenue impacts, short-term construction impacts, and cumulative effects. It will include tabular depictions of population, households, and employment to accompany the graphic representations of land use in the land use and community impact analyses.

Direct Effects: The analysis of direct effects of the various alternatives during construction and operation addresses impacts that could result from acquisition of right-of-way, changes to transportation and parking, changes to localized development patterns, and long-term operational employment. O&M cost estimates will be used to generate long-term employment estimates.

Indirect Effects: This analysis will consider the effects of other project influences on economic activity. The analysis would also include assessments of the degree that existing land uses would be affected, as well as a qualitative assessment of potential redevelopment or revitalization influences related to construction of the various alternatives. The potential effect of displacements and land acquisition for the study alternatives on local tax bases (such as property tax revenue, business tax revenue, and on-street parking revenue) will be examined. Indirect effects of operations will be estimated using regional or state multiplier factors from IMPLAN.

Construction-Related Effects: This analysis will evaluate the short-term impacts of the timing and duration of construction and construction-related employment. Capital cost estimates will be used to estimate construction-related employment. Indirect effects of construction will be estimated using regional or state multiplier factors from IMPLAN.

Cumulative Effects: This section will review the extent of induced impacts resulting from the project in combination with other projects in the corridor.

2.8 Economic Mitigation Measures

The DEIS section on Economic Impacts will identify potential mitigation measures that could reduce or eliminate adverse economic impacts related to the study alternatives. Short-term construction-related mitigation (phasing, traffic signing, open business signing, etc.) and long-term changes (design or operations) would be included and would be coordinated with the applicable areas of analysis. Potential mitigation options will be identified if significant impacts are identified. It is expected that final commitments to mitigation will be identified for the Preferred Alternative and documented in the FEIS.

2.9 Documentation

The economic analysis will be summarized in the DEIS section on economic activity and if appropriate a technical memorandum will be prepared to provide additional documentation. The authors will compile a list of reference documents, experts contacted, and related technical analyses during the analysis and list them in an appendix to the technical memorandum along with other Appendices as appropriate..

3. COMMUNITY IMPACT ASSESSMENT ANALYSIS METHODS

3.1 Introduction

This section outlines the methods that will be used to complete the community impact assessment for the Lake Oswego to Portland Transit Project (LOPT). The community impact assessment will cover the following topic areas:

- Social and neighborhood impacts, including impacts to any environmental justice or otherwise sensitive populations
- Potential displacements and relocations
- Impacts to public services

The following sections of this report describe the relevant laws and regulations pertaining to this analysis and the specific methods that will be employed to conduct the analysis. The final community impact evaluation will consist of a neighborhood profile for each neighborhood within the project study area as well as a detailed impact assessment for each alternative studied.

3.2 Applicable Laws and Regulations

The following sections list specific laws and regulations that guide analyses of impacts to communities, environmental justice populations, properties that may be displaced or relocated, and public services.

3.2.1 Community Impacts and Environmental Justice

- Presidential Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations"
- Americans with Disabilities Act of 1990
- Title VI of the Civil Rights Act of 1964

3.2.2 Displacements and Relocations

- Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 as amended
- 49 CFR Part 24, titled Uniform Relocation Assistance and Real Property Acquisition
- Oregon Department of Transportation, Right-of-Way Manual
- Tri-Met Administrative Rules for Relocation Appeals

3.2.3 Public Services

- Oregon Statewide Planning Goal 11. 2005. "Public Facilities and Services." OAR 660-015-0000(11). Salem, OR.
- Oregon Revised Statutes 2003. "Municipal Solid Waste Management." ORS Chapter 459.Salem, OR.
- Oregon Revised Statutes 2003. "When district (is) required to provide transportation waiver." ORS 327.043. Salem, OR.

- City of Portland and City of Lake Oswego Comprehensive Plans – policies related to public services
- Multnomah County and Clackamas County Comprehensive Plans – policies related to public services

3.3 Contacts, Coordination and Consultation

A. Data from outside the project team. This report will require coordination with the following groups in order to assemble necessary data.

- Metro's Data Resource Center. Metro will be asked to provide information on forecasted population and employment. It is anticipated that this data will be available on Metro's website, and coordination with Metro staff members will be minimal.
- Clackamas and Multnomah County Tax Assessor and/or Housing Authorities. These agencies, as appropriate, will be asked to provide data on subsidized housing units within their jurisdictions for this project's study area.

B. Data from within the project team. This report will require coordination with the following members of the project team, at a minimum.

- Public Involvement Team. The public involvement team will be asked to provide public input on neighborhood boundaries and significant neighborhood facilities. The public involvement team will be provided information about any environmental justice or sensitive populations in the study area and, if there are any, will be asked to conduct outreach specific to those populations.
- Conceptual Engineering Team. The conceptual engineering team will be asked to provide data on proposed right-of-way impacts for each build alternative.
- Land Use, Economics, Air Quality, Noise, Visual Resources, Parks and Recreation, and Traffic/Transportation team members. Impacts from each alternative within each of these disciplines will be needed for this report.

C. Possible coordination with other organizations. Depending on the findings of the neighborhood profiles, this report may necessitate coordination with the following groups:

- Fire, Emergency Medical Services, and Law Enforcement Agencies with jurisdiction in the study area
- School transportation providers with jurisdiction in the study area
- Postal service providers with jurisdiction in the study area
- Solid waste providers with jurisdiction in the study area
- Representatives of other public facilities in the study area (medical centers, libraries, etc)

3.4 Data Collection

This report will utilize the following data:

A. Metro's Regional Land Information System Geographic Information System (GIS) files, including:

- Aerial photo(s) of the study corridor
- Tax lot boundaries
- Neighborhood boundaries
- Census 2000 tract, block, and block group boundaries
- Traffic Analysis Zone boundaries
- City and County boundaries
- Locations of fire, emergency medical services, and law enforcement providers
- Locations of schools and school transportation routes
- Locations of postal service facilities
- Locations of solid waste facilities
- Other public facilities (libraries, community centers, etc)
- Existing building footprints

B. Census 2000 or 2005 American Community Survey data for the following characteristics:

- Total population
- Total households
- Minority population (defined as the percentage of people who did not select "white alone" as their race)
- Hispanic population
- Elderly population (defined as 65 years of age or older)
- Population with disabilities
- Non-English-speaking population
- Households with income below the poverty level
- Housing units by ownership type

C. City of Portland Bureau of Planning and Sustainability, **City of Lake Oswego** Planning Department, **Multnomah County** Housing and Public Works Department, **Clackamas County** Housing Authority, and Metro:

- Median single family home value
- Number of subsidized housing units
- Number of children who qualify for free or reduced lunch

D. Metro's Data Resource Center:

- Forecasted population

E. Project Plans including conceptual engineering drawings with initial identification of right-of-way needs.

F. Public Involvement input from the public involvement team on important neighborhood facilities and appropriate neighborhood boundaries.

- Notable characteristics of the neighborhood and its history

G. Findings from other technical reports prepared for this project:

- Impacts to traffic and transportation (changes to travel times, anticipated delays, changes in access)
- Impacts to visual resources
- Land use and economic impacts
- Noise impacts
- Air quality impacts
- Impacts to parks and recreation facilities
- Neighborhood character and history (neighborhood websites, neighborhood and stakeholder interviews, books and periodicals on the neighborhood, etc.)

H. Displacements. If residential relocations or displacements are anticipated, data on local real estate market conditions will be needed.

3.5 Affected Environment Profile

3.5.1 Study Area Definition

This report will discuss direct, indirect, and cumulative impacts to neighborhoods within a specifically defined Study Area. The Study Area will be developed in coordination with the land use and economic analysts for the project.

Impacts will be discussed for each neighborhood within the study area. The neighborhood boundaries from Metro's GIS shapefile will be used as the basis for these, but input from the public involvement team on public perceptions of neighborhood boundaries will also be taken into consideration when discussing impacts.

3.5.2 Creation of Neighborhood Profiles

Utilizing the data outlined in Section 3.4 above, the report will present a detailed profile of each neighborhood in the study corridor. These profiles will be developed in consultation with the public involvement team, specifically regarding accurate neighborhood boundaries and significant neighborhood facilities. Each neighborhood profile will contain the following information, analyzed by census block, block group, or TAZ, as appropriate. Data will be presented in tables, graphs, or maps, as appropriate.

A. Demographics and other Characteristics of the Neighborhood:

- Total population
- Population density (defined as households/acre)
- Minority population (raw total and as a percentage of the total population)
- Low income population (raw total and as a percentage of the total population)
- Elderly population (raw total and as a percentage of the total population)
- Non-English speaking population (raw total and as a percentage of the total population)
- Percentage of renters in the neighborhood
- Housing and Transportation Affordability (Metroscope)

- Number and location of urban amenities (as defined in the report: An Assessment of the Marginal Impact of Urban Amenities on Residential Pricing, Johnson-Gardner for Metro, 2007). Metro will provide the data (in a shapefile) and the consultant will analyze it.
- Neighborhood character and history

B. Existence of Environmental Justice populations in the Neighborhood:

- Neighborhood minority population percentage compared to the minority percentage in the region (defined as Multnomah, Clackamas, and Washington Counties). If the neighborhood percentage is larger, it may constitute a significant population.
- Neighborhood low income population percentage compared to the low income percentage in the region. If the neighborhood percentage is larger, it may constitute a significant population.
- If there are potential significant populations identified, this information will be communicated to the public involvement team to ensure that outreach specific to those populations is conducted.
- Number of children who qualify for free or reduced lunch.

C. Existence of Other Sensitive Populations in the Neighborhood:

- Neighborhood elderly population percentage compared to the elderly percentage in the region (defined as Multnomah, Clackamas, and Washington Counties). If the neighborhood percentage is larger, it may constitute a significant population.
- Neighborhood disabled population percentage compared to the disabled percentage in the region. If the neighborhood percentage is larger, it may constitute a significant population.
- Neighborhood percentage of non-English-speaking persons compared to the percentage of non-English speaking persons in the region. If the neighborhood percentage is larger, it may constitute a significant population.
- If there are potential significant populations identified, this information will be communicated to the public involvement team to ensure that outreach specific to those populations is conducted.

D. Anticipated Population Growth in the Neighborhood:

- Forecasted population
- Forecasted population density (defined as households/acre)

E. Public Services in the Neighborhood:

- Number and locations of fire and emergency medical services and law enforcement providers
- Number and locations of schools and school transportation routes
- Number and locations of postal service facilities
- Number and locations of solid waste facilities
- Approximate number and locations of subsidized housing facilities
- Number and locations of other neighborhood facilities, as defined through public involvement process

F. Existing Land Ownership in the Neighborhood:

- Existing significant public landowners
- Percentage of existing public versus private land
- Median single-family home value

3.6 Impact Assessment Analysis Methods

3.6.1 Direct Impact Analysis

The analysis will consider several factors about the nature of construction and operation of the proposed alternatives. First, given available engineering data, the analysis will consider the maximum extent of potential direct impacts to housing or public services. The analysis will address such issues 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.

Additionally, this analysis will consider impacts to neighborhood cohesion and quality of life that would result from each alternative.

Finally, the analysis will include a discussion of whether or not any anticipated impacts will be disproportionately experienced by environmental justice or otherwise sensitive populations.

A. Impacts to Individual Properties, including Public Services. This analysis will utilize GIS files of the proposed alternatives overlaid with the data listed in section 1.3.1 to determine if individual properties or public services would be directly impacted by the proposed alternatives. A property or public service would be considered impacted if:

- It lies in the path of a portion of the proposed alternative such that it could not continue to function in its current use;
- Access to any building on the property would be completely and permanently eliminated by any portion of a proposed alternative and could not be restored by reconfiguring the access or building;
- The widening of streets, construction of sidewalks or other improvements required in conjunction with proposed transit improvements 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.

B. Neighborhood Impacts. This analysis will utilize data gleaned from other technical reports to determine if any of the proposed alternatives would result in impacts within the following categories:

- Neighborhood Cohesion. Neighborhood cohesion consists of factors that contribute to a sense of community or social capital in a neighborhood. It can be impacted by changes to the traffic circulation pattern, changes to the bicycle and pedestrian transportation system, and the amount of overall displacement of residents, businesses, and public services in the neighborhood.

- Neighborhood Quality. These include any noise, air quality, visual, or parks and recreation impacts.
- Neighborhood Mobility. These include any changes in access to public services, major employers, or other significant features in the neighborhood.

C. Impacts to Environmental Justice or other Sensitive Populations. If environmental justice or other sensitive populations have been identified in any neighborhoods in the study area, the direct impacts from each proposed alternative will be analyzed to determine if it would result in a disproportionate adverse impact to environmental justice or other sensitive populations.

3.6.2. Indirect and Cumulative Impact Analyses

This analysis will utilize the list of future projects in the project area provided by the Project Manager. The project will be analyzed in conjunction with the entirety of other projects within a specified radius to determine if there is potential for greater impacts to public services, neighborhood cohesion, neighborhood quality, or neighborhood mobility from this project combined with other projects.

3.7 Mitigation Measures

If significant impacts are anticipated from any of the alternatives, the community impact assessment will identify potential mitigation measures. These will be discussed by topic area for each neighborhood. Potential mitigation measures for neighborhood or social impacts will focus on preserving or enhancing neighborhood cohesion, maximizing social benefits, and minimizing impacts on low-income, minority, or otherwise sensitive neighborhoods. Potential mitigation measures for impacts to public services will be identified in consultation with the public service provider.

If residential displacements or relocations are identified as part of this analysis, local real estate market data will be used to the availability of potential sites for relocation. Specific displacement cases will be analyzed in depth during the Preliminary Engineering phase of this project.

3.8 Documentation

The community impact assessment analysis will document the analysis of community impacts, environmental justice, displacements, and public services. The analysis will include documentation of existing conditions, impacts, potential mitigation and consultation. The analysis will be documented in the DEIS section on community impacts. The authors will compile a list of reference documents, data, experts contacted, and related technical analyses during the report preparation and list them in the supporting technical memorandum along with other appendices, as appropriate.

4. VISUAL QUALITY AND AESTHETICS ANALYSIS METHODS

4.1 Introduction

The purpose of the visual quality and aesthetics analysis methods section is to describe the technical analysis methods expected to be used to collect data and evaluate potential visual quality and aesthetic impacts of the Lake Oswego to Portland Transit Project study alternatives. The analysis is developed to comply with the National Environmental Policy Act (NEPA), applicable state environmental policy legislation, and local and state policies, standards, and regulations.

4.2 Related Laws and Regulations

Federal, state, and local plans and policies that encourage the protection of visual and aesthetic resources will be examined as they relate to the proposed project.

A. Federal regulations and plans that determine under what conditions visual quality and aesthetics are to be considered include:

- Regulations for Implementing NEPA, Council on Environmental Quality (CEQ), 40 CFR 1500-1508.
- Visual Impact Assessment for Highway Projects, U.S. Department of Transportation, Federal Highway Administration (FHWA), Office of Environmental Policy, FHWA-HI-88-054, 1981, reprinted 1989.
- Environmental Impact and Related Procedures, FHWA, 23 CFR 771, 1965.
- Aesthetics and Visual Quality Guidance Information, FHWA, August 18, 1986.
- Intermodal Surface Transportation Act (ISTEA)

B. State regulations and plans that influence or determine under what conditions visual quality and aesthetics are to be considered include the following:

- Oregon Administrative Rule (OAR) 660-015-0000, Oregon Statewide Planning Goal 5, Natural Resources, Scenic and Historic Areas, and Open Spaces, Oregon's Statewide Planning Goals and Guidelines, amendments effective August 30, 1996.
- Procedures and Requirements for Complying with Goal 5, OAR 660-15-0000 (5), Department of Land Conservation and Development (DLCD).
- Oregon Transportation Plan (OTP), 2006.
- Roadside Development Design Manual, Oregon Department of Transportation (ODOT), 2005.

C. Local plans, ordinances, and manuals identify visual and aesthetic values that help determine how communities may react to changes resulting from the project. Local plans to be considered include:

1. City of Portland Comprehensive Plan, Goals and Policies, Goal 8 and Goal 12, 2004.
    - Goal 8: Policy 8.14, Objectives F, G, H, J, K – Conserve significant natural and scenic resource sites and values.
    - Goal 12: Enhance Portland as a livable city, attractive in its setting and dynamic in its urban character by preserving its history and building a substantial legacy of quality

private developments and public improvements for future generations. Provides guidelines for urban design.

2. City of Portland Title 33, Planning and Zoning, 1994.
   - Section 400s – Overlay Zones: Design Overlay Zone (d), Greenway Overlay Zones (g), (n), and (r), and Scenic Resources Overlay Zone (s).
   - Section 500s – Plan Districts: Central City Plan District and Macadam Plan District, City of Portland Scenic Resources Protection Plan, 1991.

3. City of Portland Design Guidelines and Policy Direction: Southwest Community Plan, 2003; South Waterfront Plan, 2004. South Waterfront Design Guidelines and Greenway Design Guidelines, 2002; Corbett, Terwilliger, and Lair Hill Policy Plan, 1977; Macadam Corridor Design Guidelines (South Macadam), 1985; and Macadam Corridor Design Guidelines (North Macadam), 1992.

4. City of Portland Scenic Resources Protection Plan, 1991.

5. Multnomah County Comprehensive Framework Plan, Natural Environment Policies, 2009.
   - Policy 15: Willamette River Greenway. A cooperative management effort between the state and local jurisdictions for the development and maintenance of a natural, scenic, historical, and recreational "greenway" along the Willamette River.
   - Policy16-F: Scenic Views and Sites. The county's policy to conserve scenic resources and protect their aesthetic appearance for the enjoyment of future generations.
   - Multnomah County Zoning Ordinance. Special Districts: Willamette River Greenway (WRG) and Heritage Preservation (HP), 2009.

6. City of Lake Oswego Comprehensive Plan, Goals 2, 5, and 15 – Section 2, 1994.
   - Goal 2 – Section 2: The City shall maintain and enhance the appearance and design quality of Lake Oswego.
   - Goal 5 – Section 2: The City shall protect and restore the community's wooded character and vegetation resources.
   - Goal 5 – Section 6: The City shall protect, enhance, maintain and expand a network of open space areas and scenic resources within and adjacent to the Urban Services Boundary.
   - Goal 5 – Section 8: The City shall preserve the historical, archaeological and cultural resources of the community.
   - Goal 15 – Section 1: The City shall protect, conserve, enhance and maintain the natural, scenic, historic, economic, and recreational qualities of the Willamette River Greenway.

7. City of Lake Oswego Community Development Code, 2009.
   - East End Design District and Old Town Design District.

8. Clackamas County Comprehensive Plan, Natural Environment Policies, 2009.
   - Wildlife Habitats and Distinctive Resource areas are intended to protect the scenic landscapes and natural beauty of Clackamas County. Provide an urban environment where trees and landscape plantings abound and where significant features of the natural landscape are retained.

9. TriMet, Design Criteria Manual.

4.3 Coordination and Consultation

As part of the investigation of visual quality and aesthetic impacts pertaining to the LOPT Project, personnel will coordinate with the project team, including the visual simulation and public outreach consultants. In addition, staff will gather information from and/or coordinate with some or all of the following federal, state, and local government agencies:

A. Federal Agencies

- Federal Transit Administration (FTA)
- Federal Highway Administration (FHWA)

B. State Agencies

- Department of Land Conservation and Development (DLCD)
- Oregon Department of Transportation (ODOT)

C. Local Agencies

- Metro
- City of Portland
- City of Lake Oswego
- Clackamas County
- Multnomah County
- TriMet

4.4 Data Collection

This report will utilize the following data:

A. Site characteristics from survey data, Metro's Regional Land Information System (RLIS) Geographic Information System (GIS) files, and published maps including:

- Aerial photo(s) of the study corridor
- Tax lot boundaries
- Neighborhood boundaries
- City and County boundaries
- Locations of schools, parks, and other public facilities (libraries, community centers, etc)
- Existing building footprints
- Topography
- Natural waterways
- Zoning (plan districts, overlay zones, view corridors and other regulatory provisions with geographic specificity).

B. Project Plans including conceptual engineering drawings with elevations and plan details.

C. Public Involvement input from the public involvement team on important neighborhood features and facilities and appropriate neighborhood boundaries.

D. Findings from other technical reports prepared for this project. Visual quality and aesthetic conditions are influenced by all of the factors that shape an environment, such as the presence of parks, natural features, or historic and cultural features. Therefore, the other technical assessment reports contain a great deal of information pertinent to the existing and future visual quality and aesthetics of the viewshed (as defined below). Technical reports that will be reviewed include:

- Ecosystems Impacts Analysis
- Historic, Archaeological and Cultural Resources Analysis
- Land Use and Planning Analysis
- Parklands, Recreation Areas, Wildlife and Waterfowl Refuge Impacts Analysis

E. Visual simulations produced by the visual simulation consultant illustrating likely change in visual quality of views and viewpoints due to the proposed alternatives.

4.5 Visual Analysis Methods

4.5.1 Analysis Area

The analysis area for visual quality assessment is called a "viewshed." A viewshed is the aggregate landscape that can be seen from the project area and that has views of the project area. The viewshed analysis area is delineated by the surrounding topography, vegetation, and built environment, including the scale of the proposed development in relationship to the surrounding area. This means that the viewshed analysis area may not be the same as the Area of Potential Impact (API).

4.5.2 General Methods

Data collection and assessment methods will follow FHWA visual quality and aesthetics assessment methodology (FHWA 1989), because the Federal Transportation Administration (FTA) has not issued specific guidance on the visual quality and assessment methodology. This FHWA methodology was developed on behalf of communities adjacent to proposed transportation projects as a way to adequately and objectively consider the potential visual impacts resulting from highway projects. FHWA methodology has become an accepted framework for describing and analyzing a transportation project's subjective visual experience and for developing the social and physical contexts for visual impact analyses. The evaluation sequence is as follows:

1. Establish the project's visual limits (viewshed) and define the inherently distinctive subareas in the project area (landscape unit) by visiting the project area and using geographic information system (GIS) maps.

2. Determine who has views of and from the project (viewers) using project maps and the understanding gained in the previous step, and by reviewing relevant planning documents.

3. Describe and assess the built and natural environments that exist before the project (affected environment).

4. Select evaluation viewpoints in the project area and assess the views from the viewpoints as they exist before and as they are likely to be after the project.

5. Select views and viewpoints to be used for graphical simulations that illustrate likely changes due to the project and/or substantial numbers of sensitive viewers of representative features of the proposed alternatives, and/or of high quality views.

6. Describe the likely changes in visual quality that will result from the proposed alternatives.

The first three steps establish baseline or existing conditions and the extent of the project's visual context. Steps 4 and 5 are the basis for determining the level of changes in and impacts to the visual character or quality of the project area, which are then determined in Step 6.

Visualization and evaluation viewpoints (Steps 4 and 5) are places where substantial numbers of sensitive viewers have views of representative or typical features of the proposed alternatives, or of high quality views. Evaluating visual quality from these viewpoints is a useful way of understanding existing conditions and potential visual impacts. Photographs from many of the viewpoints are used in Step 3, to help portray existing conditions.

4.5.3 Effects Guidelines

The visual quality and aesthetics assessment is based on the synthesis of a set of broad criteria that include pedestrian or motorist experiences, the presence of panoramic or scenic views, overall character and quality of the area, scale and contrast between elements in the area, and other factors. There are three generally accepted impact levels (low, moderate, or high) used to assess and summarize impacts to visual resources. These are defined by the criteria shown in Table 4-1: Visual Impact Levels and Criteria, adapted from FHWA guidelines (FHWA 1989).

Table 4-1
Visual Impact Levels and Criteria

Low	Moderate	High
1. No physical changes are expected to result from the proposed project. 2. Any remodeling of existing structures necessitated by project includes blending of the remodeled buildings into the surrounding area. 3. Proposed structures would be located in areas that do not exhibit a defined visual character (areas made up of different uses, different scales of structures, and with no landmarks or historic structures). 4. Proposed project is compatible with visual character of surrounding area.	1. Proposed construction includes new structures that have a different scale, color, location, and/or orientation from surrounding structures. 2. Proposed project is located within historic district, adjacent to historic structures, or adjacent to major public buildings designed as focal points (e.g., city halls and courthouses).	1. Proposed project is of a scale that contrasts with its surroundings (e.g., contains structures of greater bulk than those in surrounding areas or introduces voids such as parking lots, into the midst of a developed area of well-defined street spaces). The magnitude of impacts will be greater in areas with a recognized visual character that reinforces their use and perception by the community as an asset. 2. Proposed project would disrupt important views (e.g., views of mountains, oceans, rivers, or significant human-made structures).

4.5.4 Terminology

Visual quality assessment has an accepted vocabulary that includes familiar, everyday words used as technical terms. Since this can be confusing, the key terms and parameters that are used for visual quality assessment are defined below.

Views are what can be seen from the project area and what can be seen of the project area from the surrounding areas. Views are defined by geography and built and natural features, and are described or assessed from a given vantage point, called the **viewpoint**. All the views visible combine to form the **viewshed**, which may be larger or smaller than the APIs. The viewshed is determined through GIS mapping and site visits. Viewers are the people who have views of or from the project. **Viewers** are discussed in terms of general categories of activities, such as resident, boater, jogger, or motorist, and in terms of their sensitivity to views.

Within a viewshed there are usually smaller areas defined by distinctive boundaries and characteristics called **landscape units**. A landscape unit is a subset of the project area and is a helpful tool for gaining a thorough understanding of the project area. The criteria for determining the limits of a landscape unit are that each landscape unit has a distinctive landscape character, has a specific geographic location, and has some degree of clear views within the unit.

The visual quality and aesthetics assessment will describe and evaluate these three composite factors summarized below: **visual character, visual quality, and viewer response**.

Visual Character is defined by the nature of existing visual resources and elements and the relationships between them. These relationships are typically described in terms of dominance, scale, diversity, and continuity. Character-defining visual resources and elements include:

- Landforms: type, gradient, and scale
- Vegetation: type, size, maturity, and continuity
- Land uses: size, scale, and character of associated buildings and ancillary site uses
- Transportation facilities (including Streetcar stops): type, size, scale, and directional orientation
- Overhead utility structures and lighting (including overhead catenaries and substations): type, size, and scale
- Open space: type (e.g., parks, reserves, greenbelts, and undeveloped land), extent, and continuity
- Viewpoints and views to visual resources
- Water bodies, historic structures, and downtown skylines
- Apparent grain or texture (e.g., the size and alternation of structures and unbuilt properties or open spaces of the landscape)
- Apparent upkeep and maintenance

Visual Quality is the assessed value of the existing visual experience and the likely value after the project is built. The assessment assigns a numeric value to three parameters that rank the existing visual quality and that which exists after the project. The three parameters are the memorability or distinctiveness of the landscape (vividness), the degree to which the landscape is a harmonious mix of elements (unity), and the degree to which the landscape is free of eyesores or elements that do not fit with the overall landscape (**intactness**).

Viewer Response is a combination of viewer exposure and viewer sensitivity. Viewer exposure considers the combined effect of the physical location of viewer groups, the number of people exposed to a view, and the duration of their view. This includes both transit users and people in the surrounding area. Viewer sensitivity is the degree to which a viewer expects a particular visual character and the extent to which that character is important to the viewer. Viewer sensitivity is the combined effect of the activities a viewer is engaged in, the visual context, and the values, expectations, and interests of a group of persons or a person involved in a particular activity or context.

4.5.5 Worksheets

In order to maintain the highest possible level of objectivity when evaluating a largely subjective experience, visual quality and visual character are assessed using descriptive and numeric worksheets. The descriptive worksheets identify visual resources and objects in the viewshed and landscape units. The numeric worksheets assign numeric values to before and after conditions of selected views according to accepted, predefined significance thresholds (see Table 4-1: Visual Impact Levels and Criteria). Impacts are assessed by comparing the difference in significance thresholds and changes in the overall quality and character. The worksheet template will be based on FHWA Visual Impact Assessment for Highway Projects. One descriptive and one numeric threshold-based evaluation will be conducted for each view. Views will be chosen according to the criteria discussed in Section 4.5.2.

Results for view evaluations will be presented in tabular form indicating view position, visual resource, and the project alternative or option. Key points for the landscape units will be summarized in tabular form, indicating the limits of the unit, and visual character and quality ranks. Visual impacts will be determined and ranked according to the significance thresholds described in Table 4-1: Visual Impact Levels and Criteria.

4.6 Impact Assessment Analysis Methods

4.6.1 Long-Term Operational Impacts Approach

Long-term adverse and beneficial impacts to the visual and aesthetic environment will be assessed using the methodology described in the previous sections. Impacts can result from the permanent addition of new elements; displacement, alteration, or removal of existing elements; or the introduction of new light and glare sources. Impact levels are based on anticipated pedestrian or motorist experience of, or reaction to, the changed visual character due to the project; the presence of and attitudes toward panoramic or scenic views; changes to the overall visual quality and character of the area; and the degree of change in scale, contrast, or character between existing elements in the area and new elements created by the project.

Key assessment views and issues of concern will be identified or confirmed through consultation with the City of Portland, City of Lake Oswego, Multnomah County, Clackamas County, and TriMet, and other advisors as necessary. Local and regional plans, policies, and regulations will be taken into account with regard to aesthetic and historic resources. The results of the historic, parks and recreation, and neighborhoods discipline reports will also inform the selection of the assessment views and identification of visual resources. Photographs of the views will be used for computer-

generated simulations of the "after" conditions. Photographs will approximate a normal viewing angle and will provide a representation of the relative scales of structures seen from the viewpoint. Selection criteria for the simulations are:

- The view is a "typical" view that represents similar landscape types in the project area and is a location with many viewers of at least moderate sensitivity.
- The view is a location of potential high visual impact and has a significant number of viewers with high sensitivity.

4.6.2 Short-Term Construction Impacts Approach

Short-term construction impacts will be evaluated by reviewing project construction plans for locations or situations where temporary installations of fences, equipment, barriers, signage, lighting, and other construction-related objects would or could occur. Temporary impacts to neighborhoods, parks and trails, landscaping, and vegetation will be evaluated in consultation with the relevant discipline reports.

4.6.3 Cumulative Impact Analysis Approach

Cumulative impacts may occur when a project's effects are combined with those from past, present, and reasonably foreseeable future projects. They can also result from individually small, but collectively significant, actions that occur over a long period of time. Specific elements, like the appropriate base year and the geographic scale of analysis, may vary by discipline area. An overall framework for addressing cumulative effects will be defined for the project and applied for this analysis.

4.7 Mitigation Measures

Potential mitigation measures for adverse visual and aesthetic impacts will be identified during the evaluation process and in coordination with other disciplines, including natural and built environment disciplines. Locations where impacts occur and the degree and nature of the impact will be noted. For these locations, possible mitigation options that could be considered include:

- Selecting and/or modifying routes
- Using interdisciplinary design teams to create aesthetic guidelines and standards in the design of project elements
- Integrating facilities with area redevelopment plans
- Minimizing clearing for construction and operation
- Planting appropriate vegetation in and adjoining the project right-of-way
- Replanting remainder parcels
- Using source shielding in exterior lighting at stations and ancillary facilities

Determination of final mitigation measures to be included in the project will be made after impacts have been identified. Mitigation measures will be the product of coordination with other disciplines and overall project goals to ensure that the measures are feasible and integrated with the entire mitigation program.

4.8 Documentation

The visual quality and aesthetics analysis and technical memorandum will be prepared to document the analysis methods, coordination, data collection, inventory of the existing environment, analysis of potential impacts, and any avoidance recommendations. The analysis will be summarized in the DEIS.

5. HISTORIC, ARCHAEOLOGICAL AND CULTURAL RESOURCES ANALYSIS METHODS

5.1 Introduction

Section 106 of the National Historic Preservation Act of 1966 requires that impacts of federally assisted projects be examined for impacts to historic districts, sites, buildings, structures, or objects, and archaeological sites listed on, or eligible for inclusion in the National Register of Historic Places. Federal agencies must coordinate with the State Historic Preservation Officer (SHPO) before undertaking projects that affect such properties. The Advisory Council for Historic Preservation (ACHP) has established procedures for the protection of historic and cultural properties that are in, or determined to be eligible for inclusion in the National Register (36 CFR 800). There are also Oregon statutes that protect archaeological sites on both private and public lands. The analysis, documentation and coordination are being conducted to satisfy Section 106 requirements for the Lake Oswego to Portland Transit Project.

The purpose of the historic, archaeological and cultural resources analysis is to identify resources and assess the impacts of the various project alternatives on known and potential historic, archaeological and cultural resources. Issues that will be identified in the historic and cultural component relate to the numbers and types of resources and their relative locations in relationship to the study alternatives.

5.2 Related Federal, State, and Local 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 (NHPA) of 1966 (P.L. 102-575; 16 U.S.C. 470), as amended. 36 CFR 800. 40 CFR 1508.27. Executive Order 11593. Secretary of Interior Standards
- National Register Standards for eligibility regulation (36 CFR 60.4)
- U.S. Department of Transportation (DOT) Act of 1966 (49 U.S.C. 1653, 23 U.S.C. Section 138), Section 4(f), as amended)
- Antiquities Act of 1906 (P.L. 59-209; 16 U.S.C. 431-433)
- Historic Sites Act of 1935 (16 U.S.C. 461-467)
- Protection and Enhancement of the Cultural Environment of 1971 (Executive Order 11593)
- Oregon SHPO regulations
- Oregon statutes that address Indian burials (ORS 97.740) and archaeological sites (ORS 358.905 and 390.235)
- Oregon Statewide Planning Goal 5 (Oregon Administrative Rule [OAR] 660-015-0000) Natural Resources, Scenic and Historic Areas, and Open Spaces. Oregon's Statewide Planning Goals and Guidelines. OAR 660-015-0000. Amendments effective 08/30/96
- Clackamas County Comprehensive Plan and standards related to historic resources
- Multnomah County Comprehensive Plan and standards related to historic resources
- Portland and Lake Oswego plans and standards related to historic resources

5.3 Contacts, Coordination and Consultation

Federal, state, and local agencies will be contacted and coordinated with, during the identification of resources and preliminary evaluation of effects. Agencies involved include Metro, Tri-Met, the Oregon Department of Transportation (ODOT), SHPO, Clackamas County, Multnomah County, and the cities of Portland and Lake Oswego. FTA, acting on behalf of the US government, will lead any contacts with Native American Tribes in the area to invite them to participate and/or consult on historic, archaeological and cultural issues. Other jurisdictions and agencies may also be consulted on an as-needed basis. Individual property owners of identified resources may also be consulted.

Consultation with the SHPO will be as defined in the SAFTEALU 6002 Coordination Plan, and include the following steps:[5]

- Initiate coordination to obtain a SHPO case number, approval of proposed methods, and concurrence with the proposed area of potential effect (APE).
- After draft determination of eligibility forms have been completed but before they have been submitted, the SHPO may be invited to a field visit to view the project area and to discuss preliminary findings.
- Determination of Eligibility forms will be submitted to the SHPO for their concurrence (or non-concurrence), along with the *draft Cultural Resources Report*.

If a project alternative requires the use of any part of a historic resource, or if the project would have an "adverse effect" on an historic or cultural resource, a preliminary Section 4(f) evaluation will be prepared for each affected historic resource. The Section 4(f) evaluation for historic and/or cultural resources will be included in the parklands (Section 4(f)) results report. The Section 4(f) methods are discussed separately in Chapter 6 of this technical analysis methods report.

5.4 Affected Environment Profile

The area of potential effect (APE) within which the historic, archaeological and cultural historical resources will be inventoried and evaluated for project effects will generally be defined as the adjacent tax parcels (extending to approximately 150 feet beyond project limits or property line) on both sides of the study alternatives and design options. In areas with a defined grid pattern such as the Portland Central City and downtown Lake Oswego, the APE would be one-half block (or approximately 100 feet) on either side of the study alternatives and design options. In some locations, the APE may extend further than 150 feet from a study alternative or design option. For the archaeological resource investigation, the vertical APE may vary according to construction practice and depth of excavation, depending on the geomorphology of the landform where the project element occurs.

5.4.1 Historic Resources

An inventory of historic resources within the APE will be developed. This inventory will include resources that are listed on the National Register of Historic Places (NRHP) or determined to be eligible for the NRHP through the Section 106 Determination of Eligibility process. For the sake of

[5] Consultation with the SHPO will be conducted by the FTA. Local agency and consultant technical staff will assist FTA as needed.

clarity, resources that have been determined to be not eligible for the NRHP through the Section 106 Determination of Eligibility process will be noted as well. The methods for developing the inventory and determining eligibility will include the following steps.

1. Tax assessor's records will be reviewed to develop a preliminary list of resources within the API that are at least 45 years old.

2. Field studies will be conducted to verify the list of resources that could potentially be eligible for the NRHP, and to photograph and document all potentially historic resources.

3. City, county, and state historic resource inventories will be consulted, including:

    - City of Portland Historic Resource Inventory (1984)
    - City of Lake Oswego Cultural Resources Inventory (1989)
    - Clackamas County Cultural Resource Survey (1983-84)
    - Multnomah County inventory of historic properties
    - State of Oregon inventory of historic properties

4. Oregon SHPO records will be consulted to determine which resources are listed on the NRHP and which resources have been determined eligible for the NRHP by previous projects.

    - Resources that have been determined eligible for the NRHP by previous projects but that have undergone a significant loss of integrity or other significant change will be re-evaluated through the Determination of Eligibility process.
    - Those resources that appear to have retained their integrity and historic character will not be re-evaluated and will be considered historic.

5. An inventory of resources within the APE that are at least 45 years old will be developed. This inventory will note whether the resource has been previously determined historic (either through listing on the NRHP or through a determination of eligibility), if it has lost a significant amount of integrity such that it is readily apparent that it is not eligible for the NRHP, or if further research is required to determine whether it may be considered eligible for the NRHP.

6. Archival research will be conducted to develop an area-wide context statement as well as brief histories for each of the resources for which a Determination of Eligibility form will be completed. Research materials could include historical maps, city directories, newspaper articles, books, and other available sources.

7. Determination of Eligibility forms will be completed for each of the potentially historic resources that require further research.

5.4.2 Archaeological Resources and Traditional Cultural Properties

An inventory of archaeological resources within the APE will be developed. This inventory will include resources that are listed on the National Register of Historic Places (NRHP) or determined to be eligible for the NRHP through the Section 106 Determination of Eligibility process. The methods for developing the inventory and determining eligibility will include the following steps.

1. A comprehensive records search at Oregon SHPO to gather data on any archaeological surveys or related studies conducted along the entire proposed alignment, including all options currently under consideration.

2. A review of historical cartographic materials, photographs, and other documents for new project areas/alignments not previously reviewed in detail. This review is to identify locations considered likely to have associated historic period archaeological resources.

3. A field reconnaissance of the project area to assess current conditions and supplement the archival research in determining if any of these areas should be considered high-probability locations for archaeological resources.

4. Federal, state and local jurisdictions, such as the State Historic Preservation Officer, Tribal Historic Preservation Officers and county and city planning departments, will be contacted for the most current inventories of historic and cultural resources within the corridor.

5. Archival research will be completed where necessary to document known resources.

6. Field studies will be conducted to identify potential resources not previously included in local inventories and to review locations and condition of previously recorded resources.

7. FTA will undertake coordination and consultation with the appropriate communities, including but not limited to Native American Tribes, to determine if there are traditional cultural properties in the project area.

5.5 Impact Assessment Analysis Methods

5.5.1 Historic Resources

For the DEIS phase of the analysis, direct (including construction), indirect, and cumulative impacts of the project alternatives will be described and evaluated. This evaluation will include a preliminary assessment of the likely effects of the project alternatives. The effects will be categorized as no effect, no adverse effect or adverse effect for each identified historic resource. Potential impacts may be evaluated in general terms (not on a resource-by-resource basis) unless there is a particular impact or a specific property that is significant enough to warrant individual treatment. Possible mitigation strategies will be identified to reduce or avoid adverse impacts. The evaluation of effects will be presented in a way that allows comparison of the project alternatives and design options.

After a preferred alternative is selected, for the FEIS phase of the NEPA analysis, individual Finding of Effect (FOE) forms will be prepared for each historic resource within the APE for the preferred alternative. These effect forms will describe the potential impacts for each historic resource and will assess the level of effect. SHPO concurrence with the FOE findings will be sought during this later phase of the project.

5.5.2 Archaeological Resources and Traditional Cultural Properties

For the DEIS phase of the analysis, direct (including construction), indirect, and cumulative impacts of the project alternatives will be evaluated and described. This evaluation will include a preliminary assessment of whether any of the project alternatives would be likely to adversely affect an archaeological resource, and whether there may be mitigation strategies to lessen or avoid adverse impacts. Consideration of Traditional Cultural Properties would be addressed, if appropriate, based on results of agency consultation with pertinent communities, including, but not limited to, Native American groups. Potential impacts will be evaluated in general terms (not on a resource-by-resource basis) unless there is a particular impact or a specific property that is significant enough to warrant individual treatment. The evaluation and impact description will be presented in a way that allows comparison of the project alternatives and design options.

5.6 Mitigation Measures

Mitigation measures will be identified and described. Mitigation measures will be focused on areas where historic, archaeological, or cultural resources may be adversely affected, with the goal of reducing or removing the adverse impact so that a finding of no adverse effect could be possible.

5.7 Historic and Cultural Documentation

The project consultant team will prepare a draft *Historic, Archaeological and Cultural Resources Report* that fulfills the requirements of Section 106, the FTA and the Oregon SHPO. The report will document the methods used for the project; precontact and historic context of the project area; identified historic resources within the project APE; resources that were evaluated and determined to be not historic; potential impacts to historic resources; a preliminary assessment of the level of effect; and potential mitigation measures. If there are known archaeological sites within the APE, the presence of those sites will be noted in the report but their locations will not be disclosed within the body of the report.

The appendix of the report will include:

- Cover Sheet from the SHPO Historic Sites Database (as required by the SHPO report guidelines)
- Summary reports from the SHPO Historic Sites Database
- Determination of Eligibility forms prepared for the project
- Final survey map showing the locations and eligibility status of resources within the APE
- 7.5’ USGS quadrangle map showing APE boundaries
- Photographs and other supporting documentation
- Bibliography
- Agency correspondence
- Detailed archaeological data (this will not be available for public review, but will be filed with the SHPO)

The analysis and draft report will be reviewed by the project partners, including Tri-Met, Metro, Portland and Lake Oswego and other parties as appropriate. This report will form the basis of the discussion of historic and cultural resources in the DEIS.

All primary and secondary sources will be listed as references in bibliographical format in the Appendix to the report. All newspapers, books, interviews, reports, papers, inventories, National

Register Nominations, and miscellaneous data will be included. As noted above, archaeological data will be summarized and documented in a separate appendix, but will not available for public review, and instead will be filed with the SHPO.

6. PARKLANDS, RECREATION AREAS, WILDLIFE AND WATERFOWL REFUGE IMPACTS ANALYSIS METHODS (including Section 4(f) and Section 6(f))

6.1 Introduction

The purpose of this section is to identify the approach for data collection, impacts analysis, and mitigation that the Lake Oswego to Portland Transit Project will use for parks, recreational resources, and Section 4(f), 6(f), and state recreation grant resources. The analysis will be developed to comply with the National Environmental Policy Act (NEPA), applicable state parklands policy legislation, and local and state parks and recreation planning policies and standards.

Federal requirements protecting publicly owned parks, recreation, and wildlife preserve lands apply to all transportation projects that utilize Federal funding. These requirements, known as Section 4(f), will be addressed in the analysis of the potential impacts of the project alternatives on parklands in the vicinity of the study alternatives. The draft Section 4(f) evaluation will be prepared and documented in the parklands technical memorandum. The Section 4(f) evaluation will focus on comparing the potential impacts of the various alternatives on park resources. The findings of the draft Section 4(f) analysis will be summarized in the Draft Environmental Impact Statement (DEIS). After selection of the Preferred Alternative, an updated Section 4(f) Statement will be prepared in conjunction with the Final Environmental Impact Statement (FEIS). A final Section 4(f) Statement will be prepared prior to issuance of the Record of Decision (ROD).

Historic and cultural resources are also protected by Section 4(f) regulations and will be evaluated as part of the FEIS. If any identified historic and cultural resources would be used by one or more of the study alternatives, a Section 4(f) evaluation will be conducted.

6.2 Related Laws and Regulations

Several Federal and state regulations are associated with the park and recreational resources. Regarding all 4(f) resources, regulations that apply to historic, archaeological, and cultural resources are addressed in the reports developed for those resources. The extent to which laws and regulations are relevant to this project will depend upon the specific resources encountered within the project area. This section outlines the Federal, state, and local laws, regulations, and planning documents that apply to the protection of park and recreational resources.

6.2.1 Federal

A. Section 4(f) of the U.S. Department of Transportation (USDOT) Act of 1966 (49 U.S. Code [USC] 303 et seq.), implementing regulations at 23 Code of Federal Regulations [CFR] 774.

The United States Department of Transportation (USDOT) Act of 1966 (49 USC 303) includes regulations that prohibit the use of parklands for transportation projects except in very unusual circumstances. These regulations, known as Section 4(f), require that USDOT agencies (including the Federal Transit Administration (FTA)):

> *…not approve the use of land from a significant publicly-owned park, recreation area or wildlife and waterfowl refuge or any significant historic site, unless there is no feasible and*

prudent alternative to the use of land from the property and the action includes all possible planning to minimize harm to the property resulting from the use.

"Use" can be permanent, temporary, 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; and
- There is a documented agreement of the appropriate Federal, state, or local officials having jurisdiction over the resource, regarding the above condition.

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 are provided in 23 CFR 77.135 and are discussed below:

- The projected noise level increase from the project substantially interferes with the use and enjoyment of a resource, 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 a 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.

B. 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). This is the first substantive revision of Section 4(f) legislation since passage of the USDOT Act of 1966. This revision provides that once the USDOT determines 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 and the Section 4(f) evaluation process is complete.

An analysis of the project alternatives will be conducted to identify potential impacts to Section 4(f) properties as outlined in 23 CFR 774.17. Section 4(f) properties may not be used for any transportation project receiving Federal funds or approval from a USDOT agency, except where de minimis impacts or use occurs or where no feasible or prudent alternative exists. Section 4(f) ensures that all possible planning has been done to minimize harm to those properties covered by the act.

C. Section 6(f) of the Land and Water Conservation Fund (LWCF) Act of 1965 (16 USC 4601-4 et seq.), and the LWCF of 1965 (PL 88-578, 78 Stat 897).

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

6.2.2 State of Oregon

A. Oregon Administrative Rule (OAR) 736-070-030, Community Opportunity Grant Program (COGP).

This regulation provides for Oregon Parks and Recreation Department (OPRD) allocation of revenue from recreational vehicle registration fees to counties for park and recreation sites and programs. The COGP provides funding on a project basis for the acquisition, development, rehabilitation, and planning of county park and recreation sites that provide camping facilities. Protection measures mimic Section 6(f) requirements, except they do not include NPS involvement.

B. OAR Chapter 736-Division 6.

This regulation provides for OPRD to allocate state lottery funds to local governments to finance the protection, repair, operation, and creation of state parks and public recreation areas through the Local Government Grant Program (LGGP). Protection measures mimic Section 6(f) requirements, except they do not include NPS involvement.

C. OAR Chapter 736-Division 7.

This regulation provides for OPRD to allocate recreational vehicle registration fees to counties for park and recreation sites and programs through the COGP. Protection measures mimic Section 6(f) requirements, except they do not include NPS involvement.

D. Oregon Statewide Planning Goals.

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. Oregon Statewide Planning Goal 15 addresses the Willamette River Greenway.

6.2.3 Local Jurisdictions

A. Metro parks and facility plans
B. City of Portland and Multnomah County comprehensive plans and zoning maps
C. City of Portland Parks 2020 Vision
D. City of Lake Oswego comprehensive plans and zoning maps
E. Clackamas County comprehensive plans and zoning maps
F. Available statewide outdoor recreation plans

Parkland and recreation facilities in the project area are owned and managed by several entities. These entities include the City of Portland Parks and Recreation Bureau for Portland, the City of Lake Oswego Department of Parks and Recreation, and Clackamas County Parks. Metro also owns and manages public parks and open spaces within unincorporated Multnomah County and functions as an open space provider for the overall Portland Metro area.[6] The cities of Portland and Lake Oswego and Clackamas and Multnomah counties continue to maintain general parks goals and policies within their Comprehensive Plans.

6.3 Contacts, Coordination and Consultation

There are several agencies that regulate lands that could be subject to Section 4(f) and Section 6(f) regulations. These agencies may be contacted or consulted to identify publicly owned parklands, recreation areas, or wildlife and waterfowl refuges under their jurisdiction. This study 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.

If uses or impacts to Section 4(f) and/or Section 6(f) resources are anticipated, the agency with jurisdiction over that resource will be identified and contacted. The project team will arrange a meeting with the official having 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 technical memorandum. Further consideration under Section 4(f) is not required for insignificant sites. For sites that are defined as significant, the Section 4(f) analysis will be completed.

Agencies that may be contacted or require coordination for the parks and recreation analysis include:

Federal Agencies:

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

[6] In 1994, Metro assumed management responsibility for the Multnomah County parks system. Ownership of these facilities was transferred to Metro on July 1, 1996.

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)

Local Jurisdictions and Agencies:

- Metro Regional Parks and Greenspaces
- Clackamas County Parks Department
- Portland Parks and Recreation Bureau
- Clackamas County
- Multnomah County
- City of Lake Oswego

6.4 Data Collection for the Affected Environment

A. Project Area

The Lake Oswego to Portland Transit Project corridor is generally located between the South Waterfront area in the Portland Central City and the Lake Oswego Town Center. It encompasses the area west of the Willamette River and generally east of Oregon Highway 43. The project area is more specifically described in the definition of alternatives report.

B. Inventory of Resources

Park and recreational resources will be identified through contact with affected agencies, site visits, and review of map resources to identify any potential Section 4(f) and Section 6(f) properties in the vicinity of the study alternatives. Metro's regional park database in the Regional Land Information System (RLIS) will also be consulted for parks identification and data. All data collection will be closely coordinated with the historic and visual analyses conducted for this project to determine the relationship of any important historic resources to potentially affected park and recreational resources.

Staff will contact local officials having jurisdiction over the recreational resources to obtain information about the character of the sites. Project staff will contact the OPRD, the Portland Parks and Recreation Bureau, and the Lake Oswego Department of Parks and Recreation to identify park and recreational sites that have received funds through LWCF, LGGP, or COGP and are subject to the protection procedures for each of these programs. The local official having jurisdiction over any park or recreational property will be requested to provide information about the grant and the availability of potential replacement properties meeting the requirements of the respective regulations.

Identified park resources located within 100 feet (or within one block in areas with a defined street grid pattern) of the alternatives will be inventoried and mapped. The inventory will describe type and size of the resource, types and levels of use, access to the resource, and unusual or significant characteristics of the resource.

Existing or planned parks or recreational resources located in the vicinity of the project are listed below, along with the owner(s) of the park or recreational resource. Additional resources may be identified during the technical studies.

- Willamette Greenway (State of Oregon, Metro, City of Portland, City of Lake Oswego)
- Willamette Shoreline Trolley Rail with Trail (Metro)
- Cottonwood Bay (City of Portland)
- Willamette Park (City of Portland)
- Willamette Moorage Park (City of Portland)
- Butterfly Park (City of Portland)
- Powers Marine Park (City of Portland)
- Peter Kerr Property (City of Portland)
- Tryon Creek State Park (State of Oregon)
- Tryon Cove Park (City of Lake Oswego)
- Foothills Park (City of Lake Oswego)
- Kincaid Curlicue Corridor (City of Lake Oswego)

Because no wildlife or waterfowl refuge has been identified in the project area to date, the focus of the Section 4(f) efforts will be on park, recreational, historic, and cultural resources; however, project documentation will include confirmation that no wildlife refuges would be affected by the project. Wetlands and other resources that may provide habitat to sensitive species but that are not managed as "wildlife refuges" as defined by Section 4(f) guidelines will be addressed in the ecosystems section of the EIS.

To address impacts to historic resources under Section 4(f), including any required Section 4(f) evaluations, the analysis will rely on the historical data developed separately for the historic and the archaeological and cultural resources analyses.

6.5 Impact Assessment Analysis Methods

All identified public parks, recreation areas, wildlife and waterfowl refuges, and historic sites will be evaluated for positive and negative direct, indirect and cumulative effects resulting from the project alternatives. Analysis specific to Section 4(f) requirements will include evaluation of each applicable resource to determine whether there would be a "use" of the site by any of the study alternatives. If applicable, the analysis of impacts to wildlife and waterfowl refuges will be coordinated with the analysis conducted for the ecosystems analysis, and possible "use" of historic and cultural resources will be evaluated in conjunction with the Section 106 analysis.

According to 23 CFR 774.17, the "use" of a significant park or recreational land, or historic resource, subject to Section 4(f) provisions, occurs when:

- Land is permanently incorporated into a transportation facility.
- There is a temporary occupancy of land that is adverse in terms of the law's preservationist purposes as determined in 23 CFR 774.13(d).
- There is a constructive use of land as determined by the criteria in 23 CFR 774.15. A constructive use could occur when the "proximity impacts" (such as noise, vibration, visual quality, or access) are so severe such that the Section 4(f) site's vital functions are

substantially impaired. A constructive use requires that the value of the Section 4(f) site's prior significance and enjoyment be substantially reduced or lost, requiring close coordination with the official or officials having jurisdiction.

Although the recommendations of the official having jurisdiction over the Section 4(f) resource substantially informs the process of determining the importance of an impact, or the net effect or magnitude of effect, to a Section 4(f) resource, the ultimate determination will be made by USDOT (FHWA and/or FTA). Also, the net adverse effect may be reduced, and potentially eliminated, through either minimization measures incorporated into the project description or adopted mitigation measures.

The plan and profile drawings of the study alternatives from the definition of alternatives report will be used in conjunction with property boundary maps for the identified resources to determine whether a use of any parkland would be involved. To determine whether there would be a constructive use, the parks analysis will be coordinated with the analyses of noise and vibration, traffic, parking, access, non-motorized use, and the visual impacts. If a use or constructive use of identified parkland would be required with any of the study alternatives, potential avoidance opportunities would be identified. If a conversion of Section 6(f) lands would be required for the project alternatives, other avoidance alternatives would be identified.

The magnitude of adverse effects to parks, recreational (such as trails), and/or historic resources will be determined by evaluating the degree to which the proposed alternatives impact the resources and the related changes in access and enjoyment of the resources. The opinion of the Federal, state, or local official having jurisdiction over ownership and management of the resource is an important consideration. The ultimate determination of magnitude will be made by USDOT (FHWA and/or FTA). Factors to consider would typically include:

- The size of the use relative to the overall size of the resource.
- The type of occupancy; for example, shaving an edge of a property rather than dividing it.
- The effect of removing compared to altering the context surrounding a structure or use area.
- The rate of occupancy of unused or highly used portions of the resource.

Determining whether or not an alternative is feasible and prudent relative to Section 4(f) requirements is a threshold test in itself. An alternative is feasible if it is technically possible to design and build that alternative from an engineering and design standpoint. An alternative may be rejected as not being prudent for any of the following reasons:

- It does not meet the project purpose or need.
- It involves extraordinary operational or safety problems.
- There are unique problems or truly unusual factors present with it.
- It results in unacceptable and severe adverse social, economic or other environmental impacts.
- It would cause extraordinary community disruption.
- It has additional construction costs of an extraordinary magnitude.
- There is an accumulation of factors that collectively, rather than individually, have adverse effects that present unique problems or reach extraordinary magnitudes.

The extent and manner in which impacts to properties subject to the preservationist provisions of Section 4(f)/6(f), LGGP, and/or COGP are identified, evaluated, and reported for this project vary by

extent and type of impact. However, under the requirements of Section 6(f), if any portion of a recreational resource has received LWCF grant support, then, unless the mapping associated with the grant explicitly identifies a limited area of the resource, a conversion of any portion of the entire recreational resource is considered a conversion.

6.6 Mitigation Measures

The Section 4(f) regulations are very specific regarding the order in which steps must be taken before authorizing the use or constructive use of a Section 4(f) property. If a use or constructive use of parkland is identified, alternatives to avoid the use of the Section 4(f) resource must be developed and examined. If no reasonable alternative can be identified, then documentation showing that there is "no prudent or feasible alternative" must be prepared and approved by the DOI. If use of a Section 4(f) resource cannot be avoided for the selected alternative, then, during the FEIS phase, measures to minimize the use must be developed, evaluated, and coordinated with the agency with jurisdiction over the resource.

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.

6.7 Documentation

A. Draft Section 4(f) Report and DEIS

The analysis methods, coordination, data collection, inventory of the existing environment, analysis of potential impacts (or use), and any avoidance recommendations will be summarized in the DEIS.

B. Section 4(f) Documentation

Should any of the proposed alternatives use or have a constructive use of a publicly owned, accessible, and significant park or recreational property, or historic or cultural property subject to the provisions of Section 4(f), then a draft Section 4(f) evaluation will be prepared and focus on comparing the potential Section 4(f) impacts of the various alternatives. The analysis will require data and analysis from the historic and cultural resources results report and will be compiled based on the findings of the parks and recreation, and historic and cultural resources technical reports. Depending on the level of effect, one of two procedures of documentation will need to be prepared, as discussed below.

C. Section 4(f) de Minimis Documentation

Recent revisions to Section 4(f) under Section 6009(a) of the SAFETEA-LU amended existing Section 4(f) procedures to simplify the processing and approval of projects that have only de minimis impacts. The project team will utilize USDOT guidance and standards for assessing and documenting de minimis impacts.

D. Full Section 4(f) Evaluation

A full Section 4(f) evaluation (Evaluation) will be required if the project alternatives would "use" land from a Section 4(f) resource and the de minimis standards do not apply. A Section 4(f)

Evaluation must rigorously document the facts regarding the use or constructive use of all Section 4(f) resources. To the extent needed, coordination with the DOI will be included. Although considered a stand-alone document, the Evaluation will be summarized in the DEIS or as an appendix to the DEIS for the proposed project. A draft Section 4(f) analysis will be done for the DEIS and the final Section 4(f) analysis and documentation will be completed in conjunction with the FEIS. If there are concurrent concerns with respect to Section 6(f) or the state recreation grant provisions, these concerns will also be discussed generally in the Evaluation; however, the "Conversion Requests/Reports" typically needed for a conversion of state recreation grant resources are typically not included with the Section 4(f) Evaluation.

E. Section 6(f) and Other Regulatory Documentation

Should any of the proposed alternatives require conversion of a property having received LWCF, COGP, or LGGP grants, the conversion and replacement review procedures pursuant to the applicable program will be implemented. Typically, the Section 4(f) Evaluation outlines the concerns and procedures, but does not include detailed documentation regarding their implementation, such as property appraisals for the converted and proposed replacement property or properties. Replacement property associated with the affected resources is preferred, although properties serving the equivalent (or higher) recreational function, of at least equivalent fair market value, and located within the same general service area are usually acceptable. Each program's procedures require the following documentation (if one property receives multiple grants, then typically one report suffices for documenting compliance with each program):

- Background
- Prerequisites for consideration of conversion
- Replacement property description (recreational value and fair market value)
- Alternatives considered
- Environmental impacts of requested conversion
- Agencies consulted
- Attachments and appendices, including maps, photos, appraisals, and applicable land use actions

7. GEOLOGY, SOILS AND EARTHQUAKE ANALYSIS METHODS

7.1 Introduction

The purpose of this section is to describe the methodology and data sources that will be used to investigate the existing geologic, hydrogeologic, soil and seismic conditions for the Lake Oswego to Portland Transit Project (Project). Information obtained in this investigation will be used to identify geologic conditions that may affect project design, schedule and costs for the proposed alternatives. The study will also investigate the affect of the project on local geologic conditions.

7.2 Related Laws and Regulations

Laws or regulations pertaining specifically to geology that are applicable to the Project area are addressed through industry practices established by the Oregon Department of Transportation (ODOT) Environmental Procedures Manual (2002). In addition, the Statewide Planning Goal 7, Areas Subject to Natural Hazards, as well as local zoning requirements pertaining to natural hazards related to soils and geology, will be addressed in the Land Use section.

The Farmlands Protection Policy Act (FPPA) of 1981 (7 U.S.C. §§4201 - 4209) protects prime or unique farmlands and soils.

7.3 Contacts, Coordination and Consultation

State and Local agencies and municipalities will be contacted to obtain existing soil and geologic reports and maps along the project alignment. Anticipated contacts include the following:

- Oregon Department of Geology and Mineral Industries (DOGAMI)
- Oregon Department of Transportation (ODOT)
- Multnomah County
- Clackamas County
- The City of Portland
- The City of Lake Oswego

7.4 Data Collection

The primary data source for the analysis will be that collected from existing maps, publications and reports. Anticipated data sources include the following:

- U.S. Army Corps of Engineers (USACE)
- U.S. Geological Survey (USGS)
- U.S. Department of Agriculture (USDA) Soil Conservation Service (SCS)
- Oregon Department of Transportation (ODOT)
- Oregon Department of Geology and Mineral Industries (DOGAMI)
- Oregon Water Resources Department (OWRD)
- Portland State University
- Metro
- City of Portland

- Reports and data developed for and by other local county, city and regional agencies
- Previous data developed by URS within the Project area.

In addition to reviewing this data, personnel will perform field reconnaissance across the project area to identify potential impacts and adverse geologic conditions. Field reconnaissance will be limited to visual observation of the surface conditions along the project alignment. Site-specific subsurface investigation and analyses will not be performed for this analysis. Detailed subsurface investigation is typically performed during preliminary and final design phases of the project.

7.5 Affected Environment Profile

The data collected will range from regional geologic maps to site specific geotechnical investigations providing detailed soil information in localized areas. This data will be reviewed and integrated with field observations to develop a model of the existing geologic conditions for the project area. Included in this model will be data such as predominant soil types, depths to rock, regional groundwater conditions and geologic hazards (such as landslides).

7.6 Impact Assessment Analysis Methods

The soil and geologic conditions of the project area will be evaluated with regard to their affect on the project alternatives. Soil and geologic conditions may affect the cost and feasibility of alternatives. Aspects of the project may also adversely affect the existing geologic conditions. Certain geologic conditions may require mitigation to maintain the safety and integrity of the project.

Existing groundwater conditions will be assessed through hydrogeologic resource studies and review of Willamette River data. The impacts of groundwater on the alternatives (for example, special construction methods may be required where groundwater is near-surface) as well as the affect of the project on groundwater resources (for example, cutting and filling may alter regional groundwater flow patterns) will be investigated.

Seismic hazards will be assessed by review of USGS and DOGAMI publications for the project area. Site ground motions based on USGS probabilistic methods will be determined. Using ground motion data and the geologic model developed for the site, potential seismic hazards such as liquefaction and slope instability will identified. The impact of these hazards with respect to the project will be assessed.

Review of published information and site observations may reveal geologic hazards along the project alignment such as poor soil conditions, landslides, or faults. Potential affects of the hazards to the project will be assessed. For example, project ground modifications may mobilize an existing, dormant landslide.

The direct, indirect, and cumulative effects of the project will be evaluated with regard to the site geologic and hydrogeologic conditions, as well as the seismic and geologic hazards.

7.7 Mitigation Measures

It is anticipated that project impacts will be identified during the completion of the assessment. General mitigation measures will be developed to address these impacts. These measures may range

from avoidance of the impact to engineered modifications to the existing conditions. Mitigation measures will be coordinated with state and local government requirements and with other technical disciplines.

7.8 Documentation

The geology, soils and earthquake analysis will document the existing conditions within the project area, impacts of the study alternatives, potential mitigation measures and information sources used in the assessment. A summary of the analysis will be included in Chapter 3 of the Draft Environmental Impact Statement.

8. ECOSYSTEMS IMPACTS ANALYSIS METHODS

8.1 Introduction

The ecosystems analysis for the Lake Oswego to Portland Transit Project (Project) will focus on identifying and characterizing the biological resources that may be affected by the study alternatives. For the purposes of this analysis, biological resources are categorized as follows:

- Vegetation, including plant species and vegetation communities
- Wildlife, including wildlife species and habitat
- Fisheries resources, including fish species and aquatic and riparian habitats
- Wetlands, including wetland conditions and functional characteristics

Potential ecosystem impacts resulting from the proposed Project will be assessed. The impact assessment will include a determination of significance based on regulatory guidelines, resource agency consultations, and review of locally protected Oregon Statewide Goal 5 inventoried resources and areas scheduled for protection under Title 3 of the Metro Functional Plan. Threatened, endangered, and sensitive (TES) species will be addressed by resource category.

8.2 Related Laws and Regulations

Construction of the Project will be subject to Federal, state, and local regulations designed to protect biological resources. The principal regulations, ordinances, and permit actions that could apply to implementation of the selected alternative are discussed below and summarized in Tables 8-1, 8-2, and 8-3. As Project design progresses, additional regulatory compliance may be required. Additional regulation will be added to tables below as needed.

8.2.1 Federal Regulations

Several Federal regulations apply to the proposed Project, including the National Environmental Policy Act (NEPA), Endangered Species Act (ESA), and Clean Water Act (CWA). NEPA provides an interdisciplinary framework for Federal agencies to evaluate potential impacts resulting from a proposed Federal action. A key component of NEPA is the preparation of an Environmental Impact Statement (EIS) for major actions that may significantly affect the quality of the environment. Detailed descriptions of anticipated environmental impacts resulting from the proposed project, including measures for mitigating adverse impacts will be provided in the EIS.

ESA was designed to protect critically imperiled species from extinction. The Act protects species which are officially listed as "endangered" or "threatened", or areas of designated critical habitat for these species. Regulatory approval for the proposed Project may be required under Section 7 of the ESA. As required by this statute, consultation with National Marine Fisheries Services (NMFS) and U.S. Fish and Wildlife Services (USFWS) will be initiated to identify listed threatened and endangered species and their habitats that could be affected by the study alternatives. It is not anticipated that listed fish species would be adversely affected by proposed crossings of tributaries to the Willamette River, or the location of the proposed alignment parallel to the Willamette River. However, as part of the FEIS, preparation of a Biological Assessment (BA) will likely be required for the Preferred Alternative because of the potential for impacts to Federally listed fish species and/or their habitats located in Tryon Creek. The BA will include an analysis of the alternatives and a

description of all potential impacts to listed species and Essential Fish Habitat (EFH) under the Magnuson-Stevens Fishery Conservation Management Act (MSA). A finding of effect on the species and its critical habitat will be presented for approval by NMFS and USFWS.

The CWA protects the physical, chemical, and biological integrity of the nation's jurisdictional waters. Section 401 of the CWA authorizes the Environmental Protection Agency (EPA) to review Federal actions for potential water quality impacts. Federal actions must receive Section 401 water quality certification. In Oregon this responsibility is delegated to the Oregon Department of Environmental Quality (DEQ).

Section 404 of the CWA regulates the discharge of dredged or fill materials into "waters of the U.S." (waters). Because the proposed alignment and alternatives are located adjacent to the Willamette River and cross several of its tributaries, non-wetland waters could be affected. Section 404 is regulated by the U.S. Army Corps of Engineers (USACE) for most projects on non-tribal lands in Oregon. Applicants desiring a Department of the Army CWA Section 404 permit must demonstrate that all impacts to waters have been avoided to the maximum extent practicable and that unavoidable impacts are compensated for. Section 404(b)(1) guidelines state that an alternatives analysis must be prepared to demonstrate that the development footprint reduced impacts to the maximum extent practicable. This analysis must present alternatives in a comparative fashion to ensure that proposed activities would cause minimal effects to the environment. In general, projects required to complete an EIS fulfill this requirement through the NEPA process.

Table 8-1
Summary of Potential Federal Natural Resource Permitting Requirements

Regulation/Permit	Responsible Agency	Resource Studies	Regulated Biological Resources
National Environmental Policy Act (NEPA)	Federal Transit Administration (FTA)	NEPA EIS addressing natural resource conditions, impacts, and mitigation	Vegetation, wildlife, and fisheries
Clean Water Act (CWA) Section 404	U.S. Army Corp of Engineers (USACE) for discharge of fill material; U.S. Environmental Protection Agency (EPA) for water quality certification	Delineate and evaluate physical, chemical, and biological impacts to Waters of the US	Waters of the US, including wetlands
Rivers and Harbors Act Section 10	U.S. Army Corp of Engineers (USACE)	Ordinary High Water Line Boundary for River	Navigable Waters of the US, including Willamette River
USACE EC116-2-211	U.S. Army Corp of Engineers (USACE)	Water Resources Policies and Authorities Incorporating Sea-Level Change Considerations in Civil Work Programs	Project areas that may become vulnerable or affected by increasing sea levels and tidal shifts
Endangered Species Act (ESA)	National Marine Fisheries Service (NMFS); U.S. Fish and Wildlife Service (USFWS)	Biological Assessment (BA) addressing project impacts to listed species, species proposed for listing, and candidate species	Vegetation, wildlife, and Fisheries
Fish and Wildlife Coordination Act	USFWS, NMFS, and ODFW	Agency consultation, identify impacts to fish and wildlife resources, and recommend mitigation	Vegetation, wildlife, and fisheries
Migratory Bird Treaty Act (MBTA)	USFWS	Identify impacts to migratory birds	Wildlife

In Oregon, wetland impact review is a coordinated process where the Oregon Department of State Lands (DSL) provides wetland boundary concurrence, which the USACE uses to process permit applications. Wetland permit applications are jointly filed with the USACE and the DSL. Issuance of a CWA Section 404 permit is a Federal action. As such an application for regulated wetland impacts will trigger the following Federal coordination:

- ESA review by the USFWS and NMFS;
- CWA 401 Water Quality Certification from the Oregon Department of Environmental Quality (DEQ); and
- Clearance from the State Historic Preservation Office (SHPO).

These Federal reviews will be handled through the NEPA process by the FTA, which is the lead Federal agency for the Project.

8.2.2 State Regulations

The proposed Project would be required to comply with several Oregon State natural resource regulations, including CWA Section 401, Water Quality Certification, the Oregon Removal - Fill Law, and Oregon State ESA. Section 401 Water Quality Certification is administered by DEQ and will be required to ensure compliance with water quality standards. Section 404 is triggered by review for Section 401 Water Quality Certification.

The Oregon Removal - Fill Law requires a permit for any removal or fill activities within Essential Salmonid Habitat (ESH) or activities involving 50 cubic yards or more of disturbance in any other waters of the state (including wetlands). The Willamette River and many of its tributaries are considered ESH. Removal Fill permit applications are filed concurrently with CWA Section 404 permit applications using the Joint Permit Application (JPA). The DSL review of the joint application includes consultation with the Oregon Department of Fish and Wildlife (ODFW), DEQ, the Department of Land Conservation and Development (DLCD), the City of Portland, and the City of Lake Oswego.

Table 8-2
Summary of Potential State Natural Resource Permitting Requirements

Regulation/Permit	Responsible Agency	Resource Studies	Regulated Biological Resources
Oregon State ESA	Oregon Department of Fish and Wildlife and Oregon Department of Agriculture (ODA)	Identify project impacts to state-listed and candidate species	Vegetation, wildlife, and Fisheries
CWA Section 401 Water Quality certification	Oregon Department of Environmental Quality (DEQ); delegated by the U.S. Environmental Protection Agency (EPA)	Assess project compliance with state water quality Standards	Rivers, streams, and other waters
Oregon Removal-Fill Law	Oregon Department of State Lands	Wetland/ waterway boundary delineation, and assessment of impacts to regulated waters in terms of area and function	Wetland and other waters of the state

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, implement research and conservation programs for plant and animal species under the auspices of the Federal ESA. The Oregon Natural Heritage Program (ONHP) plays a similar role in conservation efforts for invertebrate species. Federal ESA Section 7 consultation with the USFWS and NMFS includes consultation with ODFW if there is potential for impacts to listed fish species, and with ODA if the potential for impacts to listed plant species are identified.

8.2.3 Local Regulations

Under Oregon land use regulations, local and state jurisdictions are required to compile inventories of wetland and natural areas and protect the highest-ranking inventoried sites. Within the project corridor, this protection is provided by DSL through its Lower Willamette River Management Plan and by the City of Portland through its Environmental Overlay Zone and Willamette River Greenway Overlay Zone. Additional protection is provided through Clackamas County's setback requirements for buildings and structures along rivers or perennial streambeds. Additional environmental protection is afforded by Title 3 of Metro's Urban Growth Management Functional Plan. Compliance with Title 3 by city and county jurisdictions can be accomplished by adopting Metro's Water Quality and Floodplain Management Model Ordinance, or by demonstrating that plans and local implementing ordinances comply with Title 3 performance standards for flood protection and management.

The City of Portland (COP) regulates wetland buffers for wetlands that have been identified within a mapped environmental zone overlay. This includes most of the prominent, large, high-quality wetlands within the City. If a project is not exempt from environmental zoning regulations (COP Code Section 33.430.080) and/or the project does not meet the City's development standards (COP Code Section 33.430.140 through .190), environmental review and mitigation will be required by the City, which may include buffer mitigation. When necessary, mitigation site plans must demonstrate functional replacement of wetland/buffer resources within the same watershed as the affected environmental zone. Mitigation must occur on land that is owned by the project proponent.

The City of Lake Oswego regulates environmentally significant wetlands, stream corridors, and associated applicable buffers under Section 50.16 of the City Code. This section of code creates Resource Protection (RP) and Resource Conservation (RC) Overlay Districts. These overlay districts are shown on the Sensitive Land Atlas. Generally the significant wetlands and streams are designated RP and the surrounding buffers are designated RC. All wetlands and waterway resources identified within a property that are not already noted in the Sensitive Lands Atlas are subject to ranking and evaluation by the City to determine, through an Economic, Social, Environmental, and Energy (ESEE) analysis, if the resources merit RC or RP designation. All wetlands include "RC" buffer areas, which have widths that are defined as follows:

Buffer = 30ft:

- Class I Wetlands
- Class I Stream Corridors
- Class II Wetlands abutting Class I Stream Corridors

Buffer = 25 feet:

- Other Class II Wetlands

- Class II Stream Corridors

Buffer widths may be reduced if a qualified professional can demonstrate that doing so will not affect the functionality of the buffer in relation to the protected resource.

Table 8-3
Summary of Potential Local Natural Resource Permitting Requirements

Regulation/Permit	Responsible Agency	Resource Studies	Regulated Biological Resources
Portland Greenway Permit	City of Portland	Evaluation of impacts to native vegetation; mitigation or preservation of native vegetation	Vegetation, wildlife, and fisheries
Environmental Zone Overlay Districts	City of Lake Oswego	Identification and evaluation of impacts to wetlands or waters, including associated buffers identified in a zoning overlay district	Vegetation, wildlife, waters, wetlands, and fisheries; may include buffers
Environmental Zone Overlay	City of Portland	Identification and evaluation of impacts to wetlands or waters, including associated buffers identified in an environmental overlay zone	Vegetation, wildlife, waters, wetlands, and fisheries; may include buffers
Metro Functional Plan – Title 3	Metro	Evaluation of impacts on water quality, flood management, fish, and wildlife	Vegetation, wildlife, and fisheries

8.3 Contacts, Coordination, and Consultation

Coordination with resource and governmental agencies has been, and will continue to be, essential for obtaining regulatory approval of the project. Federal, state, and local agencies will be contacted regarding natural resources issues in the potentially affected area in accordance with the Project's *SAFTEA-LU 6002 Coordination Plan*.

8.4 Data Collection and Establishing the Affected Environment

For the purpose of this analysis the potentially affected area is limited to the existing right-of-way (ROW) for wetlands and botanical resources. The potentially affected area for wildlife and fisheries includes all areas of suitable habitat along the existing right-of-way. If other alternatives or design options are included the area of potential impact will need to be expanded. Additionally, the "action area" will be identified as it relates to critical habitat and fish species through the consultation process with NMFS.

8.4.1 Review of Existing Information

Prior to conducting field studies, background 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:

- ONHIC database
- Willamette River Greenway Plan
- Oregon Department of Forestry (ODF) fish presence maps

- StreamNet Interactive Mapper
- Lower Willamette River Management Plan
- Lower Willamette River Wildlife Habitat Inventory
- COP Environmental Zone Overlay
- COP Greenway Plan
- City of Lake Oswego Goal 5 Natural Resource Inventory
- City of Lake Oswego Natural Resources Overlay Zone
- Metro Functional Plan Title 3 Water Quality and Floodplain Management Model Ordinance
- Metro's Regional Land Information System (RLIS) database
- Metro's Greenspaces Natural Resources Inventory
- Recent color and historic aerial photographs
- ODOT BA for Highway 43 (Tryon Creek crossing)
- ODFW Fish passage data for Tryon Creek
- Local Wetland Inventories (LWI) maps (if available)
- National Wetlands Inventory (NWI) maps
- Soil Conservation Service (SCS) soil surveys

Previous studies and reports will also be reviewed, including environmental documents prepared for NEPA review, 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 included in the references section of the technical memorandum.

ODFW has conducted considerable research on fish species present in the lower Willamette River and Tryon Creek, including potential effects resulting from shoreline development. Consultation with local ODFW biologists and a review of available information on fish use in tributary streams will greatly assist in the identification of potential impacts to these resources.

Aerial photography and existing GIS datasets (Metro, SSCGIS) will be used to determine the spatial extent of riparian vegetation, commercial and residential development, and other attributes that contribute to the ecological health of waterways located within the Project area.

8.4.2 Vegetation and Wildlife Habitat Surveys

Field evaluations for vegetation and wildlife will be conducted in the vicinity of the study alternatives. A map of vegetation types within the potentially affected area will be prepared using aerial photographs, NWI maps, and existing vegetation maps. Vegetation polygons will be classified by type using accepted classification systems for wetland and upland habitats. Upland vegetation will be classified using methods described in Johnson and O'Neil (2001). Final maps will indicate locations and aerial extent of vegetation types, sensitive plant associations, important wildlife habitat, and other key ecological features. Vegetation polygons will be field-verified during reconnaissance-level field surveys.

More detailed surveys will be conducted in sensitive habitats, or where potential to impact TES species exists. Surveys will include collecting data on plant species composition, habitat quality, and structure of vegetation communities. Assessment of habitat quality will include consideration of such factors as native species composition, past disturbance, edge effect, and degree of fragmentation and

isolation. The relative function of each plant community in providing a habitat to wildlife will also be evaluated. Finally, a list of observed and expected wildlife species will be compiled.

Sensitive plant surveys will be conducted during the blooming period to ensure positive identification. The blooming period for all species with potential to inhabit the project footprint coincides with the month of June, which is when botanical surveys will occur. The BLM "intuitive controlled" survey method will be used. This method consists of two or more botanists forming a search line. Botanists will walk parallel to each other at distances determined by the size of the target species and the height and density of the surrounding vegetation. More intensive survey focus will occur in areas with known listed plant populations nearby or where appropriate special status plant habitat is observed, such as near Elk Rock.

Noxious weeds will be recorded during all ground surveys. Isolated populations of noxious weeds will be mapped where observed using GPS and the relative abundance and size of the infestation will be recorded. Where noxious weeds are widespread throughout the corridor, they will not be mapped, but rather described in the analysis narrative.

When practicable, surveys for plant species will be conducted in conjunction with vegetation mapping and wetland determinations.

8.4.3 Threatened and Endangered Species (TES) Surveys

A. Plants

Approximate population sizes of TES plant species within the ROW will be determined during field surveys. Impacts will be assessed by determining direct losses to those populations, and potential indirect effects resulting from construction and operation of the proposed Project. 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.

B. Wildlife

Impact assessments for potentially occurring TES wildlife species will be based primarily on determining project effects to suitable breeding and foraging habitat. Direct habitat loss and short and/or long-term impacts to habitat quality resulting from construction and operation of the proposed Project will be assessed. 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 positive sightings (i.e. ORNHIC database), habitat suitability, and consultation with resource agencies.

Although not listed under the ESA, the bald eagle remains protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Protection Act. Under both laws, the disturbance of eagles, their nests, and eggs is prohibited. On June 5, 2007, the USFWS issued the Bald Eagle Management Guidelines, which clarified its regulations regarding implementation of the Bald and Golden Eagle Protection Act. Consequently, a pre-field review for the bald eagle will be conducted including database searches, discussions with local experts, and an assessment of habitat within the vicinity of the proposed Project. Potential to harm individual birds at any life stage will also be evaluated. Impacts on breeding and foraging success will include an assessment of existing and

predicted levels of noise, light, vibration, and human activity during project construction and operation.

Surveys for TES wildlife species will be conducted in conjunction with wildlife habitat assessments. Surveys will focus on the field habitat assessment to predict the likelihood of TES species occurrence within the potentially affected area. Focused surveys for specific TES species will only be conducted where habitat is observed that meets the habitat requirements of one or more TES species. Results of these surveys will be used to supplement information obtained from resource agencies and existing data.

8.4.4 Fisheries

Existing conditions of all watercourses potentially impacted by the study alternatives will be assessed. Field reconnaissance will focus on characterizing stream corridors, including descriptions of riparian vegetation, stream bank 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. Finally, fish usage data will be recorded. Potential fish usage will be estimated through existing distribution information, specific habitat features (e.g., spawning habitats), and by the identification of fish barriers or other physical factors that might be limiting use by particular species.

A. TES Fish

Because fishery resources of the lower Willamette River and Tryon Creek have been studied extensively, consultation with resource agencies and a review of existing information will provide the necessary information regarding 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 to determine the likelihood that TES species occur in the potentially affected area.

8.4.6 Wetland and Waterway Assessment

URS will conduct wetland delineations using the Routine Approach, as described in the 1987 USACE Wetlands Delineation Manual and amended by the Interim Western Mountains, Valleys, and Coast regional supplement (2008). The study area contains several known small stream crossings that are mostly contained in culverts within Willamette Shore Line Consortium right-of-way. URS will survey culvert inlets and outlets, where access is provided, to establish the location of waters where they pass beneath the study area. Where waters are observed out of culvert, they will be delineated along their ordinary high water line. Where dry channels are observed they will be delineated if they demonstrate presence of bed and banks or evidence of prolonged flow (scour marks). Linear depressions abound along the edges of railroad tracks; minor linear depressions at the base of the railroad embankment that lack water presence, bed and banks, or scour marks will not be delineated.

The approximate boundary of all wetlands and waters will be hand-drawn on field maps and surveyed using GPS survey equipment with sub-meter positional accuracy. If GPS reception is unavailable, hand drawn mapping will be digitized into a GIS and refined using topographic LIDAR data. A statement of accuracy will be placed on all wetland delineation figures to indicate the level of survey accuracy.

In addition to delineating wetland boundaries, URS will collect information needed to establish jurisdictional criteria. Wetlands that are exempt from Federal jurisdiction (as per the December 2, 2008 revised CWA jurisdictional guidance from the U.S. Environmental Protection Agency (EPA)) include isolated wetlands that are not connected to jurisdictional waters by a relatively permanent tributary and have no other significant nexus. Such wetlands may be state jurisdictional, however. Wetlands that are exempt from state jurisdiction include artificial wetlands under 1 acre. These include road- or rail-side ditches less than 10 feet wide created from uplands for the purpose of conveying drainage. In order to assess the likelihood of state and Federal jurisdiction, URS will collect key data for each wetland (or group of small wetlands in mosaic situations) in an attempt to determine the following:

- Does the feature appear to meet the definition of a wetland (dominance of hydrophytic vegetation, hydric soil criteria, and wetland hydrology criteria)?
- Is the wetland isolated from other waters?
- Was the wetland artificially created from upland?
- Does the drainage feature meet the definition of a stream channel? If so, does the stream exhibit indicators of perennial, intermittent, or ephemeral flow?

In the event that a wetland is likely to be impacted by the project, URS will assess wetland functions for that wetland using the *Guidebook for Hydrogeomorphic (HGM)–based Assessment of Oregon Wetland and Riparian Sites. I. Willamette Valley Ecoregion, Riverine Impounding and Slope/Flats Subclasses. Volume IA: Assessment Methods* (Adamus and Fields 2001).

8.5 Impact Assessment Analysis Methods

The analysis will evaluate direct, indirect and cumulative effects of the project alternatives. It will address several areas as defined below.

A. Vegetation, Wildlife, and Fisheries (including TES)

The study alternatives will be assessed for both long-term (permanent) and short-term (temporary) effects to biological resources. 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. Potential cumulative impacts to biological resources resulting from the project alternatives will also be addressed qualitatively. Implementation of Project Alternatives could have both positive and negative effects on biological resources by supporting growth management policies which 1) limit growth outside of the urban boundaries, and 2) accommodating more growth in the vicinity of the system.

B. Wetlands/Waters

Impacts to wetlands will be evaluated by overlaying the proposed alternative development footprints on the delineated wetland and waterway polygons. After establishing the area of wetland impact, a wetland ecologist will consult with the project engineers to determine if any additional impact

avoidance or minimization opportunities exist. In addition to calculating impacted wetland acreage, URS will assess wetland functions impacted by the project and will also consider indirect impacts associated with long-term operational and short-term construction-related impacts. The wetland impacts resulting from each alternative will be compared in tabular form and discussed in the analysis.

8.5.1 Development of Significance Criteria

The finding of significance for impacts to biological resources will be based upon criteria outlined in NEPA (40 CFR 1508.27) guidelines, evaluation of technical data, consultation with resource agencies, and professional judgment and experience. Consideration will also be given to input from the affected public, including the degree to which the significance of an activity may vary with setting, severity, duration, and likelihood of the impact. However, the primary criteria for determining significance of impacts to biological resources will be the sensitivity rating or status assigned to the resource by Federal, state, and local agencies. For instance, impacts to the habitat of Federally listed species may be considered of higher significance than impacts to locally sensitive species' habitat. Although an indirect measure of biological rarity, status generally reflects the biological vulnerability of species (or habitats) by considering such factors as geographical distribution, remaining population size, reproductive success, distribution and status of its habitat, and threats of elimination.

A. Vegetation and Wildlife

Project impacts to vegetation, wildlife, and wildlife habitats will be determined by calculating the amount (i.e., acreage) of each vegetation type removed by each Project alternative. A qualitative assessment of impacts will also be conducted by considering the following factors:

- 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 pre-and post-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. Potential impacts to vegetation and wildlife will be assessed using information presented in the water quality and hydrology analysis for this project. The analysis will also determine the potential for direct impacts to vegetation due to increases in soil erosion and streambed scouring (e.g., uprooting of trees, shrubs, etc.). Essentially, an interdisciplinary process will be used.

B. Fisheries

The proposed Project alternatives cross the several tributaries to the Willamette River, all designated as critical habitat under the ESA. Through coordination with NMFS, proposed activities within the designated critical habitat for the salmon will be assessed to determine potential impacts to the habitat and fish runs under the Federal ESA. TES fish species and species protected under the MSA 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.

C. Wetlands and Other Waters

In addition to the development of significance criteria as per the NEPA guidelines, wetland impacts will be considered "significant" if locally-defined significant wetlands are impacted. The City of Portland and the City of Lake Oswego both regulate locally significant wetlands and other waters through their local zoning and comprehensive plans. The City of Lake Oswego regulates environmentally significant wetlands, stream corridors, and associated applicable buffers under Section 50.16 of the City code. These significant waters are shown as overlay districts on the City's Sensitive Land Atlas. The City of Portland (COP) regulates wetland buffers for locally significant wetlands that have been identified and mapped as an environmental zone overlay. In general, locally significant wetlands and waters include most of the prominent, large, high-quality wetlands and perennial rivers/streams within the Cities.

For wetlands, in cases where the project results in indirect impacts, minor direct impacts, temporary impacts, or buffer impacts only, the impact will not be considered "significant" if it does not change the functional performance of the wetland as per the results of a reference-based wetland functions assessment.

8.6 Mitigation Measures

Incorporation of mitigation into project designs to reduce or eliminate adverse project impacts to resources of concern is an important component of the NEPA analysis. General mitigation measures will be evaluated and include the following:

- Avoidance of the impact
- Minimizing the impact
- Rectifying the impact
- Reducing or eliminating the impact
- Compensating for the impact with substitute resources or environments

The degree to which one or more of these measures is incorporated into the selected alternative will depend on the level of impact and the mitigation standards required to meet permit requirements.

8.6.1 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:

- Reducing habitat fragmentation and maintaining wildlife travel routes.
- Screening sensitive habitats from project view and noise.
- Enhancing vegetation associated with wetlands and water courses used by wildlife.

8.6.2 Fisheries

The proposed project is not likely to result in direct effects to the Willamette River. However Willamette River tributary streams may be impacted to varying degrees depending on specific design and alignment decisions.

Potential impacts to aquatic ecosystems include:

- Water quality degradation
- Temporary reduction in fish passage
- Altered predator/prey relations
- Habitat disturbance
- Temporary degradation of riparian zone

Stream crossing methods and mitigation will be designed to offset potential impacts identified in the analysis. Potential approaches for addressing these concerns include:

- Using existing crossing structures to avoid in-water work.
- Placing piers outside of the channel's OHW elevation or in deep water areas to avoid impacts to migration, spawning, and/or juvenile rearing habitat if bridge or culvert replacement is required.
- Isolating pier construction activities from the in-water environment and/or using construction techniques to avoid water quality impacts.
- Limiting in-water construction to designated fisheries' windows.
- Where feasible, using high bridge designs to minimize shading.
- Using streamlined pier designs to minimize hydraulic impacts and minimize opportunities for increased predation.
- Limiting removal of riparian vegetation and restoring/replanting all areas temporarily disturbed during construction.

8.6.3 Wetlands

If wetland impacts are unavoidable, conceptual mitigation measures will be provided to describe how wetland acres and functions can be compensated to result in no net loss of either. Compensatory mitigation opportunities will be ranked according to preference by the USACE as per the Wetlands Mitigation Final Rule established by the USACE and EPA in the Federal Register on March 4, 2008. This rule expresses a preference for mitigation provided by a certified wetland mitigation bank followed by a preference for in-lieu fee mitigation, with permittee-responsible mitigation being the least desirable option. Wetland mitigation will be coordinated with other ecosystem or water quality/hydrology mitigation planning, as practicable; to minimize mitigation costs and to incorporate a watershed- based assessment of mitigation options.

8.7 Documentation

The results of the ecosystems analysis will be summarized and documented in the DEIS. A supporting technical memorandum will provide additional documentation as necessary on the existing environment, the expected impacts of the study alternatives, and potential mitigation measures. The analysis of potential impacts to listed fish species, and species protected under the Magnuson-Stevens Fisheries Conservation Management Act, and their habitats will be documented in a draft BA and submitted to the appropriate resource agencies after the selection of a preferred

alternative. Although not anticipated, if any proposed or candidate species that may occur in the project area are designated, an assessment of impacts to these species also will be included in the draft BA. The draft BA will evaluate the best available design information to determine potential impacts of each relevant alternative or option to TES species and discuss measures to avoid or reduce impacts. These evaluations will be coordinated with NMFS and USFWS to assure completeness and accuracy and to receive input about any additional information required for preparation of a final BA and completion of Section 7 ESA Consultation.

Wetland and waterway boundaries within the existing and proposed ROW along the study alternatives will be documented in a wetland delineation report. The delineation report will be submitted to DSL and USACE for boundary concurrence and jurisdictional determination. If unavoidable wetland and/or waterway impacts are identified in the analysis, wetland functions will be assessed and documented in a wetland functional assessment report and a conceptual mitigation plan will be prepared. These documents will be summarized in the Wetland/Waterway Technical Memorandum in support of the DEIS and will be used to supplement a complete JPA.

9. HYDROLOGY AND WATER QUALITY ANALYSIS METHODS

9.1 Introduction

The Lake Oswego to Portland Transit Project may affect rivers and streams through stormwater hydrology, floodplains, and water quality impacts. The stormwater hydrology, floodplain, and water quality analysis will be included in the Draft Environmental Impact Statement (DEIS) for the Lake Oswego to Portland Transit Project. The DEIS will highlight project alternatives that will be described and compared on the basis of their potential adverse and beneficial impacts. The alternatives will be compared and ranked to identify the least environmentally damaging alternative for each corridor segment. This portion of the study will deal with impacts associated with stormwater hydrology, floodplains, and water quality.

9.2 Related Laws and Regulations

9.2.1 Hydrology

Development can affect the amount and timing of runoff that leaves a site during a storm. The peak runoff rate and volume of stormwater discharges typically increase when construction removes vegetation, compacts soils, and/or covers portions of a site with buildings or pavement. Such changes: 1) reduce the precipitation intercepted by vegetation and infiltrated into the ground, thereby increasing runoff volume; and 2) reduce the effective time of concentration (Tc) of runoff from a site by collecting rain and runoff more efficiently with pavement and storm sewers. As a result, peak discharge rates increase, increasing the possibility of flooding if the capacities of downstream storm drainage system components (pipes, streams, or bridges) become constrained. Regulations are in place in order to negate these types of effects.

Hydrology and water quantity are primarily regulated locally. The City of Lake Oswego, City of Portland, and Clackamas County regulate water quantity for new and re-development through development standards by setting detention and flow reduction requirements to meet pre-development conditions for specified rain events.

The following Federal laws, state statutes, local ordinances, and guidance standards address hydrology issues associated with development:

- National Environmental Policy Act (NEPA)
- Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System
- (NPDES) Permit Regulations
- National Marine Fisheries Service (NMFS) stormwater guidance standards
- Presidential Executive Order 11990
- Oregon Administrative Rules 340-41
- Metro Regulations - Title 3: Water Quality and Flood Management Conservation
- City of Portland Stormwater, Development, and Erosion Control ordinances (City of Portland
- Code Titles 10 and 33)
- Local overlay districts, e.g., the City of Portland's Environmental Zones (E-zones) (CPC Title
- 3.430)
- City of Lake Oswego City Development Code

- Clackamas County Stormwater Rules and Regulations

Local stormwater regulations relating to hydrology and water quantity are summarized in Table 9-2 at the end of this section.

9.2.2 Floodplains

Federal, state, and local regulations establish standards for floodplain regulation. In general, established standards are to: 1) prevent flooding conditions from worsening due to new development and floodplain encroachment, and 2) to protect new facilities located in the floodplain from damage. These regulations are administered through state and local agencies. Where floodplain impacts are expected to occur, projects must compensate for encroachments by providing floodplain storage equivalent to that lost. Facilities constructed in the floodplain must be flood-proofed to prevent damage during flood events.

The following Federal and local regulations relate to flooding issues:

- U.S. Coast Guard Section 9
- National Flood Insurance Act
- Flood Disaster Protection Act
- National Environmental Policy Act (NEPA)
- Presidential Executive Order 11990
- U.S. Code of Federal Regulations, Title 33, Section 208.10
- Metro Regulations - Title 3: Water Quality and Flood Management Conservation
- Clackamas County Floodplain Regulations
- Multnomah County Floodplain Regulations
- City of Lake Oswego Community Development Code
- City of Portland Regulations, including the City's E-zones (CPC Title 33.430)

Local stormwater regulations relating to floodplains are summarized in Table 9-2 at the end of this section.

9.2.3 Water Quality

Water quality problems are typically related either to conventional pollutants or to nutrients. Conventional pollutants include suspended solids, metals, oil and grease, not usually found in a dissolved state and turbidity. Nutrient pollutants include phosphorus, nitrogen, metals, and organics found in a dissolved state. Typical pollutants are described in Table 9-1.

The following Federal laws, state statutes, local ordinances, and guidance standards address water quality issues:

- NEPA
- Section 402 of the Clean Water Act (CWA), National Pollutant Discharge Elimination System (NPDES) Permit Regulations (40 Code of Federal Regulations (CFR) 124)
- Section 401 of the CWA, State Water Quality Certification
- Safe Drinking Water Act of 1974, as amended, 42 United States Code (USC) 300f

- NMFS water quality guidance standards
- Oregon Revised Statutes (ORS), "Water Quality," ORS 468B
- Oregon Administrative Rules (OAR), "Department of Environmental Quality: Regulations Pertaining to NPDES and WPCF Permits," OAR 340-045-0005 to 340-045-0080
- OAR, "Water Quality Standards: Beneficial Uses, Policies, and Criteria for Oregon," OAR 340-41
- Metro Regulations – Title 3: Water Quality and Flood Management Conservation (Draft)
- Clackamas County Water Quality Rules and Regulations
- Multnomah County Stormwater Regulations
- City of Lake Oswego Stormwater Regulations
- City of Portland Stormwater, Development, and Erosion Control ordinances (City of Portland Code Titles 10 and 33)

Table 9-1
Typical Sources and Problems Associated with Urban Stormwater Pollutants

Contaminants of Concern	Common Sources	Known Problems
Oil and grease	Primarily from automotive and heavy industrial sources.	Hazardous to fish and wildlife, aesthetic degradation, may be associated with noxious odors and toxic chemicals.
Nutrients	Phosphorous and nitrogen occur naturally in eroded soil. Anthropogenic sources include fertilizers, detergents, and mulch.	The principle nutrients are phosphorous and nitrogen. Releases of these elements, the availability of which is limited in aquatic environments, can cause algal blooms and other problems.
Oxygen-demanding organics	Natural organics washed from paved areas.	Can cause O2 depletion when decomposed through bacterial action.
Toxic organics	Examples of toxic organics include pesticides, phenols, and PAHs.	In the greater Seattle area, EPA found 19 of 121 priority pollutants in stormwater runoff.
Metals	Concentrations of lead, zinc, cadmium, and copper primarily from automotive and industrial sources.	Toxic to aquatic and benthic organisms.
Bacteria and viruses	Fecal coliform from failing septic leaching systems, pet wastes, municipal system overflows, and other non-point sources.	Impacts to shellfish (harvest closures) and beneficial uses (e.g., restriction of recreation).
Eroded soil	Streets and construction sites.	Sediments in stormwater can smother habitat.

EPA's stormwater requirements have been promulgated as part of the CWA and the NPDES program. In most areas, including Oregon, the NPDES program implementation has been transferred to state environmental agencies. Under the NPDES program, permits are issued by the state agencies for various categories of industrial activities. Generally, these activities pertain to specific classes of operations, such as industrial sites, commercial land use, transportation, and residential uses. Best management practices (BMPs) must be implemented on each site where such activities take place.

Currently, the City of Portland, Multnomah County, Clackamas County, and the City of Lake Oswego have NPDES General Stormwater Permits. These permits require implementation of BMPs to control stormwater quality and quantity as a result of new development in the urban environment. At this time, there are no numerical performance criteria that are required to be met with these permits. However, the lower Willamette River is listed on the current 303(d) list by Oregon Department of Environmental Quality (ODEQ) as water-quality limited for several constituents and has also been issued a TMDL for bacteria, mercury, and temperature. For this reason, the jurisdictions listed above have set specific goals for pollutant removal efficiency of selected BMPs,

Table 9-2
Summary of Local Regulations Affecting Hydrology, Floodplains, and Water Quality

Local Jurisdiction	Water Quantity Regulations	Floodplain Regulations	Water Quality Regulations
Clackamas County Service District #1	Stormwater quantity control facilities must be designed to limit peak rates as follows: 1) post development (post) 25-year discharges to less than or equal to the peak rate of the predevelopment (pre) 5-year storm event, 2) Post 2-year discharges less than or equal to half the 2-year pre-event, and 3) stormwater and roof drains cannot be discharged directly to streams without approval of the district. Clackamas County has generally adopted the King County Surface Water Design Manual (1990) for all other standards dealing with the selection and design of stormwater quantity controls.	The FEMA 1-ft regulatory floodplain standard has been adopted. Floodplain fills require compensatory volume to be provided at the same elevation.	No person may discharge any quantity of stormwater or pollutant that will violate a discharger's permit, the District's NPDES permit or any water quality standard. Non-single-family development must provide an approved water quality facility prior to discharge from a site. Erosion control measures are required during all construction and site disturbance activities and until permanent ground covers are installed. Additional ground cover controls are required between October 1 and April 30 each year. Erosion control must be designed so no visible or measurable erosion leaves the property during construction. The treatment design storm is listed as 2/3 of the 2-year, 24-hour storm.
Metro		Title 3 standards apply to new development. New development is prohibited within flood management areas to the maximum extent possible. Limited development may occur if excavation and fill is performed in a manner to maintain or increase flood storage and does not increase flood elevations. Flood Hazard Areas include: 1) areas within the FEMA 100-year floodplain, and 2) other areas inundated in the February 1996 flood event.	Title 3 standards are intended to protect water quality associated with beneficial uses as defined by Oregon Water Resources Department (OWRD) and Oregon Department of Environmental Quality (ODEQ). The current version of Title 3 requires: (1) erosion and sediment control for all new development to a "no visible" and measurable standard, (2) reservation of native vegetation, and (3) no use of hazardous materials in uncontained areas. Water Quality Resource Areas include areas: (1) along perennial streams and streams draining > 100 acres - min. 50' from top of bank or 200' from top of bank on long steep slopes (25% or greater) or an intermediate distance on shorter (150 sq. ft.) steep slopes, (2) along intermittent streams draining 50 to 100 acres - 15' from top of bank or 50' from top of bank on steep slopes, and (3) 50' from the edge of wetlands or 200' from the edge of wetlands bordered by steep slopes.
City of Lake Oswego	The City Of Lake Oswego Development Code Article 50.41 specifies that sufficient storm water detention shall be provided to maintain runoff rates at their natural undeveloped levels for all anticipated intensities and durations of rainfall and provide necessary detention to accomplish this requirement. Detention volume shall be the maximum difference between: a. The storm water runoff produced from the proposed development site by a 50 year storm, and b. The storm water runoff produced from the pre-development site area by a 10 year storm. Development shall be conducted in such a manner that alterations of drainage patterns (streams, ditches, swales, and surface runoff) do not adversely affect other properties.	The City administers the NFIP program. This includes the administration of the City's floodplain ordinance, which insures that any building in the floodway will not cause a rise in the water surface elevations during the base flood event.	The City of Lake Oswego Surface Water Management Design Manual has specified, depending on the type of water quality facility, a standard of removal of up to 65 percent of the phosphorous from 100 percent of the "newly constructed impervious surface." The treatment design storm is listed as 0.36 inches of precipitation falling in 4 hours.
City of Portland	In areas with combined sewers, as much runoff as possible must be controlled on-site, where soils permit. Onsite flow control must maintain post-development peak flows at magnitudes associated with undeveloped land for the 2- year, 5-year and 10-year events with limited exceptions.	Encroachments into the floodway by development and structures defined in 24.50.020 are prohibited unless technical analysis shows that the development will not result in an increase in the base flood elevation. The minimum width of the floodway must be 15 ft.	According to NPDES permit, 80 percent of total suspended solids (TSS) must be removed from 1/3 of the 2-year storm. Construction projects that will modify drainage facilities must include a plan to control erosion and sedimentation during construction and to permanently stabilize soils disturbed during construction.

or water quality treatment criteria as outlined in Table 9-2. These standards can be used as guidance for measuring potential impacts and selecting mitigation methods and criteria.

For construction activities that would disturb one acre of land or more, other NPDES permits are required for the construction phase. It is anticipated that NPDES permits from Oregon agencies will be required for the Lake Oswego to Portland Transit Project due to anticipated areas that would be disturbed by the project. However, these permits will be required only if the project progresses to a design and construction phase; they would not be required for an EIS.

The EPA and most state agencies have established minimum water quality standards for different classes of surface waters. In OAR 340-41-445, DEQ has defined special water quality standards for the Willamette River Basin. These standards were adopted to protect the beneficial uses of surface waters within the basin and to provide minimum design criteria for waste treatment and control.

9.3 Contacts, Coordination and Consultation

As part of the investigation of hydrologic, floodplain, and water quality issues pertaining to the Lake Oswego to Portland Transit Project, in addition to internal coordination, staff will gather information from and/or coordinate with some or all of the following Federal, state, and local government agencies:

A. Federal Agencies

- EPA
- National Marine Fisheries Service (NMFS)
- U.S. Army Corps of Engineers (Corps), Portland District
- U.S. Coast Guard
- Federal Emergency Management Agency (FEMA)

B. State Agencies

- Oregon Department of Environmental Quality (ODEQ)
- Oregon Department of Transportation (ODOT)
- Oregon Department of Fish and Wildlife (ODFW)
- Department of State Lands (DSL)

C. Local Agencies

- Metro
- Clackamas County Service District #1
- Multnomah County Department of Community Services
- City of Lake Oswego Engineering
- City of Portland Bureau of Environmental Services (BES)

9.4 Data Collection

Available information on existing hydrologic, floodplain, and water quality conditions within basins within the corridor will be obtained from Federal, state, and local sources. A variety of local sources will provide data that includes state water quality standards, basin plans, and published data compiled from monitoring efforts.

9.5 Affected Environment Profile

To quantify existing conditions with respect to hydrology, floodplains, and water quality in the study area, field reconnaissance will be conducted along the entire proposed streetcar alignment and design alternatives, including proposed crossings, streetcar stops, park-and-rides, and operations and maintenance (O&M) facilities. Information on existing systems will also be gathered from local jurisdictions, ODOT, TriMet, and other sources as available.

For purposes of the hydrologic, floodplain, and water quality assessment, project facilities refer to impervious track and nonlinear features including stations, maintenance facilities, bridges, and park-and-ride facilities. It will be assumed that in many locations, ballasted track has and or will be used, and in these locations the rail track would not increase runoff, because track ballast allows infiltration and storage of precipitation and prevents runoff. This assumption will be considered to be valid for the range of soil and vegetation conditions found along the entire corridor. Therefore, ballasted track (if used) will not add to existing or proposed impervious surface values.

A. Hydrology

Existing documents to be reviewed for assessing hydrologic conditions include existing basin studies, drainage basin plans, master plans, capital improvement plans, USGS streamflow data, precipitation data published by the National Weather Service, topographic maps, aerial photographs, National Resources Conservation Service (NCRS) maps, FIRM maps, and stormwater infrastructure as-built drawings.

Field reconnaissance will also be conducted to observe general drainage patterns in the project area, including locations, sizes, and flow direction of culverts and conveyance ditches. Evidence of high water marks, scouring, and standing water will also be observed to gain a general understanding of the movement of stormwater runoff in the project area.

Information gained from the document review and field reconnaissance described above will be used to determine direction of flows and delineate subbasins within the study area. Peak flow rates and volumes generated and discharged from the study area under existing conditions will be estimated based on impervious cover, adjacent land use, existing drainage system plans, and measuring of existing culverts during field reconnaissance.

B. Floodplains

Information on existing flooding conditions will be collected for rivers, streams, and tributaries that would be affected by the proposed study alternatives. General information on basin-wide flooding conditions will be collected and described in the description of the affected environment. Existing flooding conditions at individual sites, where major or minor crossings are proposed to occur, will be estimated as part of the Floodplains Impacts Analysis. FIRM maps generated by FEMA and Flood Management Area (FMA) maps generated by Metro will be reviewed in order to determine existing floodplain conditions.

C. Water Quality

To quantify existing water quality conditions in rivers, streams, and tributaries within the study area, published data from Federal, state, and local sources will be searched and documented. Pollutant export or loading from project facilities will be estimated based primarily on assessments of existing impervious area within the Lake Oswego to Portland Transit Project.

Pollutant loading analysis will be conducted using Federal Highway Administration (FHWA) Methodology from FHWA-RD-88-006 using site median concentrations and procedures developed by ODOT for the Portland Metro area. The analysis will show just the theoretical increase in annual loading and pollutant concentrations from existing and extra impervious area that may or may not be added by the Lake Oswego to Portland Transit Project. The results from this probabilistic procedure can be used to predict the possibility of a once-in-three-year exceedance of acute water quality criteria.

ODOT has modified the FHWA procedures outlined in FHWA-RD-88-006 as follows. Site median concentrations were taken from ODOT stormwater sampling data, as reported on its NPDES Municipal Separate Storm Sewer System (MS4) Permit application, instead of from the Nationwide Urban Runoff Program (NURP) data used by FHWA. ODOT site median concentrations, as taken from ODOT's MS4 permit application, were typically measured at sites with greater urbanization and higher traffic volumes than the NURP studies; therefore, the actual median concentrations for this project will probably be lower than those assumed. Water quality criteria are taken from the ODEQ acute and chronic requirements (Table 20 of ODEQ's water quality standards), instead of the EPA acute and threshold requirements as reported in FHWA-RD-88-006. Once a preferred alternative has been selected, future studies can continue to use the FHWA method with the ODOT MS4 permit data, or more specific median concentration data from on-site monitoring can be used.

9.6 Impact Assessment Analysis Methods

The analysis will assess direct, indirect and cumulative effects of the project alternatives.

9.6.1 Hydrology

To assess potential hydrologic impacts, peak stormwater discharge rates for existing and future (post construction) conditions will be estimated along the corridor at existing drainage ditches and culverts. These results will be evaluated based on new impervious surface estimates to allow for a qualitative assessment of pre- and post-development discharge rates to determine whether significant impacts would occur as a result of the Lake Oswego to Portland Transit Project.

At this stage of project development, the hydrological analysis is focused on defining the comparative magnitude of impacts and to help define potential mitigation measures. More detailed analysis will be performed during final design and permitting phases. The final design and supporting analyses will be used for permitting applications needed to satisfy the requirements of individual agencies.

Hydrologic impacts will be considered only in association with the long-term operation of proposed project facilities in the corridor. No specific hydrologic impacts will be assigned to construction activities because:

- In most cases, short-term runoff increases are temporary and related to vegetation removal; in the long-term, runoff would be reduced from areas where vegetation would be restored;

- Most jurisdictions require strict BMP measures to limit the specific impacts of construction and often include detention to promote removal of suspended sediments;
- Most construction occurs during the dry season when hydrologic impacts would not occur; and
- Most hydrologic and flooding impacts are permanent changes to individual sites and require site-specific mitigation to be incorporated into the final site design.

Construction-related BMPs will be discussed in the section on potential mitigation measures.

9.6.2 Floodplains

A qualitative analysis will be conducted of potential floodplain impacts at all stream and river crossings and at locations of potential floodplain encroachment along the various alternatives. The investigation of potential flooding impacts will rely on FEMA NFIP studies, Metro's FMA maps, and other more recent information if available.

Potential impacts of proposed stream and river crossings will be assessed on the basis of:

- Potential floodplain encroachments;
- Potential changes in channel capacity that could affect flood depths;
- Potential changes in flow velocities that could cause morphological changes in the adjacent channel; and
- Regulatory standards and requirements, such as FEMA floodplain regulations, U.S. Army Corps of Engineers 404 permit requirements regulating the discharge of dredge or fill in waters of the U.S., and Title 3 regulations promulgated by Metro.

9.6.3 Water Quality

Surface water quality degradation can result from: 1) pollutant increases in runoff from roads and parking lots, and 2) quantity-related problems that increase erosion and sediment loads to streams and wetlands. Urban stormwater often contains increased levels of oil and grease, nutrients, sediment, and various heavy metals. Two types of significant water quality degradation can occur in association with site development: short-term (construction-related) and long-term (operations-related).

During construction, equipment operation can cause accidental releases of fuels, oil, and grease, and can degrade surface water quality by increasing erosion and sedimentation. Loss of protective vegetation cover during construction is another cause of increased sediment loading. For the analysis conducted for the EIS, it will be assumed that proper use of erosion control BMPs and spill control plans during construction would prevent significant water quality impacts. This assumption would be especially valid should construction activities involve working in a mapped FEMA floodplain. Long-term water quality impacts are associated with increases in impervious surfaces (e.g., pavement and buildings). Impervious surfaces prevent rainfall infiltration and promote the storage and wash-off of pollutants from vehicle emissions and other sources. Motorized vehicles are the primary source of water quality degradation from a variety of contaminants including oils and grease, metals, and other combustion by-products. Facilities that would cause significant increases in motorized vehicle usage can also be expected to generate significantly higher pollutant loadings. Landscaped areas, another significant source of pollutants from developed sites, can contribute fertilizer and pesticide residues, such as phosphates and nitrates, to stormwater runoff.

For this analysis, pollutant loads will be estimated for project facilities along the proposed alternatives and will be based on impervious surface estimates for the Lake Oswego to Portland Transit Project and its alignment and design options. It will be assumed that water quality treatment facilities would be provided at each site where significant development or redevelopment would occur, such as park-and-ride lots, operations and maintenance (O&M) facilities, and roadway improvements. Comparisons of baseline and post-construction loading, and general effectiveness of water quality treatment systems will be discussed qualitatively.

On a cumulative basis, impacts will be assessed qualitatively by comparing existing receiving water quality to expected impacts from proposed project facilities (railway alignments, park-and-ride lots, O&M facilities, and transit stations).

For the water quality analysis, the risk of oil and grease spills from train operations will be assumed to be negligible. Operational experience gained on the existing Eastside and Westside rail lines suggests that oil and grease releases from train operations along the proposed alignment would not be significant. It will be assumed that if the track segments were constructed with rail, ties, and ballast, then receiving water quality would not be significantly impacted by runoff from track segments.

9.7 Mitigation Measures

Mitigation alternatives will be identified and considered where the evaluation of existing and proposed hydrologic, floodplain, and water quality conditions along the alternatives indicates that potential adverse impacts could result. Mitigation alternatives will include identification of measures that could reduce and minimize potential impacts as they relate to water resources.

9.8 Documentation

The description of the affected environment, the results of the analysis, and the potential mitigation measures identified in the analysis will be documented and summarized in the DEIS. Additional documentation may be included in hydrology and water quality technical memorandum. Documentation will be provided for all calculations. Documentation of hydrologic calculations will include the results of existing and future condition peak flow estimates for various storms events; water quality analyses of existing and proposed conditions will include pollutant loading calculations; and the floodplain analysis will include conditions for all crossing locations along the study alternatives representing existing and proposed conditions. The hydrology and water quality analysis will be summarized and included in the DEIS.

10. NOISE AND VIBRATION ANALYSIS METHODS

10.1 Introduction

This section provides definitions of noise and vibration and discusses the methods proposed for use in the analyses of potential noise and vibration impacts related to the Lake Oswego to Portland Transit Corridor Project. After an introduction to noise and vibration terminology and the metrics used to describe each, the potentially applicable federal, state, and local noise and vibration rules are reviewed. Noise and vibration evaluation/impact criteria for the project will be established based on the information presented. Finally, noise impact and mitigation evaluation methodologies are described, and potential mitigation criteria discussed.

10.2 Noise and Vibration Characteristics and Descriptors

10.2.1 Noise Characteristics and Terminology

Noise is sometimes defined as unwanted sound, and the terms noise and sound are used more or less synonymously in this section. The human ear responds to a very wide range of sound intensities. The decibel (dB) scale used to describe and quantify sound is a logarithmic scale that provides a convenient system for considering the large differences in audible sound intensities. On this scale, a 10-dB increase represents a perceived doubling of loudness to someone with normal hearing. Therefore, a 70-dB sound level will sound twice as loud as a 60-dB sound level.

People generally cannot detect sound level differences (increases or decreases) of 1 dB in a given noise environment. Although differences of 2 or 3 dB can be detected under ideal laboratory conditions, such changes are difficult to discern in an active outdoor noise environment. A 5-dB change in a given noise source would be likely to be perceived by most people under normal listening conditions.

When addressing the effects of noise on people, it is necessary to consider the "frequency response" of the human ear, or those frequencies that people hear best. Sound-measuring instruments are therefore often programmed to "weight" sounds based on the way people hear. The frequency-weighting most often used to evaluate environmental noise is A-weighting, and measurements using this system are reported in "A-weighted decibels" or dBA. All sound levels discussed in this evaluation are reported in A-weighted decibels.

As mentioned above, the decibel scale used to describe noise is logarithmic. On this scale, a doubling of sound-generating activity (i.e., a doubling of the sound energy) causes a 3-dBA increase in average sound produced by that source, not a doubling of the loudness of the sound (which requires a 10-dBA increase). For example, if traffic along a road is causing a 60-dBA sound level at some nearby location, twice as much traffic on this same road would cause the sound level at this same location to increase to 63 dBA. Such an increase might not be discernible in a complex acoustical environment.

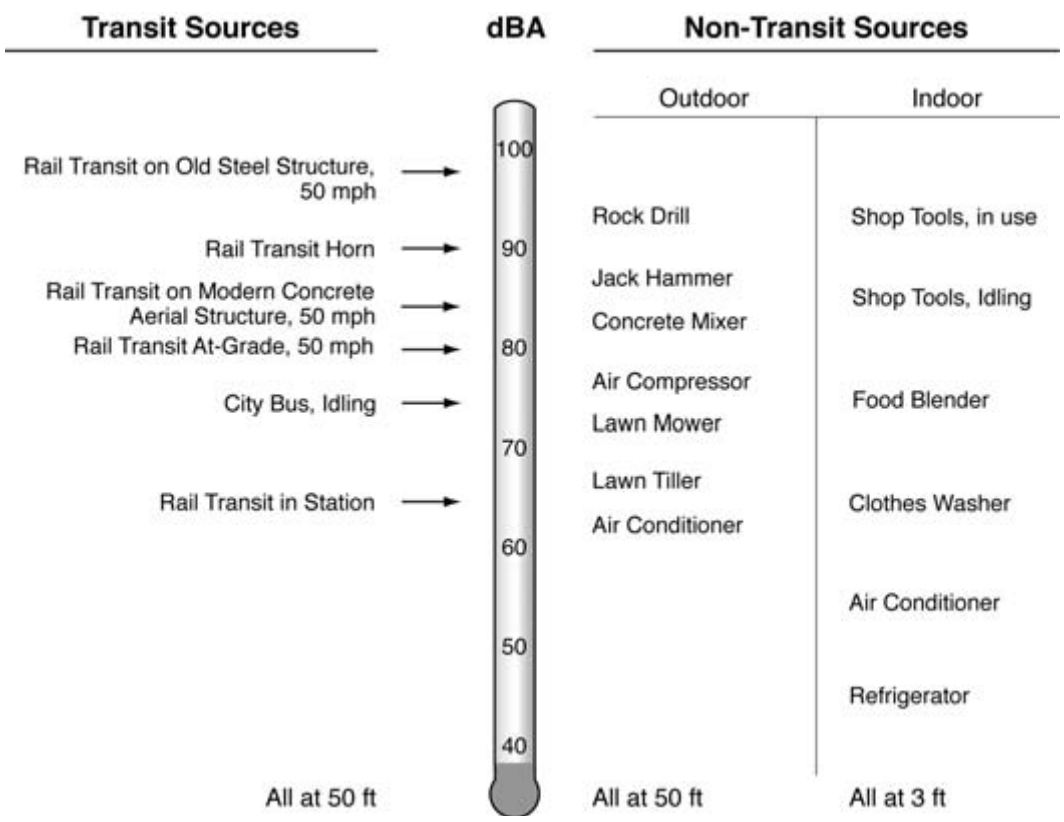
Relatively long, multi-source "line" sources such as roads emit cylindrical sound waves. Due to the cylindrical spreading of these sound waves, sound levels from such sources decrease with each doubling of distance from the source at a rate of 3 dBA. Sound waves from discrete events or stationary "point" sources (such as a backhoe operating in a stationary location) spread as a sphere, and sound levels from such sources decrease 6 dBA per doubling of the distance from the source.

Conversely, moving half the distance closer to a source increases sound levels by 3 dBA and 6 dBA for line and point sources, respectively.

For a given noise source, a number of factors affect the sound transmission from the source, which in turn affects the potential noise impact. Important factors include distance from the source, frequency of the sound, absorbency and roughness of the intervening ground surface, the presence or absence of obstructions and their absorbency or reflectivity, and the duration of the sound. The degree of impact on humans also depends on existing sound levels, and who is listening.

Typical sound levels of some familiar noise sources and activities are presented in Figure 10-1.

Figure 10-1
Sound Levels Produced by Common Noise Sources



Source: FTA 2006

10.2.2 Sound Level Descriptors

A. Equivalent Sound Level, L_{eq}

The L_{eq} is a noise metric representing the level of a constant sound that contains the same sound energy as the actual fluctuating sound over the same time period. As such, the L_{eq} can be considered an energy-average sound level. Because the L_{eq} considers sound levels over time, this metric accounts for the number, levels, and durations of noise events during a time interval (e.g., 1 hour).

Federal regulatory agencies often use the equivalent sound level (L_{eq}) to characterize sound levels and to evaluate noise impacts. The L_{eq} is the level that if held constant over the same period of time would have the same sound energy as the actual, fluctuating sound. As such, the L_{eq} can be considered an energy-average sound level. But this metric should not be confused with an arithmetic average which tends to de-emphasize high and low values, because the L_{eq} gives most weight to the highest sound levels because they contain the most sound energy.

FTA noise impact criteria apply the hourly L_{eq} of the hour of greatest transit activity during hours of noise sensitivity to assess potential impacts at receivers involving primarily daytime use (i.e., where potential sleep disturbance is not an issue). Thus, the L_{eq} is used to consider impacts at locations such as parks, schools, libraries, or churches.

B. Day-Night Sound Level, L_{dn}

The L_{dn} is like a 24-hour L_{eq}, except that the calculation of this metric includes an additional 10 dBA for sound levels between 10 p.m. and 7 a.m. This noise metric therefore reflects the greater noise sensitivity of most people during the nighttime hours when typical background noise is lower and most people are sleeping. The L_{dn} is used to characterize the noise environment in situations or areas where there are both daytime and nighttime uses, such as residences, hospitals, and hotels.

Most urban and suburban neighborhoods typically have sound levels in the range of L_{dn} 50 to 70 dBA. An L_{dn} of 70 dBA is a noisy environment that might be found at buildings on busy surface streets, close to a freeway, or near a busy airport. These sorts of sound levels are usually considered unacceptable for residential land uses without special measures taken to enhance outdoor/indoor sound insulation. Residential neighborhoods that are not near major sound sources typically have levels in the range of L_{dn} 55 to 60 dBA. If there is a freeway or moderately busy arterial nearby (or any nighttime noise), L_{dn} is usually in the range of 60 to 65 dBA.

Most environmental impact assessments in the United States use L_{dn} to describe the community noise environment. Studies of community response to a wide variety of noises indicate that L_{dn} is a good measure of the noise environment. Efforts to derive measures that are better correlated to community response have not been successful, although there are still efforts in the acoustical community to develop improved measures. The noise impact criteria included in the May 2006 FTA *Transit Noise and Vibration Impact Assessment* manual use L_{dn} for assessing noise impacts to residential and other properties used for sleeping.

C. Maximum Sound Level, L_{max}

The L_{max} is the maximum sound level that occurred during a specified period. It may be one of the descriptors used to characterize the sound level of an individual event such as an automobile or train passby. One thing missing from the L_{max} is any information about the duration of frequency of occurrence of such events. For example, a single dog bark could be somewhat annoying, but such an event would hardly compare with a neighbor's dog barking all night. The maximum level of train noise, L_{max}, has been used in many environmental assessments of urban rail transit noise. This descriptor has the advantage of being independent of other community noise and the specific train schedule. An argument often advanced for use of L_{max} is that it, and not L_{eq}, reflects human response to occasional loud noises such as transit trains that pass by every 5 to 30 minutes or freight trains that

may only occur a few times per day. Although there is some common sense logic in this argument, the available research on community response to environmental noise does not confirm the hypothesis. Although L_{max} may be useful for providing additional information regarding a single type of source, it fails to describe the effects of many sources with widely varying levels, some of which occur frequently; others infrequently.

D. Statistical Noise Level, L_n

The L_n is a statistical noise level descriptor, where the "n" is a percentage of the measurement time; usually one hour. For example, an hourly L_{50} of 60 dBA means that the sound level was at or above 60 dBA for 50 percent of that hour (or for 30 minutes). Oregon and Washington use various L_n values to determine compliance with their noise regulations.

10.2.3 Ground-Borne Vibration Terminology and Descriptors

Vibration is an oscillatory motion that can be measured and characterized by the frequency and amplitude of waves of motion. Ground-borne vibration (GBV) consists of oscillatory waves that propagate from the source through the ground to adjacent buildings. Vibration amplitude can be measured as displacement, velocity, or acceleration. Displacement is a measure of the distance a point moves away from its resting position. Velocity represents the instantaneous speed and direction of the movement, and acceleration is the rate of change of the velocity. Although displacement is easier to understand than velocity or acceleration, it is rarely used for describing ground-borne vibration.

While it is conceivable for ground-borne vibration from rail rapid transit trains to cause building damage, the vibration from trains is almost never of sufficient amplitude to cause even minor cosmetic damage to buildings. The real concern is that the vibration and radiated noise can be intrusive and annoying to building occupants. The building vibration caused by ground-borne vibration may be perceived as: 1) motion of building surfaces such as rattling of windows, items on shelves or pictures hanging on walls or 2) as a low-frequency rumbling noise, which is referred to as ground-borne noise.

Because it takes time for the human body to perceive and respond to vibration signals, vibration amplitude (i.e., the size of the wave of motion) is usually characterized using a "smoothed" amplitude based on the root mean square (RMS). RMS vibration velocity is considered the best available measure of potential human annoyance from ground-borne vibration. FTA methodology for assessing potential impacts from vibration from transit facility operations considers vibration amplitude reported as RMS velocity, converted to vibration decibel levels or VdB.

The use of RMS vibration velocity or VdB for vibration-related annoyance is in contrast to the use of peak-particle velocity (PPV) for describing vibration levels. Most vibration measurements are performed to monitor the potential for building damage from construction activities, not annoyance, and these measurements are usually in terms of PPV. The PPV represents the maximum instantaneous peak in the velocity of an object's vibratory motion about the equilibrium position. It is used to define the thresholds of potential building damage from vibration since it is thought to be more directly correlated to peak stresses in building components than RMS vibration.

10.3 Noise Limits and Criteria and Vibration Criteria (Related Laws and Regulations)

The noise and vibration assessment for the proposed project will consider these issues in accord with the impact criteria described in this section. Other potentially applicable noise limits are also discussed.

10.3.1 Federal Transit Administration (FTA) Noise Impact Criteria

The FTA describes its noise impact criteria for transit projects in the manual entitled Transit Noise and Vibration Impact Assessment (FTA 2006). These criteria apply to rail projects; stationary facilities like transit stations, maintenance facilities, and park and ride lots; and buses traveling on local roads and highways or in bus-only highway lanes.

The FTA noise impact criteria apply a sliding scale of impact levels of project-related noise based on the existing sound levels. These criteria are based on applying one of two metrics commonly used to quantify sound levels – the hourly equivalent sound level (L_{eq}) and the day-night sound level (L_{dn}), both described above.

FTA noise impact criteria use the hourly L_{eq} of the hour of heaviest transit activity during hours of noise sensitivity to assess potential impacts at receivers involving primarily daytime use (i.e., where potential sleep disturbance is not an issue). Thus, the L_{eq} is used to consider impacts at locations such as parks, schools, libraries, or churches. The L_{dn} is used to describe the noise environment in areas where there is both nighttime and daytime use, such as residences, hospitals, and hotels. FTA transit noise impact criteria are shown in Table 10-1.

Table 10-1.
Land Use Categories and Metrics for Transit Noise Impact Criteria

Land Use Category	Noise Metric (dBA)	Description of Land Use Category
1	Outdoor Leq(1) [a]	Tracts of land where quiet is an essential element in their intended purpose. 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.
2	Outdoor Ldn	Residences and buildings where people normally sleep. This category includes homes, hospitals, and hotels, where a nighttime sensitivity to noise is assumed to be of utmost importance.
3	Outdoor Leq(1) [a]	Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, and churches, where it is important to avoid interference with such activities as speech, meditation, and concentration on reading material. Buildings with interior spaces where quiet is important, such as medical offices, conference rooms, recording studios, and concert halls fall into this category, as do places for meditation or study associated with cemeteries, monuments, and museums. Certain historical sites, parks, and recreational facilities are also included.

Source: U.S. Federal Transit Administration's *Transit Noise and Vibration Impact Assessment Manual*, May 2006. FTA-VA-90-1003-06.
[a] Equivalent sound level of the noisiest hour of transit-related activity during period of noise sensitivity.

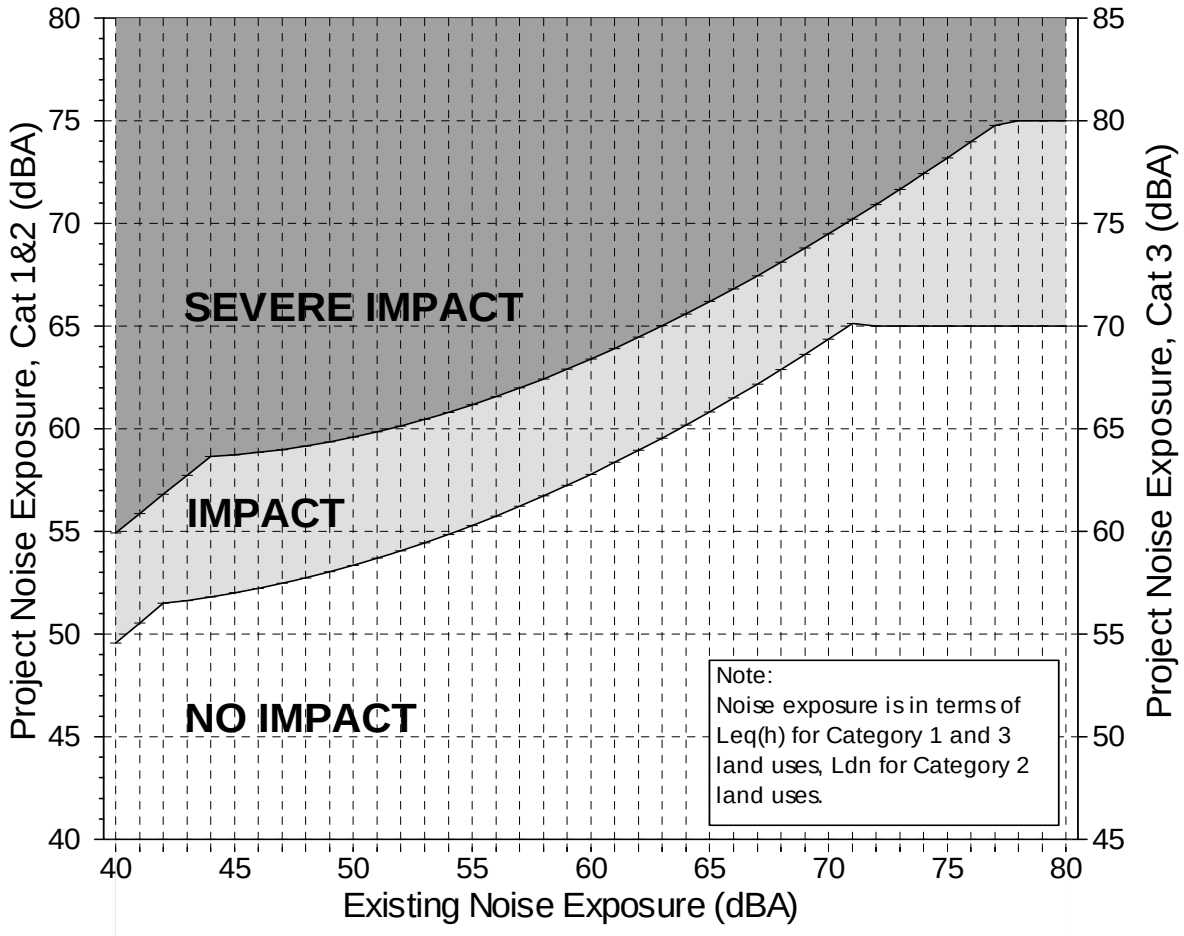
FTA noise impact criteria are based on comparing expected project-related noise to existing sound levels (see Figure 10-2). Under these criteria, receiving locations with low existing sound levels can be exposed to greater increases in overall noise due to the addition of project noise before an impact occurs. Conversely, locations with higher existing sound levels can be exposed to smaller increases in

overall noise before an impact occurs. For example, residential locations with an existing sound level of L_{dn} 40 dBA would not be considered severely impacted unless there would be a 15-dBA increase caused by project noise, while residential locations with an L_{dn} 60 dBA baseline would be considered severely impacted by less than a 5-dBA increase.

The FTA noise impact criteria are used to consider exterior locations only, such as patios, decks, pools, and play areas. When there are no such exterior uses near a sensitive receiver, the impact criteria are applied near building doors and windows. FTA guidance assumes a typical building will provide an outdoor-to-indoor noise reduction of about 25 dBA, which can in some instances result in interior sound levels that do not warrant additional noise mitigation even if impact-level noises are likely outside the building.

FTA noise impact criteria allow for special consideration of the noise-sensitive nature of some historically significant sites. Historically significant sites with residential uses, with considerable outdoor use required for site interpretation, or where quiet indoor levels are important to the operation of the site are treated as noise-sensitive receivers and evaluated using FTA criteria. Where historically significant sites are used for commercial or industrial purposes, despite being listed in the national or local historic registry, such sites are not considered noise-sensitive uses, and FTA does not identify or consider impact noise levels for such receivers.

Figure 10-2
FTA Noise Impact Criteria



Finally, FTA also recommends identifying the maximum sound level (L_{max}) from rail transit projects, particularly for those locations where the equipment and proximity to noise-sensitive uses indicate a potential for impacts. The L_{max} is the maximum sound level that occurs during a given time interval and this metric provides additional information with which to evaluate the potential effect of individual train events. FTA does not employ direct noise impact criteria for applying L_{max} levels, but does provide guidance for considering L_{max} levels in interior spaces for evaluating the effectiveness of noise mitigation for reducing interior noise levels. This guidance provides de facto interior noise criteria for train noise based on the L_{max}, as described below.

When there are no exterior uses at locations where potential FTA noise impacts have been identified, the FTA interior noise mitigation guidelines may be applied. These guidelines are based on the L_{max} during a noise event. For train pass-bys and other transit noise sources (i.e., without horn noise) the interior L_{max} noise mitigation criterion is 65 dBA. For train horn noise, the L_{max} noise mitigation criterion is 70 dBA (FTA 2006, p 6-44, with clarification provided in FTA 2007). That is, to be considered cost effective, the building structure and/or other noise mitigation measures must reduce the exterior sound levels by at least 5 dBA, and resulting interior sound levels must not exceed the L_{max} levels identified above. Therefore, if there are no exterior uses at an impacted receiver and the interior L_{max} due to project-related sources does not exceed 65 dBA, no additional mitigation measures (e.g., sound insulation) would be required under FTA policy.

10.3.2 FHWA/ODOT Noise Impact Criteria

The Federal Highway Administration (FHWA) has adopted noise standards that apply to traffic noise associated with its projects. These criteria are intended for analyzing effects related to new, expanded, or substantially modified roads controlled by state or federal agencies. [7] For alternatives or projects that affect traffic volumes on state or federal roadways but do not otherwise result in substantial modifications to the roadway, the FHWA traffic noise criteria and the Oregon state implementation of these rules through state policies, although not strictly applicable, are used to provide readers a perspective on the noise levels and the potential for noise impacts related to traffic sources.

The FHWA defines a traffic noise impact as a predicted traffic noise level (peak hourly L_{eq}) approaching or exceeding the noise abatement criteria (e.g., 67 dBA at exterior locations associated with residential uses or 72 dBA for exterior use areas associated with other types of developed lands that are not particularly sensitive to noise), or when the predicted traffic noise levels substantially exceed the existing noise levels. FHWA leaves the definition of "approach" to the states. The Oregon State Department of Transportation (ODOT) defines "approaching" the FHWA limits as sound levels within 2 dBA of the criterion level. ODOT defines "substantially exceeding" existing noise levels as an increase greater than 10 dBA.

The Macadam Additional Lane design option of the Streetcar Alternative would result in the addition of a restricted travel lane (for streetcar use and for traffic turning right) on approximately 1,500 feet of Macadam Avenue, a state-controlled roadway. Therefore, FHWA/ODOT noise impact assessment procedures should be considered. However, this lane would not result in additional overall traffic

[7] ODOT clarifies that a substantially modified road would include one where a significant change in the horizontal or vertical alignment could lead to a perceptible increase in noise (i.e., at least a 2 to 3 dBA increase).

volumes on Macadam Avenue, would not represent an additional through lane, and would not be expected to result in a 2-3 dBA increase in noise on such a busy road. Therefore, it would not be designated a "substantial realignment" according to ODOT criteria. Furthermore, the addition of a streetcar in the lane, which is quieter than a heavy truck and would be less frequent than trucks, would be expected to result in virtually no increase in overall traffic noise. Therefore, we do not propose to conduct a traffic noise impact study for the Macadam Additional Lane design option of the Streetcar Alternative. Instead, the following text (or similar) will be included in the relevant environmental documentation for the project:

> *In accordance with the provisions of 23 CFR 772 (h), (which defines a Type I project,) the proposed project will not add a through lane of traffic, construct a new roadway on a new alignment, result in an acoustically significant shift in the roadway alignment, or bring about a new traffic noise impact. Therefore, a traffic noise study is not required.* (ODOT Noise Manual, March 2009, pg 2.)

The Enhanced Bus Alternative would result in additional bus traffic traveling on a state highway but would not result in new, expanded, or substantially modified roads controlled by state or federal agencies. Therefore, the FHWA/ODOT noise impact criteria do not specifically apply and will be used only as a means of characterizing potential increases in traffic noise due to this alternative.

10.3.3 State Noise Control Regulations and Ordinances

The State of Oregon has noise control ordinances that may pertain to certain aspects of the project. The ordinances regulate noise from commercial and industrial land uses near noise sensitive receivers. The Oregon DEQ noise limits for new and existing industrial and commercial noise sources would be applicable to any maintenance bases, park and rides, and any other project-related ancillary facilities in areas where no local noise criteria exist. The applicable noise limits are shown in Table 10-3.

In addition to the overall noise limits shown in Table 10-2, OAR 340-35-035(1)(B)(b) specifies that new noise sources located on previously unused sites should not increase the ambient L_{10} or L_{50} noise levels by more than 10 dBA in any one hour. The resulting ambient statistical noise levels are to include all noises generated or indirectly caused by or attributable to the new source, even those otherwise exempt from the Oregon noise limits.

Table 10-2
Oregon Industrial and Commercial Noise Source Standards

Statistical Level	Allowable Statistical Noise Levels in Any One Hour	
	7 a.m. - 10 p.m.	10 p.m. - 7 a.m.
L50	55	50
L10	60	55
L1	75	60

Source: OAR 340-35-035
The L_{50}, L_{10}, and L_1 statistical noise descriptors are the sound levels exceeded 50%, 10%, and 1% of the time, respectively.

Traffic on public roads and construction activities are exempt from the noise regulations (per OAR 340-35-035(5)).

10.3.4 Local Noise Control Regulations and Ordinances

The streetcar line could potentially affect communities is unincorporated Multnomah or Clackamas Counties, the City of Portland, and/or the City of Lake Oswego. The applicable noise regulations in each jurisdiction are provided below. The applicability of these various noise rules will be determined during the course of the noise impact analysis.

A. Multnomah County

Multnomah County has no specific regulations regarding noise. Therefore, the applicable noise limits for activities or facilities in unincorporated Multnomah County would be those established by the State of Oregon or the City of Portland, the latter of whom may have jurisdiction by virtue of the City's enforcement of the zoning code in this area.

B. Clackamas County

Chapter 6.05 of the Clackamas County Code establishes limits on noise levels of 60 dBA between 7 a.m. and 10 p.m. and 50 dBA between 10 p.m. and 7 a.m. Noise from construction-related activities is exempt from these limits between 6 a.m. and 10 p.m.

C. City of Portland Noise Regulations

Title 18 of the Portland Municipal Code establishes noise control regulations for sources in the City of Portland. The permissible sound levels, by land use, are shown in Table 10-3. The City of Portland also has limits on tonal noise sources with maximum permissible sound pressure levels for octave band sound levels. Since the project is not expected to have any tonal noise sources, the maximum octave band levels are not presented here, but can be found in Section 18.10.010 of the City's noise ordinance.

Between 7 a.m. and 6 p.m., Monday through Saturday, the permissible sound level for construction activities is 85 dBA at 50 feet. This standard does not apply to trucks, pile drivers, pavement breakers, scrapers, concrete saws, and rock drills. Exempt sounds include sounds made by warning devices operated continuously for 3 minutes or less.

Table 10-3
City of Portland Permissible Sound Level (dBA)
(7 a.m. – 10 p.m., otherwise minus 5 dBA)

Zone Categories of Source	Zone Categories of Receiver			
	Residential	Open Space	Commercial	Industrial
Residential	55	55	60	65
Open Space	55	55	60	65
Commercial	60	60	70	70
Industrial	65	65	70	75

Source: PMC 18.10.010

D. City of Lake Oswego

The City of Lake Oswego City Code, Section 34.10.537-539 identifies noise disturbances and noise that is prohibited. Construction-related noise is allowed between 7 a.m. and 6 p.m. Monday through Friday (or Monday through Saturday in other than residential zones); between 8 a.m. and 6 p.m. on Saturdays in residential zones, and between 10 a.m. and 6 p.m. on Sundays and holidays. The Lake Oswego City Code does not specify noise limits that appear to pertain to facility operational noise.

10.3.5 FTA Vibration Impact Criteria

A. Impact Criteria Applied to Operation

According to FTA criteria, the approximate threshold of perception of vibration for most humans is 65 VdB. However, FTA considers perceptible levels of vibration acceptable in some settings, depending on the type of receiver and the frequency of occurrence of vibration events. The three FTA vibration impact categories of receiving locations and the related GBV impact criteria are described below.

Category 1 – The most sensitive receivers for vibration assessment include vibration-sensitive research and manufacturing facilities where equipment such as electron microscopes and high resolution lithographic equipment can be very sensitive to vibration, even at levels well below the human annoyance level (as distinct from the threshold of perception). The FTA impact criterion for sensitive research facilities is 65 VdB, regardless of frequency of occurrence.

Category 2 – The next most vibration sensitive uses are residences and places where people sleep.

Category 3 – Although considered less sensitive than Category 1 or 2 receivers, institutional uses such as churches, schools, and quiet offices also have the potential to be affected by GBV. FTA includes office buildings in Category 3, but not all buildings that include office space. For example, most industrial buildings have office space, but such buildings primarily for industrial uses are not considered Category 3 receivers.

Table 10-4
Ground-Borne Vibration and Noise Impact Criteria

Land Use Category	GB Vibration Impact Levels (VdB re 1 micro-inch/sec)			GB Noise Impact Levels (dB re 20 micro Pascals)		
	Frequent Events [a]	Occasional Events [b]	Infrequent Events [c]	Frequent Events [a]	Occasional Events [b]	Infrequent Events [c]
Category 1 [d]	65 VdB [e]	65 VdB [e]	65 VdB [e]	25 dBA [f]	25 dBA [f]	25 dBA [f]
Category 2	72 VdB	75 VdB	80 VdB	35 dBA	38 dBA	43 dBA
Category 3	75 VdB	78 VdB	83 VdB	40 dBA	43 dBA	48 dBA

Source: U.S. Federal Transit Administration's *Transit Noise and Vibration Impact Assessment Manual*, May 2006. FTA-VA-90-1003-06.
[a] "Frequent Events" is defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.
[b] "Occasional Events" is defined as between 30 and 70 vibration events of the same source per day. Most commuter trunk lines have this many operations.
[c] "Infrequent Events" is defined as fewer than 30 vibration events of the same kind per day. This category includes most commuter rail branch lines.
[d] Although not specifically identified as "Category 1" uses, concert halls, TV studios, and recording studios have the same ground-borne vibration and noise level criteria as Category 1 uses.
[e] This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration-sensitive manufacturing or research will require detailed evaluation to define the acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the HVAC systems and stiffened floors.
[f] Vibration-sensitive equipment is generally not sensitive to ground-borne noise, so these levels do not apply to the Category 1 uses. The specified ground-borne noise levels apply to concert halls and TV and recording studios.

Some buildings such as concert halls, TV and recording studios, and theaters can be very sensitive to vibration and noise but do not fit into any of the three categories. However, the vibration impact criteria for these uses are the same as identified in Table 10-4 for Category 1 land uses.

B. Vibration Damage Criteria Applied to Construction

FTA screening and general impact procedures will be applied to evaluate the potential for vibration damage during construction of the proposed streetcar facility. Construction equipment and activities can result in varying degrees of ground-borne vibration (GBV), depending on the equipment and methods employed. Such GBV diminishes in strength with distance from the source. Unlike GBV related to transit facility operation which is assessed based on its potential to affect (i.e., be perceived by and possibly annoy) people, construction-related GBV is typically assessed based on its potential to physically damage buildings. Construction GBV should therefore be assessed quantitatively in cases where construction activities occur very near buildings. Note that the values are given in terms of peak particle velocity (PPV) in inches per second, a standard metric for characterizing GBV when assessing the potential for building damage.

The potential for GBV to cause damage to buildings varies based on the types of buildings (i.e., building materials and structural techniques) involved. The FTA guideline vibration damage criteria for various structural categories are listed in Table 10-5.

Table 10-5
FTA Construction Vibration Damage Criteria

Building Category and Description	PPV (in/sec)
I. Reinforced-concrete, steel, or timber (no plaster)	0.5
II. Engineered concrete and masonry (no plaster)	0.3
III. Non-engineered timber and masonry buildings	0.2
IV. Buildings extremely susceptible to vibration damage	0.12

Source: U.S. Federal Transit Administration's *Transit Noise and Vibration Impact Assessment Manual*, May 2006. FTA-VA-90-1003-06.

10.4 Data Collection

The noise and vibration assessments will require collection of data related to existing sound levels (noise) as well as an inventory of buildings and uses (vibration). The techniques to be employed in these data collection efforts are described in later portions of the noise and vibration section of this report.

10.5 Affected Environment

The affected acoustical environment in the project area will be characterized using sound level measurements and field observations at selected locations. The existing vibration environment will be described in general terms based primarily on a survey of uses in the area. Both sorts of environments are described further below.

10.5.1 Sound Level Measurements

FTA noise impact criteria are based upon comparing the existing sound levels at potentially affected receivers with projected project-related sound levels. Therefore, obtaining an accurate assessment of existing sound levels is critical to characterizing the potentially affected environment and conduct of the impact assessment. Existing sound levels will be captured using the following methodology.

Existing noise levels for potentially affected areas along the project alignment will be established by sound level measurements (SLMs). Monitoring efforts are expected to include from 15 to 25 long-term (approximately 24-hour) SLMs and additional short-term SLMs throughout the study area. All short-term SLMs will be observed and documented with specific notes. All 24-hour SLMs will be primarily unobserved except during deployment and retrieval of the equipment, with possible occasional short-term visits to verify equipment operation and security. Collected sound level data will be loaded onto a computer and the data analyzed and summarized using a spreadsheet program. Observations during this field work will include existing sound sources and detailed notation of the presence and locations of noise-sensitive uses.

Locations for ambient noise monitoring will be selected after performing an on-site review of the alignment alternatives and design options and after discussion and approval of right of entry for accessing SLM locations on private properties. The criteria for monitoring location selection will include proximity to project-related facilities, land use, and number of sensitive receivers in the area. In noise-sensitive areas where noise impacts from streetcar operations are possible, 24-hour noise monitoring using unattended monitors is the preferred approach. For areas potentially affected only by an increase in traffic or bus noise, staffed short-term measurements will be taken. In addition, short-term, staffed SLMs will be taken to provide data for intermediate locations that can be compared with data from long-term SLMs for use in estimating difference in day-night sound levels at additional locations throughout the project area.

All noise measurements will be taken with Larson Davis 820 Type I sound level meters that have been factory certified within the previous 12 months and field calibrated immediately prior to each measurement. The microphones of the meters will be fitted with wind screens and set approximately five feet above the ground (at a typical listening height). The meters will be set to record sound levels in hourly intervals for the long-term measurements and 15-minute intervals for the short-term measurements and will capture, at a minimum, the hourly L_{eq}, L_1, L_{10}, L_{50}, L_{min}, and L_{max}. Other noise metrics may be recorded if applicable criteria suggest the need.

10.5.2 Vibration Receiver/Use Survey

Existing uses and vibration sources will be characterized based on a field survey of the potentially affected area. This survey will be conducted based on FTA screening distances for vibration (described in a later section), and will depict the uses of all buildings within those screening distances based on field observations and determinations of uses. These data may be supplemented for locations where uses cannot be discerned based on field observations using publicly available databases that characterize land uses.

10.6 Impact Assessment Analysis Methods

This section discusses the proposed methods for conducting the noise and vibration impact analyses. By virtue of the FTA methods employed, the analytical methods described below will address both the direct and the cumulative impacts associated with the proposed facility. Potential indirect impacts associated with, for example, related development will not be considered in these impact analyses.

10.6.1 Noise Impact Assessment Procedures

10.6.1.1 Operational Impacts

Operational environmental noise impacts will be considered for various elements of the proposed project alternatives. At a minimum, potential noise impacts could occur from streetcar operations at close proximity to sensitive receivers or from an increase in bus volumes on public roadways with the Enhanced Bus Alternative. If additional ancillary facilities, such as a maintenance base, are included as part of the project, noise from these facilities also needs to be considered. No such ancillary facilities have yet been specifically identified with any of the project alternatives.

A. Streetcar Alternative

Noise from the operation of the Streetcar would primarily be expected to come from steel wheels rolling on steel rails (referred to as wheel/rail noise). Secondary sources, such as vehicle air-conditioning systems, crossing-gate bells and other ancillary equipment, will sometimes be audible, but are not expected to be significant factors. The effect of crossing gate bells, if any, will be evaluated, and this evaluation may require a source sound level measurement to characterize these bells.

Potential noise impacts from operation of the proposed streetcar will be evaluated using FTA noise impact criteria, which require comparing the existing sound levels to estimated project-related sound levels. Streetcar noise impacts will be evaluated using up to three levels of assessment established by FTA procedures, depending on the individual location. The three levels of assessment are described below.

Screening Assessment – FTA has a screening procedure to identify locations where there is little possibility of noise impacts. This procedure provides screening distances for varying types of transit projects. The screening review applies the principle that if no sensitive receivers are identified within the specified screening distance, then no noise impacts would be expected and no further assessment is necessary. This screening procedure will be applied to the proposed streetcar line. The screening distance for low and intermediate capacity transit with steel wheels is 125 feet if there are no intervening obstructions. In other words, sensitive receivers farther than 125 feet from the streetcar line would not be expected to be impacted by operational noise from the line and would not need to be considered further in the noise impact assessment.

General Assessment – For receivers not eliminated in the screening assessment, a general noise impact assessment will be performed. The FTA general assessment procedures include using fairly simple spreadsheet calculations in conjunction with specific data like type of transit source, distance of the streetcar line from the receiver, speed and number of cars per train, average number of events during daytime and nighttime hours, number of intervening rows of buildings, and the absence or

presence of noise barriers, jointed track, or embedded track. The FTA procedures apply this information in calculations to estimate project-related noise. Because some of the information is fairly generic (e.g., the sound level information used to represent the streetcar), and because the calculation procedures are simple and do not consider complex terrain/structures, ground type, or meteorology, this level of assessment can only be expected to provide a gross idea of the potential for impact in relatively simple settings.

Detailed Assessment – If the general assessment indicates the streetcar would have the potential to impact nearby receivers, use of a detailed assessment may be warranted. A detailed assessment would include using a frequency-specific sound level measurement to characterize the streetcar noise source. This would be performed using the Cadna/A noise model, a sophisticated tool capable of considering complex terrain, intervening structures or barriers, ground types, vegetation, and meteorology. This level of assessment will provide the most accurate assessment of potential future project-related noise levels at individual receiving locations.

Source Sound Level Measurements – To prepare for the Cadna/A noise modeling necessary for portions of the project alignment, several frequency-specific source noise sound level measurements have been taken along the alignment to represent noise from some of the existing equipment and from the existing Willamette Shore Line Trolley. Additional source noise data representing new equipment that would be used on the project alignment will be taken as part of the specification testing of this equipment, and these data have been requested when they become available. These data will allow for both comparisons of the two noise sources and detailed noise modeling of the streetcar source to consider sound propagation over varying land types and in complex terrain. The data collected in these measurements will be summarized in the project documentation.

B. Buses

Potential increases in bus noise due to an Enhanced Bus Alternative will be calculated using simple computations to consider the expected changes in traffic volumes due to the project, during the project's peak traffic hour. Because noise from buses traveling on public roadways is not subject to FTA noise impact criteria, impact criteria from other stakeholders will be applied. For purposes of this assessment, any potential impacts from buses will be characterized by comparing any projected bus-related sound level increases to FHWA/ODOT traffic noise impact criteria.

10.6.1.2 Construction Impacts

Temporary intrusion from noise is associated with most large construction projects. Because of the short-term nature of the intrusion, construction noise is not usually considered an impact, unless the construction will last for an extended period of time. Construction noise will be briefly assessed using standard, published construction equipment sound levels and simple distance attenuation calculations.

10.6.2 Ground-borne Vibration Impact Assessment Procedures

The vibration impact assessment identifies areas where the potential for either ground-borne vibration or ground-borne noise may exceed the applicable impact criteria.

A. Operation

The ground-borne vibration and noise assessment will focus on operation of the streetcar only. The addition of bus trips on existing roadways with the Enhanced Bus Alternative would not be expected to result in any vibration impacts.

Screening Assessment: As with the noise assessment, FTA provides a screening level assessment to identify locations for which ground-borne vibration (and related ground-borne noise) impacts are highly unlikely. The screening assessment is based on distances from the streetcar line to potentially affected receivers, and the distances vary by the type of receiver. For Category 1 receivers (e.g., research facilities with vibration-sensitive equipment, recording studios, etc.), the screening distance for intermediate capacity transit is 200 feet. For residences and places where people typically sleep (Category 2), the screening distance is 100 feet. For institutional uses such as offices (Category 3), the screening distance is 50 feet. More detail on the definition of each category is provided in the discussion of vibration impact criteria presented above.

General Assessment: A general vibration assessment will be performed for receivers within the screening distance for facility operation. Any ground-borne vibration (and related ground-borne noise) caused by operation of the streetcars will be a function of the streetcars traveling along steel track. Factors that will affect resulting levels of ground-borne vibration (and noise) include (1) the speed of the streetcars (2) the train suspension system, (3) condition of the wheels and track, (4) track type and treatments, (5) ground type, (6) building construction material and method, and (7) receiver location within the potentially affected buildings. The FTA guidance manual includes a chart used to estimate potential vibration levels (VdB) based on a reference travel speed, a general transit vehicle type, and distance from the track. From these reference vibration levels, various adjustments can be made to account for the factors outlined above. The resulting estimated ground-borne vibration levels at each potentially affected receiver will be compared to the FTA vibration impact criteria.

For ground-borne noise (GBN), an additional adjustment will be made to the estimated ground-borne vibration (GBV) level (in VdB) in order to estimate interior GBN levels in dBA. This adjustment is made based upon whether the vibration spectrum peak is expected to be around 30 Hz (low frequency) or around 60 Hz (high frequency). Because vibration from at-grade track is typically lower in frequency than vibration from subways, we will use the low frequency adjustment. The low frequency adjustment applies a reduction of 40 to the vibration VdB level to estimate the interior noise in dBA. The resulting estimated GBN level will then be compared to the suggested GBN criteria identified previously.

B. Construction

FTA screening and general impact procedures (as necessary) will be used to evaluate the potential for vibration damage during construction of the proposed streetcar facility. The general FTA procedure for estimating vibration damage from construction activities is to adjust reference vibration source levels (provided for a distance of 25 feet) to account for variations in the distances from the building to the construction equipment. The types of buildings potentially being affected are also considered as explained in a later section. Representative construction equipment and associated vibration source levels are displayed in Table 10-6. Note that the values are given in terms of peak particle velocity (PPV) in inches per second, a standard metric for characterizing GBV when assessing the potential for building damage.

Table 10-6
Vibration Source Levels for Construction Equipment

Equipment		PPV at 25 ft (in/sec)
Pile Driver (Impact)	Upper Range	1.515
	Typical	0.644
Pile Driver (Sonic)	Upper Range	0.734
	Typical	0.170
Vibratory Roller		0.210
Hoe Ram		0.089
Large Bulldozer		0.089
Caisson drilling		0.089
Loaded trucks		0.076
Jackhammer		0.035
Small bulldozer		0.003

Source: U.S. Federal Transit Administration's Transit Noise and Vibration Impact Assessment Manual, May 2006. FTA-VA-90-1003-06.

Depending on the types of construction equipment and the category of buildings, potential "minimum safe" distances for construction-related vibration damage range from 135 feet for the worst-case impact pile driving affecting a Category IV building (i.e., a building extremely susceptible to vibration damage) to less than five feet for bulldozers affecting Category I (i.e., least vibration sensitive) buildings (see Table 10-7).

Table 10-7
"Minimum Safe Distances" from Construction Equipment to Reduce Potential for GBV Damage (ft)

Equipment		Building Categories (FTA Guideline Damage Thresholds)			
		Cat I (0.5 PPV)	Cat II (0.3 PPV)	Cat III (0.2 PPV)	Cat IV (0.12 PPV)
Pile Driver (Impact)	Upper Range	53	74	97	136
	Typical	30	42	55	77
Pile Driver (Sonic)	Upper Range	33	46	60	84
	Typical	13	18	23	32
Large Vibratory Roller		15	20	26	37
Hoe Ram		8	12	15	21
Large Bulldozer		8	12	15	21
Caisson drilling		8	12	15	21
Loaded trucks		8	11	14	19
Jackhammer		5	6	8	12
Small bulldozer		2	3	3	4

Source: Calculations by ENVIRON based on FTA data and calculation techniques, 2009.

10.7 Mitigation Measures

10.7.1 Noise Mitigation Measures and Criteria

The approach used to mitigate impacts is dependent on the type of impact and method of analysis.

A. Operation

Streetcar Noise Mitigation. Streetcar noise abatement measures that may be applied for the project include noise source modifications, noise barriers, operational management, alignment design, and in some cases, building sound insulation. This section discusses such potential mitigation measures intended to address impacts related to operation of the proposed transit facility. FTA favors noise mitigation that benefits exterior (and, by extension, interior) locations, instead of focusing mitigation for interior spaces only (i.e., building sound insulation).

The initial focus would be mitigating the noise source. In this case, the primary objective would be to reduce the noise from the wheel/rail interaction, which is expected to be the primary noise source related to the streetcar operation. TriMet and PSI maintain very effective wheel truing programs that serves to keep the rail wheels in good condition with a minimum of wheel flats. Periodic rail grinding also is also performed by TriMet and is an effective method of maintaining low overall noise levels from streetcar operations.

Streetcar noise management measures could include modifying travel speeds and applying noise-reducing measures directly to the streetcar vehicles. A reduction in speed can reduce noise levels. In most cases, though, the reduction in speed conflicts with the project objectives and reduces available scheduling. Also, the reduction in noise levels is often insignificant (e.g., 1 to 3 dBA reductions with a 40 percent to 50 percent reduction in speed).

Alignment design measures involve moving the proposed alignment further away from noise sensitive receivers. Several potential alignments are under consideration for portions of the transit corridor, and a noise analysis will be performed for each of the alignments. In the event any noise impacts are identified, potential noise mitigation measures will be evaluated. It is expected that modifications to the proposed alignments would not be feasible due to limited right-of-way, locations of existing structures, and topographical conditions.

Noise barriers constitute an effective method of reducing noise associated with rail systems. Solid walls or earthen berms can be effective noise barriers. Earthen berms require much more right-of-way than walls and, for this reason, may not be feasible. Noise walls must be constructed with sufficient height to break line-of-sight between the noise source and the noise sensitive receiver. They must also be constructed with enough length to prevent significant flanking of noise around the ends of the walls. Openings in the wall (e.g., driveways, pedestrian access) can significantly reduce the barrier effectiveness. The effectiveness of potential noise barriers, if need to be considered as part of this assessment, will be assessed using the Cadna/A noise model.

In the event effective exterior noise mitigation is not possible, a variety of building treatments could reduce interior sound levels. Potential methods include installing improved outdoor/indoor sound insulation, upgrading windows, installing storm windows, and sealing or relocating all through-wall vents. These methods of noise mitigation reduce the noise levels on the inside of the structures and would only be considered in areas where no other method of noise mitigation was feasible.

Bus Noise Mitigation. It is not anticipated that the Enhanced Bus Alternative would result in noise impacts, so no noise mitigation assessment is proposed for this alternative. If noise impacts are identified due to an increase in traffic noise with the additional bus volumes, noise mitigation could be considered using ODOT reasonableness and feasibility criteria (with a . A brief discussion of the ODOT criteria follows.

- Traffic noise abatement measures that may be evaluated for the project include traffic management measures, highway design measures, and construction of noise barriers. This section discusses each of these mitigation measures.
- Traffic management measures include modification of speed limits. Reduction of traffic speed could reduce noise levels, but it typically only achieves a 3 dBA noise reduction for a 10 mph reduction in speed. Reducing speed typically conflicts with project objectives.
- Highway design measures include altering the roadway alignment and depressing roadway cut sections. No new construction of roadways is being considered as part of this project, so structural alternation of the roadways would not be practical.
- Construction of noise barriers between roadways and the affected receivers reduces noise levels by physically blocking the transmission of traffic-generated noise.

ODOT has cost criteria used for state and federally funded projects. For residential areas, all benefited residences must be considered in determining a noise barrier cost per residence. A benefited residence is any impacted or non-impacted residence that gets a reduction of 5 dBA or more with the barrier construction. A reasonable cost will be a typical maximum of $25,000 per benefited residence. The typical maximum of $25,000 can be exceeded, but shall not be higher than $35,000 per residence. To exceed the $25,000 limit, one or more of the following conditions must occur:

1. Equity and fairness
2. Logical termini for walls, close a gap between walls
3. Strong public support for mitigation
4. A noise increase of 10 dBA or more
5. High noise levels of peak-hour L_{eq} 70 dBA or higher
6. The residence was constructed prior to 1976

10.7.2 Vibration Mitigation Measures

A. Operation

Vibration mitigation measures for at-grade streetcar systems include vehicle specifications, location and design of special track work (e.g., crossovers and turn outs), special vibration isolation track support systems, and operational changes. Each of these is discussed below:

- **Vehicle Specifications:** The ideal rail vehicle, with respect to minimizing ground-borne vibration, should have a low unsprung weight, a soft primary suspension and a minimum of metal-to-metal contact between moving parts of the truck. Specifications for the proposed streetcar will be reviewed to assess for these qualities.
- **Special Track work:** Near turnouts and crossovers, levels of ground-borne vibration will be 6 to 10 VdB higher than normal because of wheel impacts at frogs. A frog is the track device at the intersection of two crossing rails. It is often possible to avoid impacts from wheel impacts at frogs by locating special track work away from vibration sensitive receivers. Another approach is to use special movable-point or spring-nose frogs that close the gap between the mainline rails. These devices can reduce the vibration levels, although they may require more maintenance than normal frogs.
- **Vibration Isolation Track Support Systems:** Ballast mats are the most common treatment for reducing levels of ground-borne vibration from at-grade ballast and tie track. A ballast mat

basically consists of a rubber pad that is placed on a concrete slab. The normal ballast and tie track is then constructed on top of the ballast mat. There are rare circumstances where the concrete slab is not needed, and the ballast mats can be placed directly on the sub-grade. Another approach is to use resilient fasteners, which work in a similar fashion to ballast mats.

- **Equipment Maintenance:** Equipment maintenance includes truing the wheels on the light rail vehicles and performing periodic rail grinding. Wheel flats and rough tracks will increase vibration levels and maintaining the light rail vehicles and rail will help to keep vibration levels to a minimum.
- **Operational Changes:** This typically would require reducing the speed of the streetcar or the frequency of operation. It is unlikely that either of these would enable the streetcar line to meet its operating objectives. Therefore, these mitigation measures are unlikely to be implemented.

The primary approaches that will be used to minimize impacts from ground-borne vibration will be to make sure that the vehicle specifications will be state-of-the-art with respect to minimizing ground-borne vibration, keep special track work as far away as possible from sensitive receptors and install resilient fasteners or ballast mats in areas where projections indicate that the vibration impact criteria would be exceeded.

B. Construction

In the event equipment is anticipated to operate nearer to any of the buildings than the distances specified in Table 10-8, potential mitigation will be identified and could include increasing the distance between the activity and the building, changing the type of equipment used, and conducting pre-construction surveys of the building to track any potential damage.

10.8 Documentation

A noise and vibration section for the project DEIS will be prepared to document the results of the noise and vibration analyses. The section will include accessible information regarding the affected environment, methods, existing noise levels, and information on the projected noise and vibration of the study alternatives. The discussion of the environmental consequences of the project will include projected noise and vibration levels, noise from ancillary facilities (if any), and an assessment of bus noise related to the project (for the Enhanced Bus Alternative). Project-related construction noise and vibration will also be discussed. Additional technical information will be provided for attachment to the DEIS or will be referenced..

11. AIR QUALITY ANALYSIS METHODS (including Greenhouse Gases)

11.1 Introduction

The Lake Oswego to Portland Transit Project (LOPT) is within a large metropolitan area and has the potential to impact air quality on both a regional and local scale. Air quality impacts for streetcar 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. On a local scale, impacts could occur as a result of increased automobile traffic at park-and-ride facilities and as a result of modified traffic patterns at some intersections.

The purpose of the air quality analysis is to compare the existing air quality conditions to the projected conditions of air quality that would be expected with the LOPT 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 analysis of local impacts will rely on the results of the traffic analysis to identify intersections with potentially high carbon monoxide (CO) concentrations. A conformity analysis will be completed for the selected alternative and will be documented in the Draft Environmental Impact Statement (DEIS).

11.2 Related Laws and Regulations

The air quality analysis and technical report will be prepared following Federal, state, and local regulations and guidelines. The regulations are summarized below.

A. Federal

- **Clean Air Act and Clean Air Act Amendments.** The Clean Air Act (CAA) and the Clean Air Act Amendments (CAAA) form the basis for a broad range of regulations that control allowable emissions and concentrations of air pollutants in the environment.

- **National Environmental Policy Act.** The National Environmental Policy Act of 1969 (NEPA) requires that Federal agencies consider environmental impacts before taking actions that could significantly affect the human environment. As interpreted by the Council of Environmental Quality (CEQ), NEPA requires that "reasonably foreseeable" direct, indirect, and cumulative effects of a proposed action be considered in the decision making process. The terms "effects" includes "aesthetic, historic, cultural, economic, social, or health" effects.

- **National Ambient Air Quality Standards.** National Ambient Air Quality Standards (NAAQS) were established by the Federal government to protect the public from air pollution. These standards are identified in EPA (and Oregon Department of Environmental Quality (ODEQ)) rules (EPA Office of Air Quality Planning (http://www.epa.gov/air/criteria.html) and Oregon Administrative Rule (OAR) 340-202-0050 through -0130). Geographic areas where concentrations of a pollutant exceed the ambient air quality standards are classified as nonattainment. Previously designated nonattainment areas, now in compliance with air quality standards, are classified as maintenance areas. Areas that meet, and have always met, the standards are classified as attainment. Federal regulations require states to prepare State Implementation Plans (SIPs) that identify emission reduction strategies for nonattainment and

maintenance areas. The Portland area is maintenance for carbon monoxide (CO) and ozone (O_3); the SIP includes maintenance plans for both of these pollutants (ODEQ, 2004 and ODEQ, 2007, respectively). The Portland region is attainment for all other criteria pollutants.

- **Mobile Source Air Toxics.** The CAAA of 1990 identified 188 air toxics, also known as hazardous air pollutants (HAPs). The EPA defines air toxics as pollutants that cause or may cause cancer or other serious health effects. The EPA assessed this list of toxics and identified a group of 21 as Mobile Source Air Toxics (MSATs), which are set forth in an EPA final rule, Control of Emissions of Hazardous Air Pollutants from Mobile Sources (66 FR 17235). From the list of 21 MSATs, EPA identified six toxics as the priority MSATs. These are benzene, formaldehyde, acetaldehyde, diesel exhaust (particulate matter / diesel exhaust organic gases), acrolein, and 1,3-butadiene. While these MSATs are considered the priority transportation toxics, the EPA stresses that the lists are subject to change and may be adjusted in future rules.

  The EPA is responsible for the establishment of NAAQS, national guidance, and guidelines for the uniform and scientifically reliable study of air pollutants. To date, there are no NAAQS for MSATs, and there are no established criteria for determining when MSAT emissions should be considered a significant issue. In its February 2006 interim guidance for MSATs in NEPA documents, the Federal Highway Administration (FHWA) has identified three levels of analysis:

  1. No analysis for projects with no potential for meaningful MSAT effects;
  2. Qualitative analysis for projects with a low potential MSAT effects; or
  3. Quantitative analysis to differentiate alternatives for projects with higher potential MSAT effects.

  Greater potential for MSAT effects typically occurs for roadways with an annual averaged daily traffic (AADT) volume of 140,000 to 150,000 vehicles or more per day in 2030 (design year).

- **Greenhouse Gases.** Climate change is a global problem caused by emissions of greenhouse gases (GHG) from every conceivable source in every nation of the world. Transit projects, in general, can both add (e.g., operations of mass transit) and reduce GHG (e.g., the overall reduction of vehicle trips). Studies suggest that transit operation emissions are less than GHG emissions from the operations of other build transportation alternatives (see Figure 2, at http://www.fta.dot.gov/documents/PublicTransportationsRoleInRespondingToClimateChange.pdf). Further, because transit projects funded by the Federal Transit Administration (FTA) vary – e.g., streetcar purchases; vehicle maintenance; construction of transit facilities, to name a few – it is difficult to provide an overall statement of transit projects' impacts on GHG. However, very generally speaking, the (adverse) impact of any one transit project on GHG emissions, even in a cumulative effects evaluation, is miniscule within the global context of the problem. Thus, the increased use of transit (in total) across the United States may have a measurable (positive and adverse) impact on the environment from the overall reduction in GHG emissions, a single transit project by itself will not. Therefore, as a general proposition, FTA does not view climate change as a useful consideration in choosing a preference from among the alternatives considered during the NEPA review of a single proposed transit project.

There are no current Federal rules for greenhouse gas reporting, and the proposed rules would likely not apply to the LOPT project, based on source type and threshold emission levels for carbon dioxide (CO_2).

- In response to Public Law 110–161, EPA has issued the Final Mandatory Reporting of Greenhouse Gases Rule. The rule requires reporting of greenhouse gas (GHG) emissions from large sources and suppliers in the United States, and is intended to collect accurate and timely emissions data to inform future policy decisions. Under the rule, suppliers of fossil fuels or industrial greenhouse gases, manufacturers of vehicles and engines, and facilities that emit 25,000 metric tons or more per year of GHG emissions are required to submit annual reports to EPA. The gases covered by the proposed rule are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), sulfur hexafluoride (SF_6), and other fluorinated gases including nitrogen trifluoride (NF_3) and hydrofluorinated ethers (HFE). The final rule was signed by the Administrator on September 22, 2009. However, given the characteristics of the LOPT project, no reporting will be required.

B. State of Oregon

- **Air Quality Standards.** The ODEQ has established state ambient air quality standards (SAAQS) in OAR Chapter 340, Division 202 (OAR 340-202), "Ambient Air Quality Standards and Prevention of Significant Deterioration (PSD) Increments", The SAAQS are at least as stringent as the NAAQS. These standards are identified in EPA and ODEQ rules (EPA Office of Air Quality Planning (http://www.epa.gov/air/criteria.html) and OAR 340-202-0050 through -0130).

- **Conformity.** Criteria and procedures for determining conformity with SIPs of transportation plans, programs, and projects in Oregon that are developed, funded, or approved by the U.S. Department of Transportation (USDOT) and by metropolitan planning organizations (MPOs) or other recipients of funds under Title 23 U.S.C. or the Federal Transit Laws are established in OAR 340-252, "Transportation Conformity". The conformity regulations are applicable to projects within nonattainment or maintenance areas, such as the LOPT.

  The requirements to demonstrate conformity for a project are twofold. First, it must be included in a conforming Regional Transportation Plan (RTP) and Transportation Improvement Program (TIP) to address long-term regional impacts. Metro evaluates the total emissions associated with all planned projects in the Portland area to determine if the projects will cumulatively exceed the emissions budget for on-road mobile sources contained within the air quality SIP. If the emissions are within the budget, then no regional adverse air quality impacts occur as a result of the planned projects, and the RTP and the TIP are found to conform. This region-wide analysis, including the extension of streetcar service (LOPT) has been completed (Metro 2035 RTP, project number 10912), and approved by FTA (February 29, 2008).

  The second requirement is that a project hot spot analysis must be performed for projects located in a CO, PM10, or PM2.5 (particulate matter less than 2.5 microns in diameter) nonattainment or maintenance area for intersections that meet hot spot analysis conformity criteria. This local hot spot analysis will be done as a part of the DEIS tasks. As mentioned

above, the LOPT project is located in the Portland CO maintenance area. To meet project level conformity, the results of the hot-spot analysis must demonstrate that the project will not cause or contribute to a violation of the NAAQS in this area.

- **Permits.** The owner or operators of an indirect source, such as a parking facility having 1000 or more spaces and within an applicable CO maintenance area, are required to obtain an Indirect Source Construction Permit (ISCP) under OAR 340-254.

  Stationary source of air pollution, such as asphalt and concrete mix plants, may be required to obtain air contaminant discharge permits (ACDP) from ODEQ. If these temporary facilities are used for the project, the operator or contractor would be required to obtain the appropriate permit(s).

- **Nuisance.** The operator of a source of fugitive dust, such as occur during construction activities, must take reasonable precautions to prevent dust from becoming airborne, and maintain and operate the source(s) to minimize emissions. Construction contractors are required to comply with OAR 340-208, which addresses visible emissions and nuisance requirements, including limits on fugitive dust that violates other regulations.

- Similar to the proposed Federal rule, GHG reporting is also covered under OAR 340-215. The rule does not apply to the LOPT project based on source type and threshold emission levels for CO_2, which are lower than the Federal standard, but still well below emissions expected from any potential stationary or indirect sources associated with the project.

C. Local

There are no additional local laws or regulations related to air quality. Many local governments are in the process of developing policies on Climate Change and Greenhouse Gasses.

11.3 Contacts, Coordination and Consultation

As part of the investigation of air quality issues pertaining to the LOPT Project, personnel will coordinate with the project team, including the traffic consultant. In addition, staff will gather information from and/or coordinate with some or all of the following Federal, state, and local government agencies:

A. Federal Agencies
- United States Environmental Protection Agency (EPA)
- Federal Transit Administration (FTA)
- Federal Highway Administration (FHWA)

B. State Agencies
- Oregon Department of Environmental Quality (ODEQ)
- Oregon Department of Transportation (ODOT)

C. Local Agencies
- Metro
- Portland Bureau of Transportation (PBOT)

11.4 Data Collection

Traffic data will be obtained from the traffic consultant for the LOPT project. A data request will be submitted to the traffic consultant for traffic volumes, and intersection data from Synchro and HCM model outputs.

Additional traffic data, as necessary for regional analyses, will be obtained from Metro. MOBILE 6.2 emission factor data will also be obtained from Metro for the applicable analysis years.

Relevant existing air quality data will be obtained from ODEQ air quality monitoring reports.

Further descriptions of data needs are provided in the analysis methods below.

11.5 Analysis Methods

11.5.1 Existing Air Quality

Air quality conditions in the region and in the LOPT project corridor will be documented using existing ambient monitoring data available from ODEQ (ODEQ, 2008). The entire LOPT project is within the CO maintenance area, which is the only pollutant of concern for this analysis. Other pollutants will not be analyzed in detail.

11.5.2 Emission Factors

Emission factors as a function of speed will be supplied by Metro for the regional emissions analysis. This will ensure that the emission factors used in this analysis are consistent with the emission factors used in the maintenance planning process. Emission factors used in the analysis of localized CO impacts in the corridor will be developed using MOBILE 6.2. This emissions model is an updated version of the Mobile Source Emission Factor Model program, which the EPA developed to calculate emission factors from highway motor vehicles in the units of grams per pollutant per mile traveled. Data for use in running MOBILE 6.2 will be provided by Metro, with consultation from DEQ on appropriate model input assumptions.

Emission factors and idle emission rates are based on average vehicle speeds, regional vehicle registration mixes and annual mileage accumulation rates, the effects of vehicle inspection and maintenance programs, and regional ambient conditions. Emission factors will be obtained for the current year (2009) and the future year analyses, for vehicle speeds of 2.5 mph (for calculating idle emission rates in grams per hour), and for the posted speed(s). Idle emission factors will be calculated by multiplying the 2.5 mph emission rates from MOBILE 6.2 (in gram per mile) by 2.5 (miles per hour), to obtain an idle emission rate in grams per hour, as required for CAL3QHC input. To be conservative, CO emission factors are based on winter temperatures.

11.5.3 Regional Impacts (Burden) Analysis

A project area burden analysis is normally conducted to show that project emissions are within the budget accounted for within the SIP, and to compare potential air quality impacts between the No Build and Build Alternatives. As mentioned above, the 2035 RTP includes the LOPT, and has been

approved by the FTA. A summary of this documentation and air quality conformity determination will serve to demonstrate this aspect of conformity for the project

11.5.4 Local Impacts (Hot Spots) Analysis

A local CO hot-spot analysis is used to identify when traffic patterns, idle times, queue lengths, and vehicle CO emission rates might lead to elevated CO levels near congested intersections, possibly exceeding the ambient air quality standards (AAQS). A comparative analysis of the local air quality impacts of the No-Build and Build Alternatives will be performed on the three or four most congested, highest volume intersections, depending on the representativeness of intersections being modeled. Signalized intersections for the CO analysis will be selected using traffic data from the LOPT project traffic analysis, following ODOT and EPA guidance (ODOT, 2008 and EPA, 1992, respectively). The guidance recommends ranking intersections based on level-of-service (LOS) and traffic volumes (vph) to select the intersections where CO impacts are most likely to occur. Signalized intersections expected to operate at LOS D, E, or F must be included in the ranking analysis.

Carbon monoxide levels near the intersections will be predicted using the EPA approved CAL3QHC air dispersion model (EPA, 1995). Project CO impact modeling evaluates PM peak hour estimated traffic counts for existing conditions (2009) and future year analyses for both the No Build and Build Alternatives. CAL3QHC is a line-source dispersion model that predicts pollutant concentrations near roadways. CAL3QHC input variables include MOBILE 6.2 free-flow and calculated idle emission factors, roadway geometries, traffic volumes, site characteristics, signal timing, and meteorological conditions. Peak one-hour concentrations are predicted using stable meteorology and peak-hour traffic flow. Table 11-1 lists the CAL3QHC input parameters used in all of the modeling analyses. Intersection signalization parameters will be obtained from the traffic consultant. Receptor locations will be selected following the methodology presented in EPA guidance (EPA, 1992). Receptors will be located on both sides of the roadways at distances of 3, 25 and 50 m along the roadway as measured from the center of the intersection and at least 3 meters from the edge of the active roadway surface. A breathing height of 1.8 meters is specified as the receptor elevation.

Table 11-1
CAL3QHC Input Parameters

Averaging Time	60 minutes (1 hour)
Surface Roughness	Locations to be determined
Wind Speed	1 meter/sec (approximately 2.2 mph)
Wind Angle	0 to 360 degrees, in 10 degree increments
Stability Class	4 (D)
Mixing Height	1,000 meters
Persistence Factor (1-hr to 8-hr conversion)	0.76 (Portland average)
Ambient Background Concentration	2.0 ppm

Source: ODOT, 2008

The evaluation of localized CO impacts is based on winter weather conditions. CO emissions are inversely proportional to temperature, due to less efficient combustion at lower temperatures. In addition, maximum CO concentrations usually occur during winter months when temperature inversions trap vehicle emissions near the ground. For the LOPT Project, 1-hour CO concentrations

will be predicted using the CAL3QHC model. A background concentration of 2 ppm will be used for the 1-hour average (ODOT, 2008). Average 8-hour CO concentrations will then be calculated by multiplying the 1-hour concentrations by the average ODOT persistence factor for Portland of 0.76 (ODOT, 2008).

11.5.5 Mobile Source Air Toxics (MSATs)

As discussed above in Section 11.2.1, the level of analysis for MSATs is dependent on the potential for the project to have an impact on MSATs, typically based on project traffic levels. The FHWA's Interim Guidance on Air Toxics Analysis (FHWA, 2006) will be used to evaluate MSAT impacts from the LOPT project.

11.5.6 Greenhouse Gases (GHGs)

As discussed above in Section 11.2.1, the impact of individual transit projects on GHGs is typically so small that it is neither relevant nor meaningful; it is not viable to evaluate a single project's effect on climate change. However, as discussed above, an estimate of operating GHG emissions will be made for the project alternatives following the methodologies used by Metro in their regional analysis for the statewide GHG reduction goals..

11.5.7 Conformity Demonstration

To demonstrate conformity, a project must be included in a conforming RTP and a hot spot analysis must be performed using Federally approved air quality models. Confirmation of the project's inclusion in the RTP will be made. The methodology for the hot spot analysis is discussed above in Section 11.5.4.

11.5.8 Short-Term (Construction) Effects

The potential for impacts to air quality during construction will be addressed qualitatively in the Air Quality Technical Report. Potential construction impacts would likely be expected from clearing, excavation, grading, blasting, and demolition. Short-term impacts may also result from additional traffic congestion during construction.

11.5.9 Indirect Effects

The forecast traffic volumes used to analyze the air quality impacts of the project alternatives will be based on the future expected land use and employment information for the project area. These analysis methodologies include expected traffic from development in the region and project area and traffic related air quality impacts will include expected development.

11.5.10 Cumulative Effects

The forecast traffic volumes used to analyze the air quality impacts of the project alternatives will include traffic from other sources. Background concentrations representing the cumulative emissions of other sources in the area are added into the predicted local concentrations for CO at intersections. Because of these inclusive analysis methodologies, the impacts will be representative of cumulative air quality impacts.

11.5.12 Summary of Permits Required

As discussed above in Section 11.2.2, the owner or operators of an indirect source, such as a parking facility having 1000 or more spaces and within an applicable CO maintenance area, are required to obtain an ISCP under OAR 340-254. Stationary sources of air pollution, such as asphalt and concrete mix plants, may be required to obtain an ACDP from ODEQ. If these temporary facilities are used for the project, the operator or contractor would be required to obtain the appropriate permit(s).

11.6 Mitigation Measures

Mitigation alternatives will be identified and considered where the evaluation of air quality impacts for the LOPT alternatives indicates that potential adverse impacts could result.

11.8 Documentation

The description of the affected environment, the results of the analysis, and the potential mitigation measures identified in the analysis will be documented in the DEIS. A technical memorandum may be prepared as additional documentation. A conformity determination will be included.

12. ENERGY IMPACT ANALYSIS METHODS

12.1 Introduction

The purpose of performing an energy analysis is to compare, in general, the amount of energy that each alternative would require to construct and operate the facility. Energy use and supply in the greater Portland/Vancouver area will be characterized for petroleum, electricity, natural gas, including supply sources, rates of energy use, and demand forecasts.

The energy consumption of the proposed project will be evaluated using the existing year, the design year and future year. It will evaluate the No-Build Alternative and the Streetcar Alternative. The existing year will serve as the base year condition in this analysis. This section describes the analysis methods that will be used to identify the effects on energy expenditure of the project alternatives and design options.

12.2 Related Laws and Regulations

No specific federal, state of local energy regulatory standards apply to the project. However, several federal state and local polices related to energy use should be considered. The analysis of energy consumption for the project alternatives will consider the expected energy demand for construction and operations of the study alternatives.

12.2.1 Federal

There are various Federal laws, regulations and guidelines related to energy conservation, many of which specifically address transit as a means for reducing energy use and use of fossil fuels. The most significant of these include:

- National Environmental Policy Act (NEPA) of 1969.
- Federal Highway Administration Technical Advisory T6640.8.
- Energy Policy Act of 2005 Public Law 109-58.
- Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991.
- US Energy Policy Conservation Act (Title 42 of the United States Code (42 USC 6201, 13401, and 13431).
- Clean Energy Act (CEA) of 2007.
- Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU)
- American Recovery and Reinvestment Act of 2009.
- Annual Energy Outlook 2009.
- State Energy Programs (SEP) Goals (10 CFR 420).

12.2.2 State of Oregon

- Oregon State Energy Plan, Biennial Energy Plan.
- Oregon Statewide Planning Goals and Guidelines: Goal 13 - Energy Conservation, (OAR 660-015-0000(13)).

- Transportation Planning Rule (OAR 660-12-035). Section 35 of the State Transportation Planning Rule (TPR), Oregon Administration Rule (OAR) (OAR 660-12-035)
- Oregon Transportation Plan.
- Oregon Highway Plan.

12.2.3 Local Jurisdictions

A. Metro

- Regional Travel Options 2008-2013 Strategic Plan

B. City of Portland

- City of Portland Comprehensive Land Use Plan.
- City of Portland: Energy Efficient Transportation Policy**.**

C. City of Lake Oswego

- Lake Oswego Comprehensive Plan

D. Multnomah County

- Multnomah County Comprehensive Plan *Policy 22: Energy Conservation* The development of energy-efficient land uses and practices;

E. Clackamas County

- Clackamas County's *Energy Sources and Conservation* plan.

12.3 Analysis Methods

The procedures and analysis will be in accordance with the ODOT Energy Manual (April 1997), Caltrans and the FTA (Federal Transit Administration). Energy used for operation and construction will be determined for each of the project alternatives. Operational energy use includes the amount of fuel energy used to operate vehicles in the primary and secondary APIs. To determine construction energy, an analysis method developed by the California Department of Transportation (Caltrans) will be used[5] which calculates energy use based on energy factors for manufacturing, processing and placement of construction materials.

Information to determine light rail and bus energy use, such as Vehicle Miles Traveled (VMT), will be provided by Metro's regional travel model. Bus energy efficiency (miles per gallon) will be based on fuel consumption estimates from the FTA and USDOE (United States Department of Energy).

12.3 Contacts, Coordination and Consultation

Sources for data for the energy analysis are:

A. Federal

- US Department of Energy (USDOE)
- Federal Highway Administration (FHWA)
- Bonneville Power Administration (BPA)

B. State of Oregon

- Office of Energy
- Department of Environmental Quality (DEQ)
- Department of Transportation

C. Regional and Local

- Northwest Power Planning Council
- Pacific Northwest Utilities Conference Committee (PNUCC)
- Tri Met
- Metro
- Portland Streetcar Inc (PSI)
- City of Portland
- City of Lake Oswego

12.4 Data Collection

Traffic volume data will be obtained from the modeling conducted for the project and reported in the transportation and traffic technical memorandum. Metro will provide travel demand model runs from the Metro regional model. These EMME/2 forecasting model runs will be calibrated for the Existing Year condition to develop growth rates for future forecasting.

Future traffic volumes forecasts for the following years: design year for the opening year of the project and the future year (2035) for the planning horizon.

12.5 Affected Environment Profile

The affected environment section provides a discussion of general energy use including the type, source and utilization for applicable energy sources in the Pacific Northwest Region and State of Oregon. This section provides a brief and general description of:

- existing use and demand for energy resources in the nation and region;
- present energy use for transportation; and
- available and forecasted supply and demand of energy.

Specifically, the discussion focuses on the energy use of petroleum fuel, electricity, and natural gases. Since gasoline and diesel are the primary fuel sources for the transportation sector the discussion focuses on energy derived from petroleum-based fuel sources. Energy use generally refers to energy originating from crude oil products, since energy derived from these sources generally account for over 95 percent of the total energy demand for the transportation sector.

12.5.1 Oregon Energy Supply and Demand

For energy generation, Oregon is part of the Pacific Northwest Regional Power system as defined by the Pacific Northwest Electric Power Planning and Conservation Act. Along with Oregon, Washington, Idaho, western Montana, and portions of Nevada, Utah, and Wyoming within the Columbia River drainage basin comprise this power system. Utilities comprising the Pacific

Northwest regional power system are bonded by coordinated operation of the regional hydroelectric generation system (OOE 2000).

Oregon utilities are also part of the Western Systems Coordinating Council (WSCC), and interconnected transmission system that links utilities and power suppliers in all 11 western states and the western Canadian provinces of British Columbia and Alberta. Being connected to this system allows participating utilities to purchase, sell and exchange power to optimize load and resource diversity amongst the participants.

12.5.2 Petroleum

Petroleum is the largest source of energy used in Oregon. Oregon imports 100 percent of its petroleum. Approximately 90 percent of Oregon's petroleum comes from refineries in the Puget Sound area in Washington through the Olympic Pipeline to Portland and then on to Eugene.

The remaining ten percent comes from California and some amounts come from the northern Rockies states and are imported from Asia and Canada. Oil from California is transported by ship, truck and rail and oil from the Rockies states are transported from Salt Lake City through Chevron's pipeline. Imported oil arrives by ship, truck, and rail (OOE 2000).

Between 1990 and 1997, Oregon's petroleum consumption grew by about eight percent (ODOE 2000). In 2000, approximately 47 percent of Oregon's energy consumption came from petroleum. Since then, the demand for petroleum has decreased, but still accounts for the largest share of energy consumption at 35.7 percent, which is substantially less than the national average of 40.5 percent (USDOE 2004).

12.5.3 Electricity

Hydroelectricity (Hydro) power is the primary source of Oregon's electrical power production, supplying approximately 60 percent of the electric supply in the Pacific Northwest (OOE 2000). Most of the Hydro power is tied to the Federal hydroelectric system, marketed and distributed by the Bonneville Power Administration (BPA), a Federal agency under the Department of Energy. BPA operates and maintains approximately 75 percent of the Pacific Northwest region's high-voltage transmission, and BPA facilities distribute approximately 45 percent of all the electric power used in the Northwest.

12.5.4 Natural Gas

The majority of natural gas consumed in Oregon comes from Western Canada. Additional natural gas used in Oregon is from the Rocky Mountain area, and a small amount comes from Oregon production fields. Gas flows into Oregon through two major pipelines. The Williams Northwest Pipeline brings natural gas produced in British Columbia, Canada and the Rocky Mountain states through Washington State, and the Pacific Gas and Electric Gas Transmission Northwest which transports gas produced in Alberta, Canada. The two major gas pipelines intersect near Stanfield, in eastern Oregon (OOE).

12.5.5 Other Energy Supplies

Other energy sources include coal and renewable resources (Hydropower, wood and wood byproducts, solar, wind, geothermal and biomass). Coal is primarily used in Oregon for power generation, and coal use has remained relatively steady. Most of the electrical generation from coal is produced in Montana and Wyoming and some of this electricity may be purchased for use in Oregon.

Renewable resources provide an increasing amount of energy, and Oregon uses more renewable energy than any other states. Hydropower and wood provide the majority of Oregon's energy supply, and Hydropower provides over half of the state's electricity. Wood supplies electricity for the lumber and paper industry.

Wind, geothermal, solar and biomass account for smaller portions of the Pacific Northwest's energy supply, but advances in technology, volatility in the more traditional power supply markets, and decrease cost of generating power from renewable sources have made renewable energy and especially wind power a more integral component of the power supply for the region.

12.6 Impact Assessment Analysis Methods

Energy analysis addresses two components: direct impact (operational energy consumption) and indirect impact (construction energy consumption). Direct energy impacts refer to the fuel consumed by study alternatives, such as buses and streetcar vehicles. Indirect energy impacts refer to the energy associated with construction of the study alternatives. The following sections describe the analysis methods.

A. Direct Impact - Operational Energy Consumption

The operational energy evaluation will involve an analysis of the energy consumed by the operations of vehicles for the No Build Alternative and Streetcar Alternative. Also referred to as the direct energy impact of the project, the operations energy is the energy consumed by vehicles using a facility based on vehicular volumes, weight, and average travel speeds. The project's long-term effects on energy supply and demand are related to the operations of the affected transportation facilities.

The direct energy analysis will be analyzed by applying the Urban VMT Fuel Consumption Method. The calculations procedure follows the guidelines outlined in the California Department of Transportation (CALTRANS) Energy and Transportation Systems Manual (CALTRANS, 1983).

Traffic volumes used for the energy analysis include average daily trips (ADT) and VMT. Vehicle type 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. Each classification is associated with a unique fuel consumption rate; autos are assumed to use gasoline fuel and trucks are assumed to use diesel fuel.

The operations energy formula will be applied to the VMT to produce the average daily and annual fuel consumption for each alternative. The calculation uses the number of vehicles, the types of vehicles, an estimated average vehicle speed and the length of roadway. The traffic volume and distance will be multiplied by a fuel consumption factor specific to the year, and estimated speed for the roadway section.

The aggregated fuel consumption will then converted to British Thermal Units (Btu)2, which will be used to provide a common unit for the purposes of calculating and comparing the different forms of energy involved in the project.

The following equation will be applied to calculate the vehicle fuel energy:

Operations Energy Formula: E = V x L x FCR x CF

Where: E = Energy consumed (Btu);

- V = Number of vehicles (ADT);
- L = Length of roadway segment (miles);
- FCR = Fuel consumption rate (gal/mile) for average speed; and
- CF = Btu per gallon conversion factor based on fuel type (gasoline vs. diesel).

Operations energy determinations include the following assumptions for vehicles:

- One gallon of gasoline for light and medium automobile vehicles provides 125,000 Btu of energy; and
- One gallon of diesel for heavy gasoline trucks provides 139,000 Btu of energy.

Computations for determining energy use for Streetcars will be determined by using the number of Streetcar vehicle miles traveled and current utility records for electrical use. The number of Streetcar vehicle miles traveled per year will be multiplied by the average electrical energy consumption factor in kilowatt-hours (kwh) to obtain the total kwh per year of electrical use. This figure is multiplied by the Btu conversion factor to determine yearly energy consumption in Btu for the Streetcar Alternative.

The following equation will be applied to calculate the Streetcar energy:

((Streetcar miles/year x 8 kwh/car mile) x 3,412 Btu/kwh days per year) = 0.124 x 109 Btu/day)

Streetcar miles will be provided by Portland Streetcar Inc, TriMet and Metro and the energy consumption factors will be provided by Portland Streetcar Inc and TriMet.

B. Indirect Impact – Construction Energy Consumption

The construction energy evaluation involves analyzing the total energy required for the construction of the Streetcar Alternative. Also referred to as the indirect energy impact of the project, construction energy covers production and transport of materials, powering on-site equipment, worker transportation and factors including the materials used in construction. The project's temporary effects on energy demand are exclusively associated with the construction of the project because no additional energy would be required after the construction is complete.

The indirect energy analysis will be conducted using the Input-Output Approach for Urban Conventional Highway Construction developed by CALTRANS (1983). The estimated amount of energy consumed by the construction of the project was based on preliminary construction cost

estimates. This approach estimates the construction energy requirements using energy factors that were developed for a variety of construction activities (e.g. construction of structures, site work, etc.). These energy factors relate project costs with the amount of energy required to manufacture, process, and place construction materials and structures.

The Input-Output Approach assigns an energy-to-dollar ratio to various roadway construction activities. The cost estimates for each type of facility are reduced to a base-year equivalent and then multiplied by the appropriate Btu per dollar ratio. Data necessary for this analysis included the type of facility proposed, i.e. urban conventional highway; and the cost of each construction activity as determined for the base year.

The following equation was applied to calculate the construction fuel energy:

Construction Energy Formula: E = C x DEF x DC

Where: E = Energy consumed (Btu);

- C = Cost of a particular construction activity (2009$);
- DEF = Dollar-to-Energy Factor (Btu/1973$); and
- DC = Dollar Conversion, Price Escalation (1973$/2009$).

The analysis will be interpolated to relate the current year/planning horizon year (2009/2035).

C. Cumulative Effects Approach

Cumulative effects occur when a project's effects are combined with those from past, present, and future projects. They can also result from individually small but collectively substantial actions that occur over a long period of time. The energy analysis relies on information generated from the forecasts of future traffic volumes and operations. The transportation model takes into account other planned and future projects and the effects of those projects on the various transportation modes, thus capturing cumulative effects.

12.7 Approach to Potential Energy Mitigation Measures

Mitigation measures are typically provided to reduce significant impacts of the project alternatives. Mitigation measures are typically not required to reduce energy impacts. However, measures are typically identified to help reduce long-term and short-term energy use.

A. Measures for Indirect Impacts

Potential measures to reduce the energy consumed by the construction of the project could include conservation of construction materials and energy-efficient practices during construction.

B. Measures for Direct Impacts

A typical goal for many transit and transportation projects is to reduce the operational energy consumed in the overall transportation system. If the energy analysis shows that the Streetcar Alternative would reduce energy consumption as compared to the No Build Alternative, then mitigation measures would not be required. If energy consumption would not be reduced by one of

the build alternatives, then decision-makers must factor this into their evaluation of whether to choose a build alternative and weigh other benefits against the increased use of energy in the transportation system. Other measures that reduce operational energy usage (reduce travel demand, improve operational efficiency, etc.) may also need to be considered.

12.8 Documentation

The energy analysis will be summarized in the DEIS. A technical memorandum may be prepared to provide additional documentation on the results of the energy analysis. The report would include sections describing the affected environment, existing energy levels, and information on the projected energy needs of the study alternatives. Project-related construction energy needs will also be discussed.

13. HAZARDOUS MATERIALS ANALYSIS METHODS

13.1 Introduction

This section describes the data sources and methods that will be used to help identify potential hazardous material or hazardous waste sites within the Lake Oswego to Portland Transit Project corridor. Hazardous wastes are defined in 40 CFR 261.3 as those specifically named in the regulation, or substances exhibiting ignitability, corrosivity, reactivity, or toxicity.

A hazardous material site is a location or facility which has a known or suspect recognized environmental condition (REC). The term "recognized environmental condition" is defined in American Society for Testing and Materials (ASTM) E 1527-05 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.[8] 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."*

Existing conditions with the project's area of potential effect will be assessed for the presence of suspected presence of hazardous substances sites of concern, and to comparatively evaluate the environmental issues likely to be encountered in the construction and operation of the project 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 project area. As the project enters later development stages, including advanced design, property acquisition, and construction, more detailed environmental engineering investigations and analysis may be conducted, including the development of appropriate site-specific management plans.

13.2 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 study alternatives.

A. Federal Environmental Protection Laws

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

[8] 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).

- Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) 1980. 42 USC 9601 et seq.
- Resource Conservation and Recover Act (RCRA) of 1976. 42 USC 9601 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 sec.
- The Toxic Substances Control Act (TSCA). 15 USC (C. 53) 2601-2692.

B. State of Oregon Regulations

The following State of Oregon regulations will guide data collection for hazardous materials sites in the project 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.

13.3 Contacts, Coordination and Consultation

The following agencies are sources of data that are expected to be used for the Hazardous Materials analysis. These agencies may be contacted by project staff to coordinate the collection on data and review the project analyses:

- U.S. Environmental Protection Agency (EPA)
- Oregon Department of Environmental Quality (DEQ)
- Oregon Water Resources Division
- Oregon Division of Consumer Business Services
- Oregon State Fire Marshall

13.4 Data Collection

A. Federal and State Database Search

A search of federal and state regulatory database records will be conducted by Environmental Data Resources, Inc. (EDR) of Milford, Connecticut. The EDR database report will meet the government records search requirements of ASTM E 1527-05 Standard Practice for Environmental Site Assessments. A detailed list on environmental databases is presented in Table 13-1. Archived regulatory files are not considered reasonably ascertainable and therefore will not be reviewed. The databases shown in the list in Table 13-1 will provide information regarding known as well as potential hazardous materials sites.

Table 13-1
Environmental Database Search Data Sources List

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
CRRACTS – Corrective Action Report
RCRIS-TSD – Resource Conservation and Recover Information System-Transportation, Storage, or Disposal Facilty
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/TSCA 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
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 Dry Cleaning Facilities
OR HAZMAT – Oregon Spills Reported to Fire Marshall
OR UIC – Oregon Underground Injection Control
OR CDL – Oregon Uninhabitable Drug Lab Properties

EDR Proprietary Historical Databases
OR Coal Gas – Oregon Former Manufactured Gas (Coal Gas) Sites

Brownfield Databases
US Brownfields – Brownfields Projects
US Inst Control – Intuitional Control Site List
OR Brownfields – Oregon Brownfields Projects
OR Inst Control – Intuitional Control Site List

B. Historic Land Use Research

Historic land use information will be reviewed using available and relevant fire insurance maps (Sanborn maps) and aerial photographs. Sanborn maps typically show historic features or former buildings, including hazardous chemical or fuel storage areas, potential release pathways (i.e. drains) and use of properties. Additional information includes site addresses, building materials, property boundaries, utility lines, and underground storage tanks. Aerial photographs can indicate commercial and industrial land uses that have potential to be impacted by the project.

When available aerial photographs and Sanborn maps will be reviewed from mid-1930s to present in approximate10 year intervals. Sanborn maps will be ordered from EDR covering a 1 block radius surrounding the study alternatives.

C. Other Data Sources

As available and appropriate, data from previous technical reports, agency file reviews, field investigations, or other site-specific evaluations that have been completed for other projects in the corridor will be examined. For example, information from the following DEQ web sites will be researched.

- Environmental Cleanup Site Information (ECSI)
- Leaking Underground Storage Tank (LUST)
- Underground Storage Tank (UST)

13.5 Affected Environment Profile

The area of potential effect (APE) for the identification of potential hazardous material or hazardous waste sites within the area of the study alternatives will be adjacent parcels or lands within 500 feet of the study alternatives. As noted earlier hazardous wastes are defined in 40 CFR 261.3 as those specifically named in the regulation, or substances exhibiting ignitability, corrosivity, reactivity, or toxicity.

The EDR database report will include the standard ASTM search radii (around the boundary of the study alternatives) for the respective databases. The search area is expanded beyond the APE to include sites either incorrectly mapped or sites with potentially long contaminated groundwater plumes. URS will review the EDR database report for hazardous material sites then located within the APE or with contamination potentially entering the APE as defined above.

13.6 Impact Assessment Analysis Methods

The following will be considered in evaluating impacts:

1. Would project operations pose a risk to human health or the environment by exposing hazardous substances? This would be evaluated using sound environmental practices and strategic goals.

2. Would project construction activities expose or exacerbate contamination, posing a risk to human health or the environment? This evaluation would rely on applicable state of federal standards and an assessment of exposure pathways and potential receptors.
3. If the project were to acquire a hazardous materials site, what are the sites that may pose the highest concerns for cleanup, potential project delays, and added costs or liabilities associated with the site cleanup? Could one of the study alternatives or a design option provide an opportunity to avoid or minimize the risk? This evaluation would be based on an assessment of known sites on, adjacent, or near the proposed Streetcar alignment, with a focus on properties to be acquired. The current status of regulatory and cleanup actions will be recorded. 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 property acquisition, 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.

An appendix table will be generated which will include the hazardous material sites located within the APE as either "near" or "displaced" by the study alternatives (Affected Environment). The term "displaced" refers to sites that could be displaced by or acquired for the study alternatives; the term "near" refers to sites located within the APE.

Using the appendix table, an Affected Environment table will be generated showing the number and type of known hazardous material sites located within the APE as either "near" or "displaced".

A review of the DEQ ECSI and LUST web sites will be conducted for additional site information which may not be provided in the EDR database report. These web sites provide a summary of the regulatory status (i.e. no further action determination), contaminants of concern, investigation history, and types of media impacted (i.e. sediment, surface water, soil, and/or groundwater). This additional information will be added to the appendix tables.

The impacts of the hazardous material sites will be evaluated for each alternative (Environmental Consequences). A table will be prepared of the hazardous material sites by each alternative.

13.6.1 Long-Term Impacts Approach

Long-term impacts could include remedial actions to address the exposure or mobilization of contaminated materials. Remedial actions could include deed restrictions, engineering controls, placement of soil caps, or groundwater treatment systems. Remedial actions could impact the project by causing delays, additional costs, or operational conflicts. If a contaminated site is discovered prior to construction (during a pre-construction assessment) the property owner would largely be responsible for remedial actions, including cleanup. It is in the best interest of the project to identify contaminated sites, and either avoid them or identify the property owner prior to acquisition. The project will also explore potential contamination within the Willamette Shoreline right-of-way and assess issues related to cleanup if contamination is found. The analysis will also discuss the use of and policies for managing hazardous materials in the operation and maintenance of Streetcar operations and maintenance facilities.

13.6.2 Short-Term Impacts Approach

Short-term impacts could include increased costs and delays from:

- Notification to regulatory agencies.
- Work stoppage due to potential exposure to construction and excavation workers.
- Identification of and negotiation with potentially responsible parties and/or regulatory agencies.
- Focused investigation/characterization of affected media.
- Implementation of remedial actions.

Construction-related equipment relies heavily on petroleum products. Improper fuel transfers may result in spills to the ground potentially leading to soil and groundwater contamination. Other chemicals are also used during construction activities. Chemical pollutants such as points, acids for cleaning masonry surfaces, cleaning solvents, asphalt products, concrete-curing compounds, and fertilizers may be used at construction sites and may be carried in runoff. Fertilizers used in landscaping contain nitrogen and phosphorus which, in large doses, can adversely affect surface waters, causing eutrophication (a condition which excessive algal growth occurs and reduces oxygen available to aquatic wildlife). This evaluation will consider typical construction techniques and compounds involved, if available, and will discuss the potential adverse effects of those compounds if released to the environment.

13.6 3 Cumulative Effects Approach

Numerous project actions could potentially have beneficial and non-beneficial effects on the project area, both during and after the completion of activities. When combined with other projects and potential development, beneficial cumulative effects include:

- Improved public and environmental safety within and adjacent to the project area as a result of subsurface investigations and site-remediation actions necessary for construction activities and risk-based site closures in the area (associated with anticipated projects in the area).
- Better understanding of existing hazardous materials located above and below the ground surface.
- Enhanced understanding of existing geologic conditions due to subsurface investigations and excavations.

The potentially non-beneficial effects include:

- Possible increase to human health and safety hazards due to potential disturbance and exposures to contaminated soil and groundwater during and after construction activities. The level of exposure to construction workers could be minimized with proper training and the use of appropriate protective equipment.
- Potential increased use of hazardous materials in the project area as a result of possible increased commercial development and activity due to project completion. Further development of the area may lead to the likelihood that sites not contaminated with hazardous materials will become contaminated. Further construction of utility corridors and structures on the impacted sites will lead to exposure to construction workers and building occupants.
- Potential increased cumulative demand for impacted soil disposal facilities.

13.7 Mitigation Measures

The acquisition and/or leasing of land containing hazardous materials could incur risk of financial liability if contamination requiring characterization, removal, or disposal were to be discovered. To reduce liability risks, the data compiled in this report would be reviewed and evaluated to identify parcels where hazardous materials are known to exist or may be present.

Prior to acquisition and/or leasing, the appropriate regulatory agencies would be contacted in order to determine whether more recent information is available, and whether further assessment of the parcels is scheduled. Entering into an agreement with a regulatory agency, such as a Prospective Purchase Agreement (PPA) may lessen future liabilities resulting from purchasing impacted properties.

Where potential hazardous materials sites would be displaced or are located in close proximity to the proposed alternative, additional in-depth study would be conducted as needed. This could include conducting geophysical surveys and/or conducting subsurface assessments. A limited sampling and analysis program, coordinated in conjunction with geotechnical investigations, could be developed and implemented on sites with known contamination.

Adverse impacts from contamination during construction would be minimized or avoided. A work plan would be designed for each site, which would include actions to be implemented if construction activities encounter impacted soil and/or groundwater. The contaminated sites must be investigated by a qualified contractor. Controls and measures would be planned, designed and implemented to avoid further exacerbation of impacted sites, and plans and procedures would be prepared to prevent future releases or spills.

Depending on the selected alternative and the potential severity of hazardous materials exposure associated with it, a Health and Safety Plan would be developed for all construction activities consistent with applicable laws in effect at the time of construction.

The closure of impacted soil and/or groundwater areas remaining beneath the newly constructed alternative would be addressed with the appropriate regulatory agencies prior to construction.

Mitigation measures for hazardous material spills will consist of accident prevention and diverting spilled materials away from surface water resources.

The construction contractor will comply with all applicable federal, state, and local laws and regulations as they pertain to the storage, handling, management, transportation, disposal and documentation of hazardous substances (as defined in ORS 465.200); oil and hazardous materials (as defined in OAR 340-108-0002); hazardous waste (as defined in 40 CFR 261 and OAR 340-101-0033); solid waste (as defined in 40 CFR 258, ORS 459 and OAR 340).

For all facilities or residences in the project area that will be renovated, relocated, or demolished, the appropriate governing bodies will be contacted to assure proper handling and disposal of regulated materials. With their approval, the work will be completed in accordance with the appropriate laws, rules, and regulations.

The construction of the preferred alternative may require the demolition of structures. Asbestos-containing materials (ACM) and other hazardous building materials including: lead-containing paints, polychlorinated biphenyl (PCB) light ballasts, mercury vapor-containing fluorescent light tubes, and mercury halide lights may have been used in these buildings.

For buildings to be relocated or demolished, the DEQ is required to be notified, even for those not containing ACM. Prior to the removal of the buildings in the proposed right of way, an Asbestos Hazard Emergency Response Act (AHERA) accredited asbestos inspector and an Oregon Department of Human Services (DHS) certified lead-based paint inspector will complete a hazardous building materials assessment. If ACM is detected in buildings that will be demolished or removed, the contractor and method of removing, handling, and disposal of the materials will be approved by the DEQ.

13.8 Documentation

The hazardous materials analysis will identify and document known or suspected hazardous materials sites, analyze the data, and compare the study alternatives in relation to potential impacts. Preliminary environmental engineering recommendations (mitigation) will be presented. A technical memorandum may be prepared that would include sections on analysis methods, data collection, agency coordination, affected environment, impacts of study alternatives, and potential mitigation measures. A summary of the data and analysis will be presented in the DEIS.

14. TRANSPORTATION AND TRAFFIC ANALYSIS METHODS

14.1 Introduction

The purpose of this chapter is to describe the approach for data collection, impacts analysis, and mitigation that the Lake Oswego to Portland Transit Project will use for traffic and transit analysis. The analysis will be developed to comply with the National Environmental Policy Act (NEPA), applicable state transportation policy, and local transportation planning policies and standards.

As the project evolves and the range of project alternatives and options becomes better understood, methods may be refined to address new and/or different issues.

14.2 Related Laws and Regulations

A. ODOT and City of Portland Standards

Local traffic impacts are measured by impacts to intersection Level of Service (LOS), delay, and queuing. The Oregon Department of Transportation (ODOT) and the City of Portland have defined standards for intersection operations. A description of the development and application of these standards to local street operations is provided below.

The ODOT Analysis Procedures Manual (APM) requires that the performance standards from the Oregon Highway Plan (OHP) be used to analyze existing conditions and the No-Build Alternative. ODOT has jurisdiction over OR 43, which runs north-south through the study area. The general OHP volume-to-capacity (V/C) standard for intersections on OR 43 is 0.99 for the highest two consecutive hours of weekday traffic volumes. Two segments of OR-43, between Bancroft Street and Taylors Ferry Road and between Terwilliger Boulevard and McVey Avenue, are Special Transportation Area, which may have alternative operational standards for each segment.

The APM states that the LOS standards contained in the Highway Capacity Manual (HCM) will be used for the evaluation of all build alternatives. The V/C standard listed in the HDM for regional highways and for district/local roads is 0.85. For all other intersections in the study area under ODOT's jurisdiction, a V/C standard of 0.99, as stated in the OHP, will be applied to the build alternatives.

The results from the Synchro/SimTraffic intersection models for the intersections along OR 43 are measured against the above standards for both the evening peak hours. Limited analysis of the morning peak hours will be prepared for locations where the morning peak traffic could be important. Table 14-1 summarizes the intersection standards for ODOT.

For City of Portland roadways, driveways, and intersections in the study area, LOS standards from the Portland Bureau of Transportation (PBOT) apply. Like ODOT, PBOT has two tiers of standards—one that is used for the analysis of the No-Build Alternative and one for the build alternatives. The LOS standard in PBOT's Transportation System Plan (TSP) states that signalized intersections must meet LOS D in the No-Build Alternative. Unsignalized intersections must meet a standard of LOS E. These standards also apply to the build alternatives. However, in the case where intersections in the build alternatives do not meet the LOS standard, they are still considered to be performing acceptably if they pass PBOT's "do no worse" policy. That is, intersections in the build

alternatives that fail to meet the LOS D/E standard, but perform better than under the No-Build Alternative, meet PBOT's requirements. Table 14-1 summarizes the intersection standards for the City of Portland.

Table 14-1
ODOT and City of Portland Intersection Standards

Jurisdiction	Method	Existing	No Build	Build
ODOT (street intersections) [1,2]	V/C	0.99	0.99	0.99
City of Portland (signalized)[3]	LOS	D	D	D[4]
City of Portland (unsignalized)[3]	LOS	E	E	E[4]

[1] The standard stated in the Oregon Highway Plan applies to existing conditions and the No-Build Alternative.
[2] The standard stated in the Oregon Highway Design Manual applies to the build alternatives.
[3] Based on the Portland Transportation System Plan.
[4] PBOT also considers build alternatives to meet standards if they perform no worse than the No Build.

For purposes of the Draft Environmental Impact Statement (DEIS), if the project would degrade an intersection's performance to an unacceptable LOS, the project will work with the operating jurisdiction to develop a cost-effective solution to mitigate the intersection performance to the minimum of the peak hour standard. If vehicular queuing blockages occur with both the No-Build Alternative and the project, then the project would be mitigated to No-Build conditions.

If the No-Build Alternative does not meet warrants or safety criteria (e.g., traffic signal warrants, access spacing criteria) but the project does, the project would include mitigation measures to address the warrants or safety impacts.

14.3 Contacts, Coordination and Consultation

- Federal
- State
- Local

14.4 Data Collection

The foundation of any traffic operations analysis is a clear and thorough understanding of existing conditions through the collection of detailed traffic data. The study area for the Lake Oswego to Portland Transit Project contains a diverse transportation system with a highway system, a network of local area roads, and bicycle and pedestrian systems. The traffic composition within the study area is mix of commuters, truck traffic, transit users, local business and residential traffic, and bicycle and pedestrian users.

The traffic data to be used in this analysis will be collected primarily during the summer of 2009. Data will include intersection turn movement counts on OR 43 at up to 20 signalized intersections, 22 unsignalized intersections, and 28 driveways. AM peak hour counts will also be collected, at up to five locations that are evaluated in the PM peak hour where the total entering volume is higher in the AM peak hour. In addition, PM peak period travel time runs and queuing observations, as well as 24-hour classification counts at select locations along the highway, will be collected. Bicycle and pedestrian counts will be collected as part of the intersection turning movement counts. Traffic data collection will occur during August of 2009. Traffic counts will be seasonally adjusted to represent the peak month of traffic volumes.

The various traffic counts for this study will be collected at sites that will be identified through discussions with Metro, ODOT, the City of Lake Oswego, TriMet, and the City of Portland staff.

The preliminary set of intersections to be evaluated is listed below. Additional intersections and/or driveway access points may be added:

A. OR Highway 43 in the John's Landing area at the following cross streets:

1. Bancroft Street
2. Moody Avenue
3. Hamilton Court
4. Seymore Court/Kelly Avenue
5. Julia Street
6. Richardson Court
7. Mitchel Street
8. Boundary Street/Landing Square
9. Sweeney Street
10. Riverside Lane
11. Flower Street
12. Pendleton Street
13. Iowa Street/driveway
14. Carolina Street
15. Dakota Street/driveway
16. Nebraska Street
17. Idaho Street
18. Vermont Street
19. Florida Street
20. California Street/driveway
21. Texas Street
22. Nevada Street
23. Taylor Ferry Road/Miles Street
24. Sellwood Ferry Road
25. Sellwood Bridge Connection
26. River View Cemetery Driveway
27. Radcliffe Road

B. OR Highway 43 Between John's Landing and Lake Oswego at the following cross streets:

1. Briarwood Road
2. Midvale Road/Elk Rock Road
3. Greenwood Road/Breyman Avenue
4. Military Road
5. Palatine Hill Road
6. Riverwood Road
7. Carey Lane
8. Riverdale Road

C. OR-43 in Lake Oswego Area at the following cross streets:

1. Terwilliger Boulevard connection/Stampher Road
2. E Avenue
3. D Avenue
4. B Avenue
5. A Avenue
6. Foothills Road
7. North Shore Road
8. Leonard Street
9. Church Street
10. Wilbur Street/Middlecrest Road
11. McVey Avenue/Green Street

14.5 Affected Environment Profile

A profile of the affected transportation environment will be prepared, including the roadway demand to capacity ratio, average travel speeds on OR-43, AM and PM peak hour travel speeds on OR-43, signalized intersection operations on OR-43, trip distribution, model split, and duration of congestion on OR-43.

14.6 Impact Assessment Analysis Methods

The impact assessment will focus on a comparison of the alternatives and design options. At the project level, the effect of each alternative on the transportation system will be evaluated with respect

to its compatibility with the statewide transportation standards and guidelines, the Regional Transportation Plan and the local Transportation System Plans.

The analysis will evaluate the effectiveness of the project alternatives in serving existing and future transportation demands within the corridor. The analysis of impacts will include travel time and other direct impacts, indirect impacts including parking revenue impacts, short-term construction impacts, and cumulative effects.

Direct Effects: The analysis of direct effects of the various alternatives during construction and operation addresses impacts that could result from acquisition of right-of-way, changes to traffic operations and changes to transit and parking.

Indirect Effects: This analysis will consider the effects of other project influences on the transportation system. The analysis would also include assessments of the degree that potential land uses changes would affect transportation, as well as a qualitative assessment of potential changes in transportation safety related to the various alternatives.

Construction-Related Effects: This analysis will evaluate the short-term impacts of the timing and duration of construction on the transportation system.

Cumulative Effects: This section will review the extent of induced impacts resulting from the project in combination with other projects in the corridor.

14.6.1 Study Area

The study area for the traffic analysis will follow the alignment of OR 43 from Bancroft Street in Portland to McVey Avenue in Lake Oswego and the alignment of the existing Willamette Shoreline tracks from the existing southern terminus of the Portland Streetcar near Bancroft Street to the southern terminus of the transit alignment near the Albertson's site in Lake Oswego. The specific limits of the study area will be determined once the project alternatives and options are finalized.

14.6.2 Study Periods

The traffic analysis will be focused on existing conditions (generally in 2009) and projected year 2035 conditions. Current traffic volumes within the study area are typically at their highest on weekdays between 7 a.m. and 9 a.m. and between 4 p.m. and 6 p.m. This trend is expected to continue into the future. The majority of the traffic performance analyses for this report will focus on PM peak hour, with limited analysis of the AM peak hour. In addition, some data will be presented for a daily (24-hour) period.

Future year traffic volumes will be based on travel demand forecasts to be provided by Metro with post-processing by David Evans and Associates Inc. (DEA) using ODOT analysis procedures methodology.

14.6.3 Travel Demand Forecasting Overview

Travel demand models have been in use since the 1950s and use a market-based approach by considering both the transportation supply and travel demand for producing mobility characteristics

such as roadway traffic volumes and transit ridership. Metro will manage the travel demand modeling for this project and provide model results to the project team.

The regional travel demand model uses a four-step process, which includes the following components:

- Trip generation determines the location, magnitude, and purpose of trip-making based on land use and socioeconomic input data.
- Trip distribution identifies origins and destinations of trips which allows the calculating of trip lengths and travel times from transportation system attributes.
- In mode choice, trips are sorted into the various vehicle, transit, walk and bike modes.
- Through an equilibrium assignment of trips, routing choices for vehicle and transit trips are determined for several time periods throughout the day.

Various modeling tools will be used to forecast travel demands and evaluate traffic operations. These are defined in the following sections.

A. EMME

The EMME transportation modeling software program assigns regional travel demands to a transportation network using an equilibrium assignment. The assignment results in roadway link volumes where no traveler can achieve additional travel time savings by changing routes. The software program itself is used to edit networks, analyze data, display and plot results, and import and export data.

The transportation analysis will use Metro's regional travel forecasting model to simulate highway and transit option packages to derive transportation performance measures. The transit assignments will be done using the EMME software package.

B. VISSIM

VISSIM is a behavior-based multipurpose traffic simulation program. For many engineering disciplines, simulation has become an indispensable instrument to optimize complex technical systems. This is especially true for transportation planning and traffic engineering, where simulation is an invaluable and cost-reducing tool.

VISSIM offers a wide variety of roadway and transit applications, integrating multiple modes of transportation including truck, bus, streetcar, bicycle, pedestrian, and general vehicular traffic. The traffic simulation model is able to model complex traffic conditions and is capable of analyzing traffic operations under both uncongested and congested conditions. For this analysis, VISSIM will be used to model streetcar operations on OR 43 in the John's Landing area (Bancroft Street to Taylors Ferry Road), at the Sellwood Bridge under the preferred replacement configuration, and in the Lake Oswego area (A Avenue to North Shore Boulevard). An existing VISSIM model for the John's Landing area will be provided by ODOT to use as a base for this analysis.

C. Synchro/SimTraffic

Synchro is a software application for optimizing traffic signal timing and performing intersection capacity analysis. The software optimizes traffic signal splits, offsets, and cycle lengths for individual intersections, an arterial, or a complete network. SimTraffic is a microscopic model that simulates individual vehicles using the roadway network. The Synchro/SimTraffic software will be used to provide Highway Capacity Manual (HCM) based intersection analysis to support the traffic, air, noise, and energy analyses.

As a microsimulation model, SimTraffic animates traffic flow based on input volumes and signal timing and is able to model congested conditions on arterials, including overcapacity operations at signalized intersections, unbalanced lane utilization, and vehicle queue buildup, and dissipation over morning and afternoon/evening peak periods. SimTraffic models signalized and unsignalized intersections, and roadway segments with automobiles, trucks, pedestrians, and buses. By basing the traffic analysis on driver behavior (driver reaction to the environment) rather than individual capacities, SimTraffic is able to model arterials as a traffic system, where congestion at one intersection influences operations both upstream and downstream of that intersection.

14.6.4 Transportation Operations Analysis Overview

A. Streetcar Operations

The VISSIM simulation model will be used to guide design improvements in shared-traffic alignment in OR 43 (Macadam Avenue) in the Johns Landing area. The VISSIM model will simulate traffic operations on OR 43, including general vehicles, trucks, bicycles, pedestrians, and the streetcar. Where appropriate, signal timing will be modified to include transit signal priority and/or preemption. When signal timing is changed, efforts will be made to maintain the No-Build level of arterial bandwidth on OR 43.

The VISSIM model will be used to evaluate both the impact of the general traffic operations on the streetcar and the impact of streetcar operations on the general traffic. Travel time, delay, and queuing will be used to evaluate the impacts.

ODOT will provide the project with a VISSIM model of streetcar operations on OR 43. This model will be used as the base for all VISSIM analysis. The model will be updated with new regional model traffic volumes to be provided by Metro and recalibrated to new traffic counts to be collected during June 2009.

B. Local Street Operations

At signalized intersections, LOS is a function of control delay, which includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay. Delays and V/C ratios are calculated for all movements at a signalized intersection, since all movements are stopped at some time during the signal cycle. Some movements, particularly side street approaches or left turns onto side streets, may experience longer delays because they receive only a small portion of the green signal time during a signal cycle even though their V/C ratio may be relatively low. It is important to examine both factors—delay and V/C ratio—before drawing conclusions about operational performance. The intersection capacity utilization (ICU) value will also be determined for each intersection. The ICU is the sum of time required to serve all movements at saturation given a reference cycle length, divided by the reference cycle length.

At stop sign-controlled intersections, LOS is also a function of control delay. In addition to calculating delay, the analysis calculates V/C ratio for all stopped movements at the intersection. Although delays can sometimes be long for some movements at stop sign-controlled intersections, the V/C ratio may indicate that there is adequate capacity to process the demand for that movement.

Key signalized and stop sign-controlled intersections will be evaluated with the Synchro/SimTraffic analysis software package, which uses methodology outlined in the *2000 Highway Capacity Manual* prepared by the Transportation Research Board. Table 14-2 summarizes the LOS criteria for both signalized and unsignalized intersections based on the manual's criteria.

Table 14-2
LOS Criteria for Signalized and Unsignalized Intersections

	Control Delay (seconds/vehicle)	
LOS	**Signalized Intersections**	**Unsignalized Intersections**
A	≤ 10	≤ 10
B	> 10 and ≤ 20	> 10 and ≤ 15
C	> 20 and ≤ 35	> 20 and ≤ 25
D	> 35 and ≤ 55	> 35 and ≤ 35
E	> 55 and ≤ 80	> 55 and ≤ 50
F	> 80	> 50

Source: Transportation Research Board, *Highway Capacity Manual*, 2000, p. 16-2 for signalized intersections and p. 17-2 for unsignalized intersections.
Note: The LOS criteria are based on control delay, which includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay.

The LOS criteria for unsignalized intersections are somewhat different than the criteria used for signalized intersections. The primary reason for this is that drivers expect different levels of performance from different kinds of transportation facilities. In general, the expectation is that a signalized intersection is designed to accommodate higher traffic volumes than an unsignalized intersection. Additionally, several driver behavior considerations combine to make delays at signalized intersections less onerous than at unsignalized intersections. For example, drivers at signalized intersections are able to relax during the red interval, while drivers on the minor street approaches to two-way stop sign-controlled intersections must remain attentive to the task of identifying acceptable gaps and vehicle conflicts. Also, there is often much more variability in the amount of delay experienced by individual drivers at unsignalized intersections than signalized intersections. For these reasons, the total delay threshold for any given LOS is considered to be less for an unsignalized intersection than for a signalized intersection.

14.6.5 Performance Criteria

Project performance criteria will be developed based on the project Purpose and Need statement. The specific performance criteria will be finalized once the Purpose and Need statement for the project is finalized.

Some potential criteria that relate directly to traffic and safety include:

- Mobility, reliability, accessibility, congestion reduction, and efficiency;
- Modal choice; and
- Safety.

The following sections describe specific measures used to evaluate each traffic and safety-related criterion in the project area.

A. Mobility, Reliability, Accessibility, Congestion Reduction and Efficiency

Measures used to evaluate mobility, reliability, accessibility, congestion reduction, and efficiency include:

- Reduction in travel times and delays.
- Reduction in the number of hours of highway congestion.
- Improvement in person throughput in the OR 43 corridor between Lake Oswego and Portland.
- Improvement in vehicle throughput in the OR 43 corridor between Lake Oswego and Portland.

B. Modal Choice

Measures used to evaluate modal choice include:

- Increased transit mode split.
- Improvement in pedestrian/bicycle connectivity.
- Increase in vehicle occupancy.

C. Safety

Measures used to evaluate safety include:

- Enhancement in transit/vehicle/freight/ safety.
- Enhancement in pedestrian/bicycle facilities and safety.

14.7 Mitigation Measures

The transportation and traffic impacts analysis will identify potential mitigation measures that could reduce or eliminate adverse transportation impacts related to the study alternatives. Potential mitigation options will be identified. It is expected that commitments to mitigation will be identified for the Preferred Alternative in conjunction with development of the FEIS.

14.8 Documentation

A transportation and traffic analysis will document analysis methods, coordination, data collection, operations, analysis of potential impacts, and any mitigation recommendations. The results will be summarized in the DEIS. Further details of the traffic and transportation will be documented in a technical memorandum.

15. PUBLIC SAFETY AND SECURITY ANALYSIS METHODS

15.1 Introduction

This section describes the methods that will be used to collect data and evaluate impacts to public safety and security for the Lake Oswego to Portland Transit Project. This analysis will be developed to comply with the National Environmental Policy Act (NEPA), state and local policies, standards and regulations, and to respond to concerns raised by the community through the public and community involvement processes.

The safety and security section of the DEIS will document potential safety and security issues and 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 transit system and its facilities. Some of the issues that will be considered in this analysis will also be discussed in other sections of the DEIS, 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 how the potential location of transit facilities might change public safety conditions based on transit related crime statistics and accident rates.

This section is also intended to communicate programs already in place and assumed to be part of the project alternatives, but which may not be readily understood by the general public. For instance, TriMet has developed and adopted a system-wide Transit Security Plan that also includes community policing goals and techniques to transit security. The study will include evaluation of the existing policies as they relate to the unique character of this corridor as a relatively remote property traversing undeveloped areas, steep slopes, trestles and a tunnel. Elements of the plan would be incorporated into the design and operation of the Lake Oswego to Portland Transit Project.

Local police and emergency response services would support TriMet's Transit Police activities. Some of these activities include:

- In house training of transit district employees to increase awareness of and prevention of criminal activities;
- Coordination with local law enforcement and emergency services 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 and emergency response; and
- Emergency communication, tracking and surveillance technology.

15.2 Related Laws and Regulations

This section describes laws, regulations and other guidance that will guide data collection and the criteria for gauging potential project effects.

A. Federal

National Environmental Policy Act (NEPA) as implemented through 40 CFR 1508. Issues raised during scoping should be addressed in the DEIS.

Federal Transportation Administration regulations and guidelines implementing fire/life/safety measures applicable the project.

B. Local

Local jurisdiction plans and polices regarding emergency service operational goals and service standards that would be used to evaluate effects and impacts including facilities and response times. These plans often establish long range goals, strategies and service standards that will be used to evaluate programs and approaches to minimize public safety concerns.

15.4 Data Collection

The project team will collect information from:

- FTA's National Transit Database (NTD) reporting program for transit-related crime and public safety incidents
- TriMet, including programs and proposals to enhance transit security and in response to directives in SAFETEA-LU
- Transportation Security Administration (TSA), which administers grants and programs under the Department of Homeland Security
- Statistical information on crime occurrences in the corridor, and available information from the cities of Lake Oswego and Portland, Multnomah and Clackamas Counties, the State of Oregon and TriMet on crime incidence and security measures in the project area, and on the existing transit system.

The study will also rely on information gathered from other technical analyses, such as accident location reporting in the Transportation section of the DEIS, and analysis of potential impacts to emergency response times, which will be discussed in the public services section of the community impacts analysis.

The study will include projections of motorized, pedestrian and non-motorized transportation traffic in and across the corridor to establish potential rates of exposure to assist with the development of mitigation measures and priorities.

15.3 Contacts, Coordination and Consultation

This study will include data from or coordination with facility staff or representatives from the following agencies and service districts/providers:

- Oregon State Police
- Lake Oswego Police
- Clackamas County Sheriff
- Multnomah County Sheriff
- Portland Police

15.4 Analysis Methods

This evaluation will address whether safety and security conditions would be negatively affected by either construction activities or the long term operation of the project. The analysis will be coordinated with the public involvement activities, which is designed to provide community members the opportunity t--o voice concerns and provide input about project design, project facility locations, and other project related issues that would influence safety and security. Project staff will provide safety and security information to the Project's technical and citizen advisory committees.

15.5 Affected Environment Profile

The affected environment profile will identify the location of existing public safety service areas and facilities. This may include fire and emergency medical services and law enforcement. Information will document location of service providers, type of service provided, area served, population served, and critical access routes and response times. The affected environment profile will report crime statistics collected by each locally to provide an overlay of existing conditions along the corridor.

15.6 Impact Assessment Analysis Methods

The project team will evaluate the degree to which study alternatives may affect public safety and security conditions. The analysis will also respond to comments and concerns raised through project related public involvement activities. It will address public safety issues at specific study alternative facilities, such as park-and-ride lots and transit stops.

15.7 Mitigation Measures

TriMet and Portland Streetcar Inc (PSI) programs for fire/life/safety and standard design procedures will be referenced as potential impact mitigation/minimization measures, along with recommendations of project staff.

15.8 Documentation

The safety and security evaluation will be documented in the DEIS. Additional details of the safety and security analysis may be included in a technical memorandum.

16. UTILITY IMPACT ANALYSIS METHODS

16.1 Introduction

This section describes the methods that will be used to collect data and evaluate impacts to major utilities by the study alternatives. Major utilities generally include any utility not owned by an individual property owner. This includes major water, sewer, power, gas, fiber optics and storm pipes in the public right-of-way. It does not include power, cable, water and sewer services to individual properties.

The Willamette Shore Line right-of-way presents a somewhat unique circumstance for utilities. It is an abandoned railroad line that includes some utilities, but it is not public right-of-way. Instead it is owned by the Consortium of local agencies that purchased it from the railroad. It currently contains some utilities. Utilities within the corridor and/or crossing the corridor are subject to the Consortium's review and approval.

16.2 Related Laws and Regulations

This section describes the laws and regulations and other guidance for data collection and gauging potential project effects on utilities.

A. Federal

National Environmental Policy Act (NEPA) as implemented through 40 CFR 1508.

This act requires federal agencies consider effects to the environment when a project has a federal nexus. The Portland to Lake Oswego Transit Project would be considered to have a federal nexus because of possible federal transit funding for the project improvements. Streetcar projects frequently encounter utility conflicts and require utility improvements or relocations.

Code of Federal Regulations Title 23 (23CFR Part 645) 23 CFR 645.

This code governs federal reimbursement for Utility Relocations. It defines eligibility and applicability for payment.

- National Electric Safety Code (NESC) and the National Electric Code (NEC).

  These codes developed by the National Bureau of Standards, the NESC and the NEC are designed to bring consistency and safety to the design, construction, operation and use of electric supply and communication installations throughout the U.S.

B. State

- Oregon Statewide Planning Goal 11 – Public Facilities and Services. Oregon Administrative Rules (OAR) 660-015-0000(11).

This regulation requires local jurisdictions in Oregon to develop community plans that include public facility plans. It primarily pertains to water and sewer provisions.

- Oregon Department of Transportation – Oregon Highway 43 runs north and south the length of the corridor. There are many utilities within this right-of-way that could be affected by a transit improvement in the corridor.

- Local Agencies: The City of Portland, City of Lake Oswego, Multnomah County, and Clackamas County all have jurisdictional lands in the corridor. Each has a comprehensive plan with utility elements that could apply in the corridor, both within the Willamette Shoreline rail corridor and within other public rights-of-way within the corridor.

16.3 Contacts, Coordination and Consultation

Project planning and engineering staff efforts will involve coordination and/or collecting data from representatives from at least the following agencies or providers:

A. Water, wastewater, and stormwater collection:

- City of Portland, Water Bureau and Bureau of Environmental Sciences
- City of Lake Oswego,
- Multnomah County,
- Clackamas County
- Oregon Department of Transportation (ODOT)
- water districts in unincorporated areas

B. Telecommunications Services

- QWEST
- Sprint
- T-Mobile
- Verizion
- Comcast

C. Electricity

- Portland General Electric
- PacifiCorp and Pacific Power

D. Natural Gas

- Northwest Natural

16.4 Data Collection

The project team will collect information from a number of sources, including:

- Preliminary project design maps
- Maps and GIS data from Metro's Regional Land Information System, the City of Portland, the City of Lake Oswego. Primarily, Metro's Regional Land Information System information will help to identify facility locations and services in the corridor area. The following types of information will be identified:

    - Sewer districts
    - Water districts
    - Utility lines and corridors

After examining maps, collecting and reviewing existing documents and project design information, the project team will conduct field visits along and within the vicinity of the project area to identify and confirm utility facilities and infrastructure that may be affected by the study alternatives. The field review will include a summary of overhead electrical transmission and distribution wires and towers, telephone lines, substations, and other utility structures that could interfere with or be compromised by the study alternatives. This inventory is intended to identify the major utilities and utility owners that could be affected by the study alternatives.

16.5 Affected Environment

The description of affected utilities will identify the location of major facilities, lines, pipes, conduits, systems, and other infrastructure on a map, either provided by the design team, service providers, or GIS. This section will indicate other relevant, significant characteristics associated the utilities and their proximity to the study alternatives and options. It may include:

- Service lines
- Areas served
- Population served
- Critical access routes
- Land identified for current or future utility improvements

16.6 Impact Assessment

Based on available project design information, the project team will evaluate whether the project design would result in any direct or indirect impacts to utility services and infrastructure. The construction impacts discussion will address the projects typical effects on existing overhead and below grade utilities such as utility crossings, utility services interruptions and revisions, utility relocations, street grades, future accessibility to infrastructure, and the ability of existing faculties to withstand potential vibrations or settlement from project alternatives. The emphasis will be on major utilities. The effects of the project on minor utilities or local connections will be more general, identifying the types of impacts that would be expected. Operation impacts may include new utility infrastructure requirements to serve the study alternatives, including rail lines, power substations, with emphasis on potential utility upgrades and substations required to meet the electrical power demand, and potential conflicts with existing utility operations.

If a major utility could be affected by construction or operation of the study alternatives, the level of impact will be estimated depending on the purpose of the affected facility, the approximate number of customers affected, and the length of the transmission conduit (e.g. pipe, wires, etc.)

Short term impacts will be determined by evaluating temporary displacements and relocations of utility facilities and possible short-term disruption of utility usage during project construction.

16.7 Mitigation

The identification of potential mitigation measures will summarize applicable design and coordination measures that may be taken to avoid or minimize utility impacts. Preliminary and final engineering for the project is expected to include extensive utility coordination and the development of more specific design and avoidance measures. Options for mitigating utility impacts could include design measures, replacement or relocation of utilities, altering planned construction timing to create services outages during more convenient times, and altering planned construction practices to limit duration of service outages and the extent of utility line impacts. Other design modifications could include utility tunneling instead of open-cut installation, as well as pipe support systems, and trench sheeting and shoring.

16.8 Documentation

The utility impacts analysis will primarily be used to inform the design of the study alternatives and further refinement of engineering details that will continue to be developed for the study alternatives and options. The utilities analysis will be documented in the DEIS. Documentation will include a summary of contacts, field surveys, maps and other data that are collected for the analysis.