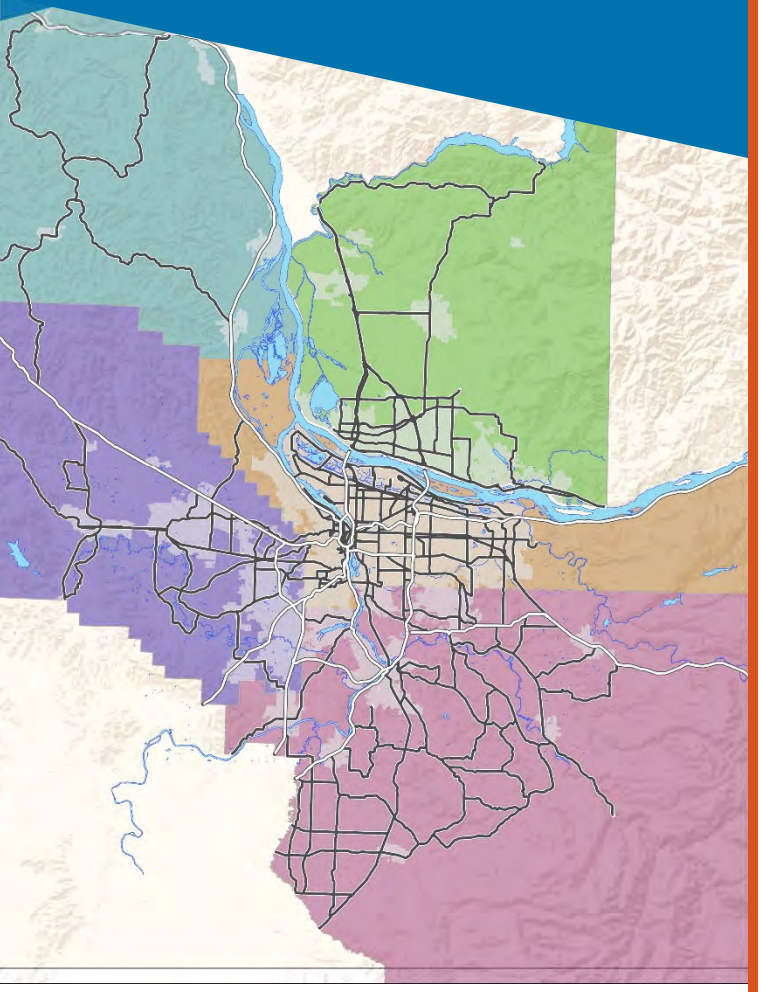

DRAFT

Phase I Draft Report

Regional Emergency Transportation Routes Update

for the Portland-Vancouver Metropolitan Region in Oregon and Washington

Prepared for

February 4, 2021
154-035-016

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DRAFT

Phase 1 Draft Report

Regional Emergency Transportation Routes Update

for the Portland-Vancouver Metropolitan Region in Oregon and Washington

Prepared for
RDPO and
Metro

February 4, 2021
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Prepared by
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EXECUTIVE SUMMARY

The five-county Portland-Vancouver metropolitan region's infrastructure systems need to be resilient and prepared for multiple natural hazards, including earthquakes, wildfires, landslides, floods, volcanoes, extreme weather events, and the increasing impacts of climate change. Emergency management planning will help mitigate the risks these hazards pose to the public health and safety of communities and the region's economic prosperity and quality of life.

Research and experience demonstrate that climate change and natural hazards have a disproportionate effect on historically marginalized communities, including Black, Indigenous and people of color (BIPOC), people with limited English proficiency, people with low income, youth, seniors, and people with disabilities, who typically have fewer resources and more exposure to environmental hazards, and are, therefore, the most vulnerable to displacement, adverse health effects, job loss, property damage and other effects.

A critical element of emergency preparedness for the region's hazards includes designation of emergency transportation routes (ETRs). First designated in 1996 by the Regional Emergency Management Group (REMG), the region established its first official network of regional ETRs. The last update occurred in 2006, under the direction of the Regional Emergency Management Technical Committee (REMTEC) of the Regional Emergency Management Group (REMG) predecessor to the RDPO.

A partnership between the Regional Disaster Preparedness Organization (RDPO) and Metro, this planning effort updated the Regional Emergency Transportation Routes (RETRs) for the five-county Portland-Vancouver metropolitan region. The geographic scope of the effort included Clackamas, Columbia, Multnomah and Washington counties in Oregon and Clark County in Washington.

Regional ETRs are travel routes that, in the case of a major regional emergency or natural disaster, would be prioritized for rapid damage assessment and debris- removal.

These routes would be used to move people, resources and materials, such as first responders (e.g., police, fire and emergency medical services), patients, debris, fuel and essential supplies. These routes are also expected to have a key role in post-disaster recovery efforts.

rdpo.net/emergency-transportation-routes

Over the past 15 years, the region has experienced significant growth and demographic changes and new technology, data and mapping have greatly expanded our understanding of the region's natural hazard risks, particularly to a catastrophic Cascadia Subduction Zone (CSZ) earthquake. During that same period investments were made to improve seismic resilience of some roads and bridges in the region and additional planning was completed by the City of Portland, the five counties and the Oregon Department of Transportation (ODOT) to evaluate seismic risks along state-designated seismic lifeline routes (SSLRs) located in Oregon.

The Regional Disaster Preparedness Organization (RDPO) and Metro initiated an update of the regional ETRs (RETRs) with funding from the Urban Areas Security Initiative (UASI). A literature review and other research conducted by the Transportation Research and Education Center (TREC) at PSU in August 2019 served as a foundation, providing a summary of recent work as well as identifying best practices and considerations for updating the RETRs. A consultant team, hired in fall 2019, provided technical support and facilitated the update with the work group, under the direction of project managers from both RDPO and Metro, and oversight from executives at both agencies.

This report presents the results of the two-year collaborative planning effort and recommendations for future work.

Phase 1 Project Scope and Timeline

The geographic scope of the planning effort included Clark County in the State of Washington and Columbia, Clackamas, Multnomah and Washington counties in the State of Oregon. The RDPO established a multi-disciplinary work group of more than thirty representatives from seventeen agencies to provide expertise in emergency management, transportation planning, public works, engineering, operations, ports and public transit.

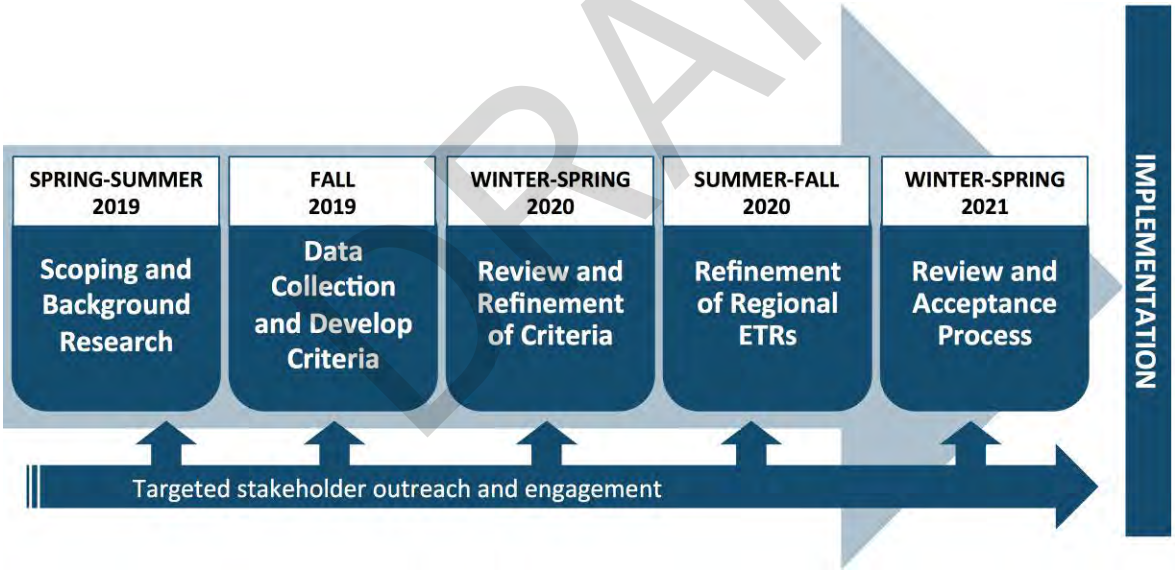

Figure ES.1 Phase 1 Project Timeline

Phase 1 Project Outcomes and Deliverables

This project represents the first phase of a multi-phase update to the regional ETRs. This phase resulted in:

- Multi-disciplinary collaboration of emergency management with transportation planning, engineering and operations, ports, transit and public works stakeholders.

- Enhanced visibility of RETRs and improved understanding of their resilience that informed a regional dialogue regarding resilience and recovery among policymakers, senior leadership and planners.
- A regionally-accepted network that provides adequate connectivity to critical infrastructure and essential facilities, as well as the region's population centers and vulnerable communities.
- A comprehensive regional GIS database and online RETR viewer established for current and future planning and operations. The data and on-line viewer provide valuable resources to support transportation resilience, recovery and related initiatives in the region.
- A regionally-accepted set of recommendations for follow-on work to support ongoing local, regional and state efforts to improve the region's resilience.

> ***Engagement of policymakers, planners, and other stakeholders was extensive for this RETR update to better integrate transportation planning with planning for resiliency, recovery, and emergency response, as well as the investments that will be needed to make the region's transportation system more resilient***

Coordination and Consultation

Regional Disaster Preparedness Organization (RDPO)

RDPO Policy Committee

RDPO Steering Committee

REMTEC- Regional Emergency Manager Technical Committee (formerly called REMG)

RDPO ETR Work Group

RDPO Public Works Work Group

Metro

Metro Council

Metro Technical Advisory Committee (MTAC)

Transportation Policy Alternatives Committee (TPAC)

Joint Policy Advisory Committee on Transportation (JPACT)

SW Washington Regional Transportation Council (SW RTC)

Oregon Department of Transportation (ODOT)

Washington Department of Transportation (WSDOT)

Oregon Department of Geology and Mineral Industries (DOGAMI)

Tri-County Metropolitan Transportation District (TriMet)

South Metro Area Regional Transit (SMART)

Clark County Public Transit Benefit Area Authority (C-TRAN)

Ports of Vancouver and Portland

Clark Regional Emergency Services Agency (CRESA)

Cities and Counties (five county region)

ETR Work Group

Key Findings from the Analysis

CONNECTIVITY AND ACCESS FINDINGS

The updated routes provide adequate connectivity and access to the routes and regionally- significant critical infrastructure and facilities identified through the process. However, there remain areas with limited alternate routes, areas with higher hazard vulnerability that may require more redundancy, and some areas with higher reliance on state routes. These areas need further attention in future phases. In addition, further study of critical infrastructure and essential facilities will help with operational decisions and future RETR updates, as they are critical in post-disaster response and continuity of life-saving/sustaining services to communities.

ROUTE RESILIENCE FINDINGS

The analysis demonstrates seismic and landslide impacts to roads and bridges will hinder connectivity and access during an emergency. Further planning and investment is needed to seismically strengthen bridges, particularly for crossings of the Columbia and Willamette rivers. Additional analysis that anticipates transportation impacts and closures that may result from a CSZ earthquake, landslide, wildfire and flood hazard risks on RETRs will be beneficial for operational decisions, disaster debris management plans and future updates. Further, an expansive engineering analysis would be necessary to identify roads and bridges at risk and propose specific retrofits to improve their survivability after a severe earthquake.

COMMUNITY AND EQUITY FINDINGS

The updated routes provide adequate connectivity and access to the region's population centers and areas with concentrations of vulnerable populations. However, there are limited alternate routes and transportation services in some rural areas where there is also a higher prevalence of people over 65, people under 18 and low-income households, with fewer travel options.

Measuring social vulnerability is complex. More in-depth equity analysis and community-specific engagement is needed to better understand and address the unique needs of urban and rural communities, particularly potential disproportionate impacts and the needs of vulnerable populations. This can help identify potential areas of concern and inform the best approaches to enhance connectivity and access, while ensuring equitable outcomes in emergencies.

BY THE NUMBERS
[insert TBD three summary infographics on the routes]
XX miles of routes are designated
XX miles new routes were designated
X% of critical infrastructure and essential facilities connected

Add regional map of the updated routes (SSLRs and RETRs)

Conclusions and Next Steps

The regional emergency transportation routes play an important role in the region's resilience and ability to respond to multiple hazards, particularly to a catastrophic CSZ earthquake. The data set and on-line RETR viewer produced in this effort will be distributed to emergency managers and transportation planners throughout the region for use in future planning and during disaster response and the early recovery period. Coordinated planning can inform emergency transportation response planning and set the stage for agencies to seek funding for improvements to increase route resiliency to accelerate response and recovery times within the region.

Section 8 of the report outlines a set of necessary follow-on work raised during the course of this planning effort, but which the current project could not meaningfully address. The recommendations are summarized below, including a Phase 2 project led by RDPO and Metro (pending funding from the Urban Areas Security Initiative) to address recommendations 2, 3, 4 and 6. Additional resources are needed to advance the full list of recommendations for future work.

	Recommendation	Level	Lead / Key Partners
1	Integrate RETRs into other planning and investment decision-making processes	State, Regional, and Local	Various
2	Prioritize or tier the regional ETRs	Regional	RDPO & Metro (RETR Phase 2)
3	Develop RETR management plans to include: RETR operations in an emergency, evaluation of specific hazard events, maintenance and coordination between jurisdictions, and transition to recovery	Local with regional facilitation	Local jurisdictions with facilitation by RDPO & Metro (RETR Phase 2)
4	Better address vulnerable populations	Regional and Local	RDPO & Metro (RETR Phase 2 and Social vulnerability Tool (SVT)
5	Integrate RETR and LETRs into evacuation planning	Local and regional	TBD
6	Formalize the RETRs and agree to a plan for consistent updates	Regional	RDPO & Metro (RETR Phase 2)
7	Engineering evaluation of top priority routes for seismic upgrades	Local and regional	TBD
8	Evaluate river routes	Regional/State	Ports and Coast Guard, State Resilience Office
9	Develop equity-centered public messaging for transportation in emergencies	Regional	RDPO Public Messaging TF
10	Evaluate bike and pedestrian options for emergency transportation	Local	Various

This report was developed and is being released at a time when the Portland-Vancouver region — along with the rest of the world — is confronting a different kind of disaster in the response to COVID-19. The region (and Oregon) also experienced devastating wildfires in September 2020 as this work was underway, underscoring the need to be prepared and resilient. The alignment of these circumstances has provided an opportunity to reflect on how the current public health and economic disruption, and the 2020 wildfires are both like and unlike the kind of disruption that may occur at a regional scale following a CSZ event.

Contents

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Phase 1 Draft Report

Regional Emergency Transportation Routes Update

for the Portland-Vancouver Metropolitan Region in for the Portland-Vancouver Metropolitan Region in Oregon and Washington

1.0 INTRODUCTION

In 2019, the Regional Disaster Preparedness Organization (RDPO), in partnership with Metro, contracted the Thuy Tu Consulting Team, consisting of Thuy Tu Consulting, LLC; Salus Resilience; Cascade GIS & Consulting, LLC; and FLO Analytics to update the designated Regional Emergency Transportation Routes (RETRs) for the five-county Portland-Vancouver metropolitan region. The approximately 4,440-square mile study area consists of Clackamas, Columbia, Multnomah, and Washington counties in Oregon as well as Clark County in Washington. The last update occurred in 2006[1] under the Regional Emergency Management Technical Committee (REMTEC) of the Regional Emergency Management Group (REMG) predecessor to the RDPO.

For this RETR update effort, the project team assembled data, input, and participation from agencies within the region; established a methodology and evaluation factors; and developed a process and proposed evaluation framework to update the existing RETRs. This first phase establishes an agreed upon updated and cataloged network of RETRs, a comprehensive dataset for use in future planning and update efforts, and an evaluation that will aid future phases of work. A second phase of the project will enable the agencies within RDPO to regionally prioritize and operationalize the RETRs for an emergency response to a Cascadia Subduction Zone (CSZ) level event or other regional emergency.

Coordinated planning and prioritization can then to inform emergency transportation response planning and set the stage for agencies to seek funding for improvements to increase route resiliency to accelerate response and recovery times within the region. Although this effort is primarily focused on updating the RETRs for emergency response immediately following a large seismic event, considerations for other natural hazards, such as flooding, landslide, and severe weather, have been incorporated into the data set and project recommendations for future consideration, including work to support all hazard transportation recovery planning.

1 REMG was created in 1993 through an intergovernmental agreement between the five counties, City of Portland, Metro, and 15 other jurisdictions in the Portland Metropolitan Region and consisted of a technical committee (REMTEC), and a policy committee of elected leaders (REMPAC). The mission was focused on information-sharing and networking among public and private sector emergency managers and advancing projects like the ETR project. REMTEC reported to REMPAC (elected leaders representing member jurisdictions) about opportunities for and the status of their regional collaborative efforts. The RDPO absorbed REMTEC into its structure, as well as the work groups of the then UASI program structure, and created new Steering and Policy Committees when its IGA was fully executed in early 2015.

1.1 Purpose and Outcomes

1.1.1 Project Purpose

This report presents the results of a 2-year regional project led by the RDPO and Metro to update RETRs in the five-county Portland-Vancouver metropolitan region. The geographic scope of the planning effort included Clark County in the state of Washington, and Columbia, Clackamas, Multnomah and Washington Counties in the state of Oregon.

1.1.2 Regional ETR Project Update Purpose

The regional ETR update project (2019-2021) built upon an existing network of regional Emergency Transportation Routes (ETRs) designated in 1996 and updated in 2006. The project accounted for multiple natural hazard risks and incorporated updated natural hazard risk analyses, such as the Oregon Department of Geology and Mineral Industries (DOGAMI) Enhanced Earthquake Impact Analysis (2018-2020) and more recent planning work by the City of Portland, the five counties, and the Oregon Department of Transportation (ODOT) to evaluate seismic risks along state-designated seismic lifeline routes (SSLRs) located in Oregon. The project also accounted for seismic updates to infrastructure within the region since 2006, such as the seismically resilient Sellwood and Tilikum Crossing bridges. **The project resulted in an expanded network of regionally-designated surface transportation routes that connects the region's most critical infrastructure and essential facilities, population centers and most vulnerable communities in the event of an emergency.**

The RETR update project report is not:

- An engineering evaluation
- A cost benefit analysis
- A capital investment plan
- A publicly reviewed plan
- A multi-modal study
- An operational plan or guideline

This planning effort was supported by the ETR work group (EWRG), a multi-disciplinary team of more than 30 local, regional, and state emergency management, transportation planning, engineering, and operations and public works staff from 17 agencies within the five counties. The EWRG provided input on the project scope and deliverables and helped to coordinate and solicit input on key deliverables from stakeholders in their respective jurisdictions. The members of this work group are listed in Appendix A.

Project Outcomes

1. Multi-disciplinary collaboration of emergency management with transportation planning, engineering, and operations, ports, transit and public works stakeholders.
2. Enhanced visibility of regional ETRs and improved understanding of their resilience that informed a regional dialogue regarding resilience and recovery among policymakers, senior leadership, and planners in the region.
3. A regionally-accepted network of updated RETRs that provides adequate connectivity to critical infrastructure and essential facilities as well as the region's population centers and vulnerable communities.

4. A comprehensive Geographical Information System (GIS) database and on-line RETR viewer established for future planning and operations. The data and on-line viewer provide valuable resources to support transportation resilience, recovery and related initiatives in the region .

5. A regionally-accepted set of recommendations for follow-on work to support ongoing local, regional and state efforts to improve the region's resilience.

1.1.3 Key Project Deliverables

As guided by the EWRG, the key deliverables of this first phase of the RETR update project include the following:

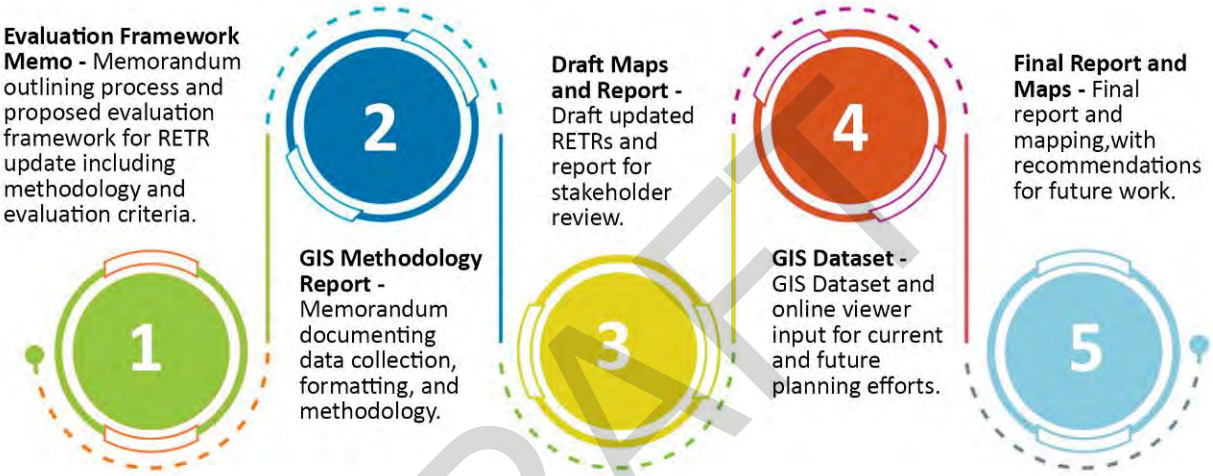

Figure 1.1: Key Project Deliverables

1.1.4 Process and Timeline

The project team established the following process and timeline for updating the RETRs.

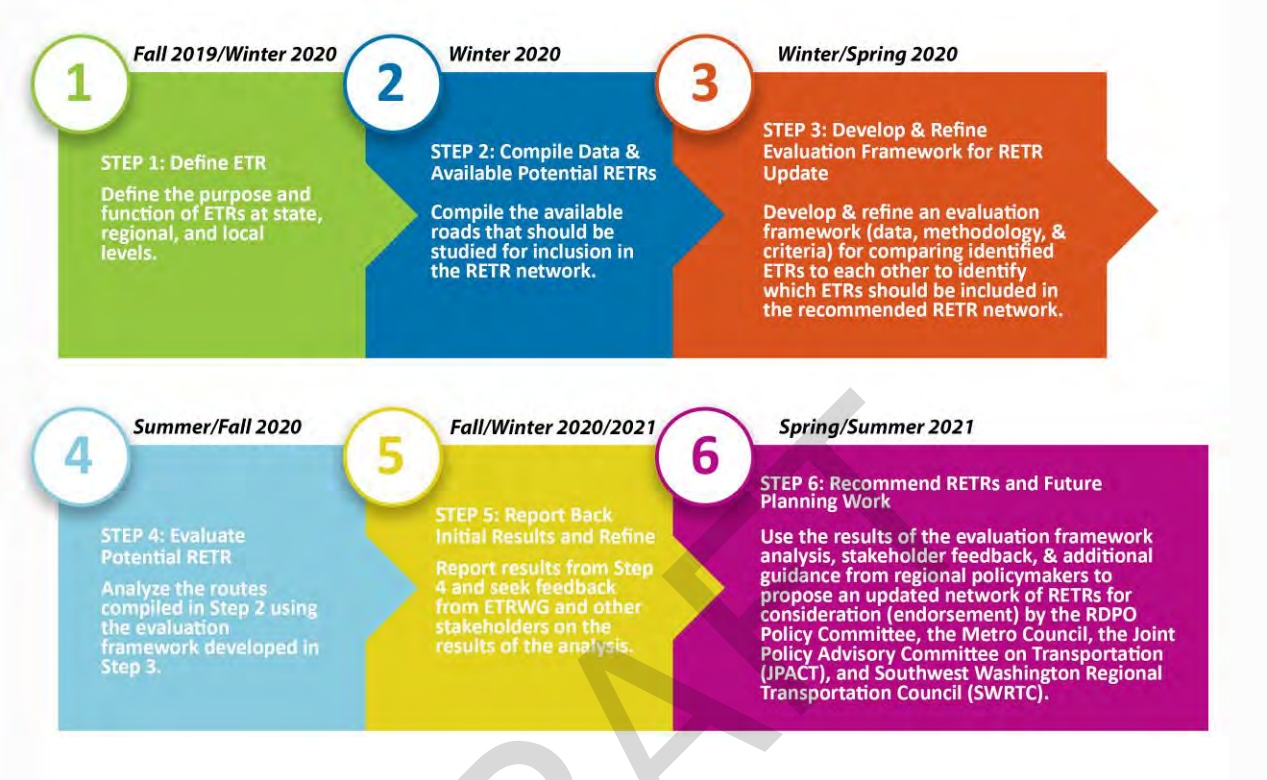

Figure 1.2: Process and Timeline for RETR Update Project

1.2 Document Contents

- **Section 1** provides the introduction, purpose, and project outcomes with key deliverable and approach.
- **Section 2** provides the background and history of regional ETRs and the summary of a Portland State University (PSU) memorandum on best practices for emergency transportation route designations developed in 2019.
- **Section 3** provides an overview of key concepts and the ETR development methodology. Definitions are provided for ETRs, critical infrastructure, and essential facilities. The process included compiling data and available potential RETR routes; developing the evaluation framework for RETR designation; and evaluating the potential RETRs based on route connectivity and access, route resiliency, and community and equity.
- **Section 4** provides a brief summary of data collection, data analysis methods, and mapping components for the project.

- **Section 5** provides analysis results, considerations and assessments of route connectivity, and route resilience and community and equity implications. A discussion on debris management, route redundancy, highlighted routes with significant resilience issues, and routes to be refined at a later date is also provided in this section.
- **Section 6** provides the final updated route summary.
- **Section 7** outlines the anticipated applications and recommendations for future planning work.

2.0 STAKEHOLDER ENGAGEMENT PROCESS

2.1 Introduction

A partnership of the Regional Disaster Preparedness Organization (RDPO) and Metro, the Regional Emergency Transportation Routes (RETRs) update resulted in an update to the regional ETR designations for the five-county Portland-Vancouver region, which includes Clackamas, Columbia, Multnomah and Washington counties in Oregon and Clark County in Washington. The last update occurred in 2006.

A project management team comprised of RDPO and Metro project managers provided day-to-day oversight of the project and management of the consultant team. A project executive team comprised of RDPO and Metro management provided strategic policy guidance and support to the project management team.

The ETR working group—a multi-disciplinary team of more than 30 local, regional, and state emergency management, transportation planning and public works staff from 17 agencies—supported the planning effort. The working group provided input on the project deliverables and helped to solicit input on key deliverables from stakeholders in their respective jurisdictions.

The planning effort evaluated existing and potential routes across a range of connectivity, resilience and equity factors to recommend an updated set of designated regional ETRs that:

- Connect to Statewide Lifeline Routes in Oregon
- Provide connectivity and access to state and regional critical facilities and essential destinations within and across the five-county region

A partnership between the Regional Disaster Preparedness Organization (RDPO) and Metro, this planning effort updated the Regional Emergency Transportation Routes (RETRs) for the five-county Portland-Vancouver metropolitan region. The geographic scope of the effort included Clackamas, Columbia, Multnomah and Washington counties in Oregon and Clark County in Washington. Regional ETRs are travel routes that, in the case of a major regional emergency or natural disaster, would be prioritized for rapid damage assessment and debris-clearance. These routes would be used to move people, resources and materials, such as first responders (e.g., police, fire and emergency medical services), patients, debris, fuel and essential supplies. These routes are also expected to have a key role in post-disaster recovery efforts.

rdpo.net/emergency-transportation-routes

- Provide connectivity and access to the region's population centers and most vulnerable communities

The planning effort also developed a database of readily available geospatial data and identified recommendations for future planning work. The database is expected to be a valuable resource for coordination with stakeholders for ongoing state, regional, and local emergency response planning and resilience efforts as well as development of local and regional transportation plans and capital improvement programs. Coordinated planning can help set the stage for agencies and the region to seek funding for improvements to increase route resiliency to decrease response and recovery times within the region.

2.2 Project Timeline and Process

The overall project timeline is provided in **Figure 2-1**.

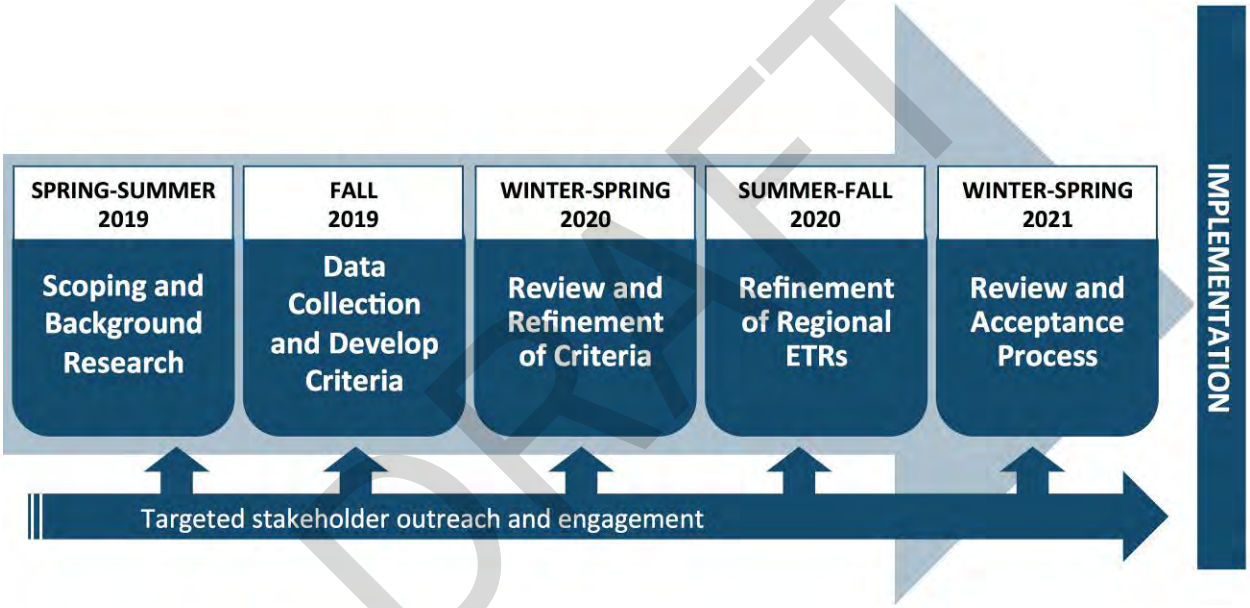

Figure 2.1: Timeline for Updating Regional Emergency Transportation Routes

Technical work and engagement of policymakers, planners and other stakeholders was more extensive for this RETR update to better integrate transportation planning with planning for resiliency, recovery and emergency response as well as the investments that will be needed to make the region's transportation system more resilient.

2.3 Stakeholder Engagement Overview

The RDPO and Metro developed a focused stakeholder engagement plan with the ETR work group that aimed to:

- Communicate complete, accurate, understandable, and timely information to the regional stakeholders throughout the project.

- Actively seek stakeholder input prior to key milestones during the project and share with Metro Council and RDPO Steering and Policy committees in a manner that supports the decision-making and acceptance process.

- Build broad stakeholder support for project outcomes.

- Provide meaningful opportunities for input from policymakers and key stakeholders.

2.3.1 Summary of Key Engagement Activities | 2019 to 2021

The stakeholder engagement plan guided the strategic direction, approach and desired outcomes for sharing information with and seeking input from local, regional and state partners and relevant transportation, emergency management, and public works stakeholders throughout the process.

The engagement plan relied on existing RDPO and Metro technical and policy committees and working groups (including the ETR work group that was formed to advise on this project) as well as briefings to county coordinating committees to engage individual cities within each county in a coordinated manner.

A summary of activities in 2019 and 2020 is provided below (2021 engagement will be added to the final report):

- 7 Regional ETR work group meetings *(2019-2020)*
- 2 TPAC/MTAC workshops *(2019-2020)*
- 1 community leaders' forum *(2019)*
- 10 county-level coordinating committee meetings *(2020)*
- 3 county-level coordinating committee meetings *(2020)*
- 8 jurisdictional specific meetings to review draft maps *(2020)*
- 3 REMTEC briefings *(2019-2020)*
- 2 Public Works work group briefings *(2020)*
- 3 RDPO Steering Committee briefings *(2019-2020)*
- 1 Joint Policy Advisory Committee on Transportation briefing *(2019)*
- 1 Metro Council briefing *(2020)*
- 1 Southwest Washington Regional Transportation Council briefing *(2020)*

2.3.2 Agency and Jurisdictional Outreach and Coordination

RDPO and Metro staff engaged and consulted with cities, counties and agencies with focused outreach and communication efforts to address specific needs of each agency or jurisdiction and facilitated collaboration and coordination among the agencies and jurisdictions in the process. Throughout the process, staff engaged, consulted and coordinated with:

- Transportation, emergency management, and public works departments of each of the five counties and the City of Portland (via the RDPO's working groups for these disciplines)
- Oregon Department of Transportation (ODOT)
- Washington Department of Transportation (WSDOT)

- Oregon Department of Geologic and Mineral Industries (DOGAMI)
- Transit providers, including TriMet, SMART, and C-TRAN
- Port of Vancouver
- Port of Portland
- Cities within each of the five counties (through RDPO working groups, Metro advisory committees, jurisdiction specific meetings, and county coordinating committee meetings)
- Clark Regional Emergency Services Agency (CRESA)

The team convened seven ETR work group meetings and two joint MTAC/TPAC workshops in 2019 and 2020. The project team engaged the Metro Council, the Joint Policy Advisory Committee on Transportation (JPACT), standing County Coordinating Committees (as well as their technical advisory committees), Southwest Washington Regional Transportation Council (SW RTC), and Southwest Washington Regional Transportation Advisory Committee (RTAC).

The RDPO working groups of REMTEC, which includes representatives from electric and natural gas utilities and Public Works (which includes the Regional Water Provider's Consortium), were engaged and consulted as key stakeholders due to their roles in emergency response and/or critical infrastructure and social services for vulnerable populations.

In March 2020, the COVID-19 emergency declaration and response prompted Emergency Operations Centers (EOCs) to activate region-wide and forced cancellation of in-person meetings throughout Oregon and Washington for the remainder of the project. As a result, most engagement activities in 2020 occurred online using virtual meeting platforms.

2.3.3 Community Engagement

On August 2, 2019, Metro hosted a community leaders' technical briefing and discussion, bringing together community leaders focused on social equity, environmental justice, labor fairness and community engagement. Invitees included community representatives on Metro Policy Advisory Committee (MPAC), Metro's Committee on Racial Equity (CORE), Metro's Public Engagement Review Committee (PERC), Metro Technical Advisory Committee (MTAC) and Metro's Transportation Policy Alternatives Committee (TPAC), as well as previous participants in 2018 Regional Transportation Plan (RTP) regional leadership forums and those involved in discussions about an affordable housing measure. More than 100 community leaders were invited, and approximately 20 leaders participated. The regional ETR update was one of three planning efforts community leaders were asked to provide feedback on.

Organizations who participated in the Community Leaders' Forum:

- Woodlawn Neighborhood Association
- Urban League
- Sullivan's Gulch Neighborhood
- Asian Pacific American Network of Oregon (APANO)
- Immigrant and Refugee Community Organization (IRCO)
- Portland African American Leadership Forum (PAALF)

- Willamette Falls Trust
- Proud Ground
- The Street Trust
- 1000 Friends of Oregon
- Transportation for America
- Verde
- Central City Concern
- East Portland Action Plan
- Safe Routes to School Partnership

Appendix B contains a summary of the discussion.

2.3.4 Public Information

Information on the progression of the project was communicated through a project website (https://rdpo.net/emergency-transportation-routes), project factsheets, and ongoing agency and jurisdictional outreach.

Appendix B includes a summary of key engagement and consultation activities from 2019 to 2021, which includes agency and jurisdictional outreach and coordination, community engagement, public information, decision-making processes and endorsements. **Section 8** outlines t recommendations for future planning and engagement work.

3.0 BACKGROUND AND HISTORY

3.1 History of RETRs

First designated in 1996 by REMG, the current RETRs are priority routes targeted for rapid damage assessment and debris removal during an emergency to facilitate life-saving and life-sustaining response activities. They were established in a memorandum of understanding (MOU) between the ODOT; WSDOT; the Port of Portland; Clackamas, Columbia, Multnomah, and Washington counties; and the City of Portland in 2006. The route changes are shown below in Figure 3.1.

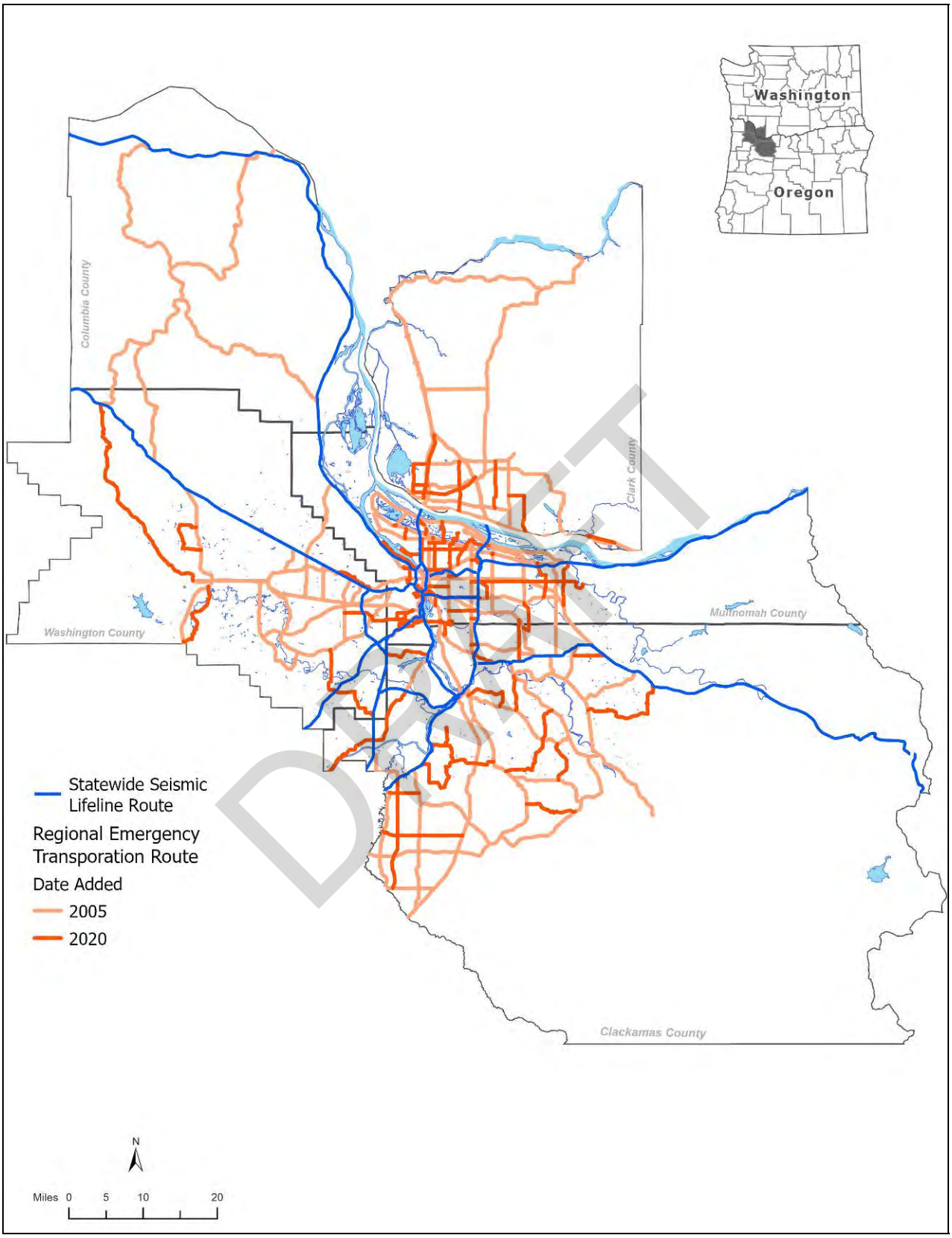

Figure 3.1. Evolution of RETRs

Since 2006, the region has experienced significant growth and demographic changes and new technology, data, and mapping have greatly expanded our understanding of the effects of seismic hazards in the region. The project considered these population trends and better-defined risks, as well as priorities for emergency response. Priorities for emergency response include debris removal and transport of first responders (e.g., police, fire, public works, emergency medical services), fuel, essential supplies, debris, and patients, and access to critical facilities and services, especially for vulnerable populations.

This RETR project delivers an updated RETR map and data in GIS platform, a list of ETR corridors, and accompanying report, and recommendations for use by state, regional, and local entities in future planning for resiliency, recovery and emergency response.

For the purposes of this project, the RETRs were primarily evaluated using a seismic lens (including landslide risk), specifically for a CSZ level event. The evaluation considered other hazards, such as flooding and landslides,; however, due to the limited scope and budget of this project, a future project that includes a more detailed evaluation of these and other hazards, such as wildfire, severe weather, and climate change, has been recommended in *Section 7 Anticipated Applications and Recommendations for Future Work* of this report.

3.2 Summary of Portland State University Research

A background research report developed by the Transportation Research and Education Center (TREC) at PSU in August 2019 provides a summary of best practices and considerations for updating the RETRs in the Portland-Vancouver metropolitan region. That report is included in this report as Appendix C. The authors reviewed local, regional, and statewide technical documents and reports authored by various planning, policy, and emergency management agencies. They also solicited feedback from representatives at the City of Portland Bureau of Transportation (PBOT) and ODOT, as well as Multnomah, Washington, Clackamas, Columbia and Clark counties. These documents are included in the appendix of the report, their publication date, agency, and how ETRs are defined within the document and their context on emergency transportation is outlined in the review summary.

Based on the PSU research, four types of ETRs were discussed in local, regional, and statewide planning, engineering, and emergency management documents. Among all the documents reviewed, the majority of the documents identified transportation as crucial to recovery after a disaster. Some pointed out that routes may be impassable following an event, and others discussed the use of evacuation routes in the event of an emergency; however, none established criteria or processes for identifying ETRs at the local or regional level. The background provided in this report acted as the foundation for the development of our update methodology outlined in *Section 3.0 Overview of Key Concepts and ETR Development Methodology*.

3.3 ODOT and Local Government Document Review

3.3.1 Statewide Seismic Lifeline Routes Review

The team reviewed the ODOT Seismic Lifelines Evaluation, Vulnerability Synthesis, and Identification report dated May 2012 and subsequent Seismic Plus report (2014). This report identified three main goals of lifeline routes.

1. Support survivability and emergency response efforts immediately following event
2. Provide transportation to facilities that are critical to life support functions for interim period following event
3. Support statewide economic recovery

The reports establish a three-tier system for prioritizing retrofits of lifeline segments, with the most critical linkages necessary to serve the greatest number of residents at the lowest investment of time and money get top priority. Links to the reports are provided below, and Section 6 of the report outlining ODOT's Statewide Seismic Lifeline Routes is provided in Appendix D. which includes tier definitions and a map of Tier 1, 2, 3 routes.

https://www.oregon.gov/ODOT/Planning/Documents/Seismic-Lifelines-Evaluation-Vulnerability-Synthese-Identification.pdf

https://www.oregon.gov/ODOT/Bridge/Docs_Seismic/Seismic-Plus-Report_2014.pdf

3.3.2 ODOT and County Seismic Lifeline Bridge Detour Reports

In 2018, ODOT requested that each county in western Oregon develop recommendation for local alternate routes that could serve as detours to SSLRs (defined in *Section 3.1.2 Define Critical Facilities and Essential Facilities*) that have seismically vulnerable bridges. The goal was to evaluate potentially more resilient bridges or routes with bridges that would be more cost-effective to retrofit or replace than retrofitting or replacing seismically-vulnerable bridges on the statewide seismic lifeline routes. Multnomah, Clackamas, and Washington counties completed this review concurrent with the RETR update.

Each county convened a work group that included ODOT and the cities in their respective county to complete this work. While the overall approach, stakeholder engagement and level of analysis varied in each county, each county considered unstable slopes, liquefaction, and landslide susceptibility in their evaluation of ETRs. Clackamas County used this work to update and prioritize their County's ETRs considering hazard data as well as populated areas, isolated populations and locations of critical infrastructure and essential facilities. Washington County used this work as an opportunity to update their County ETRs, similar to Clackamas County, but did not prioritize their routes. Multnomah County limited their focus to the SSLRs, considering unstable slopes and landslide susceptibility and did not review their County ETRs more broadly to identify potential updates, considering populated areas and locations of critical facilities. Recommendations for seismic detour routes from each county were shared with the RETR project team and have been included in the updated RETRs.

3.3.3 City of Portland Transportation Recovery Plan

In addition to the three ODOT/County seismic lifeline bridge detour reports, the City of Portland developed a Transportation Recovery Plan in 2018. Development of the plan included a review of ETRs and critical infrastructure and facilities in the City of Portland. The Plan identified several recommendations that have been included in the updated Regional ETRs, including the addition of:

- New and/or improved transportation facilities (such as the new Sellwood Bridge and the Tilikum Crossing)
- Routes that provide access to the Oregon Health Sciences University (OHSU) campus, TriMet's Center Street, Merlo and Columbia Boulevard bus garages.

4.0 OVERVIEW OF KEY CONCEPTS AND ETR DEVELOPMENT METHODOLOGY

4.1 Key Concepts and Definitions

4.1.1 Define ETRs

Emergency Transportation Route (ETR): Routes used during and after a major regional emergency or disaster to transport resources and materials including first responders (e.g., police, fire and emergency medical services), fuel, essential supplies, debris, equipment, patients and personnel.

The first step in developing our methodology was to develop specific definitions of ETRs based on the PSU/TREC research included in Appendix C, on local, regional, and state ETRs planned in the region; best practices from other states and British Columbia, Canada; and discussions with the RDPO EWRG and other stakeholders. The results of this research and stakeholder discussions indicate that the levels and types of ETRs planned within the region have not been consistently defined to date and often overlap. To establish a common definition in the region, **an ETR is defined as a route used during and after a major regional emergency or disaster to transport emergency resources and materials, including essential supplies, debris, equipment, patients, and personnel.** It is recognized these routes will also play an important role as the region transitions from emergency response to recovery in the short- and long-term. Section 3.1 .2 distinguished between five tiers of ETRs and their role in an emergency,

4.1.2 Define Critical Facilities and Essential Facilities

Critical infrastructure and essential facilities are grouped into three categories: State/Regional, County/City, and Community/Neighborhood. Critical infrastructure in this case includes lifelines other than the roadway transportation network, such as water, wastewater, electricity, fuel, communications, and intermodal transportation (e.g., transit, rail, airports, and marine terminals, river access points). Utility GIS data were not readily available for this project; however, a brief review of connectivity to Portland Water Bureau (PWB) critical infrastructure was included. These data are not included in the overall GIS database for security reasons.

Essential facilities included places such as hospitals and health care facilities; emergency operations centers (EOCs); police and fire stations; public works facilities; state, regional, and local points of distribution (PODs); designated debris management sites; and shelters and community centers.

Table 4.1 below shows how critical infrastructure and essential facilities are grouped into the three categories based on what is typically accessed from each level of ETR (see graphic on following page for levels). Further details on the critical infrastructure and essential facilities incorporated in the GIS analysis can be found on in *Section 4.2 Compiled Data and Available Potential RETRs*.

Table 4.1 – Critical Infrastructure and Essential Facilities

Category	Critical Infrastructure Considered	Essential Facilities Considered
State/Regional	• Airports • Marine port terminals • Rail yards • Regional level lifeline facilities, such as power and water transmission lines and state and regional fuel PODs • Regional transit facilities, such as transit EOCs, bus barns, and maintenance facilities	• Regional hospitals • State, regional and county EOCs • State and regional PODs • State and county public works facilities and equipment stores • Regional Debris management sites • Fairgrounds
City/County	• Local lifeline facilities, such as local water transmission infrastructure • Local river connections (boat ramps) • Transit hubs and transit centers	• Health clinics and local hospitals and health care facilities • Police and fire stations • City EOCs • County and city PODs • City and utility public works facilities • Designated debris management sites • Local Transit Centers
Community/Neighborhood	• Lifeline distribution systems • Isolated lifeline distribution infrastructure	• Churches • Schools • Community centers • Shelters • Community PODs

Considering the background research and stakeholder input, the project team identified five tiers of ETRs in the region, as listed below and shown on Figure 4.1 below. A discussion of each tier follows.

- Federal Strategic Highway Network (STRAHNET)
- Statewide Seismic Lifeline Routes (SSLRs)
- Regional Emergency Transportation Routes (RETRs)
- Local Emergency Transportation Routes (LETRs)
- Local Emergency Response Routes (LERRs)

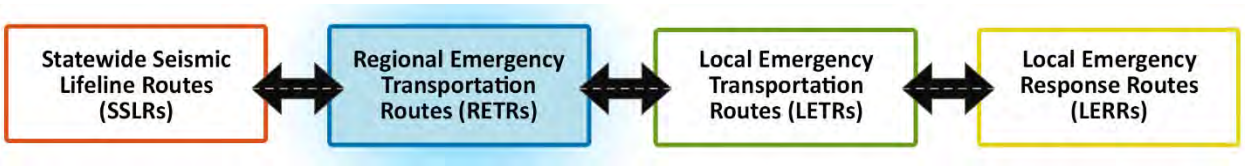

Figure 4.1: Emergency Transportation Route Tiers

Federal Strategic Highway Network (STRAHNET) and Connectors

The STRAHNET is a national system of roads identified by the Department of Defense (DOD) in coordination with the Federal Highway Administration (FHWA) for the purposes of emergency mobilization and peacetime movement of heavy armor, fuel, ammunition, repair parts, food, and other commodities.

Statewide Seismic Lifeline Routes (SSLRs)

State-owned roadways pre-designated in the Oregon Highway Plan by the Oregon Transportation Commission as priority transportation routes in Oregon. SSLRs provide key emergency response connections between regions within Oregon. Their primary function is to provide "a network of streets, highways, and bridges to facilitate emergency services response and to support rapid economic recovery after a disaster." The Oregon Department of Transportation (ODOT) has identified tiered levels of SSLRs that are prioritized by the desired time for routes to be open to vehicular traffic after an event (e.g., Tier 1 routes are most important and desired to be open first).

Regional Emergency Transportation Routes (RETRs)

A network of state- and locally owned (county and city) roadways pre-designated by the region as priority transportation routes that can best provide connectivity for emergency operations in the region in the event of a major disaster or earthquake. These routes are priorities targeted during an emergency for rapid damage assessment and debris clearance and used to facilitate life-saving and life-sustaining response activities throughout the region.

These routes often connect multiple jurisdictions in the region, providing key emergency response connections from SSLRs to State/Regional essential facilities and critical infrastructure, as well as to local ETRs in each county. Their primary function is to form a regional backbone of roads that connect regional population centers, essential facilities, and critical infrastructure and services of state and regional importance to the SSLRs.

Local Emergency Transportation Routes (LETRs)

Locally owned roadways, pre-designated by local agencies (county and city) as priority transportation routes intended to provide a local network of arterials, collector, and local streets that will connect LERR (defined below) to RETRs. They are generally used to connect to more City/County critical infrastructure and essential facilities either directly or via RETRs.

Local Emergency Response Routes (LERRs)

Locally owned roadways intended to provide a network of streets to facilitate prompt response to routine fire, police, and medical emergencies within a single jurisdiction. LERRs also provide a connection from LETRs to Community/Neighborhood facilities and services, such as shelters, medical facilities, and community PODs. These facilities are often not pre-designated and can be defined based on the community needs, scale of the disaster, and resulting damage.

The Figure 4.2 displays the STRAHNET, SSLR and RETR for the region.

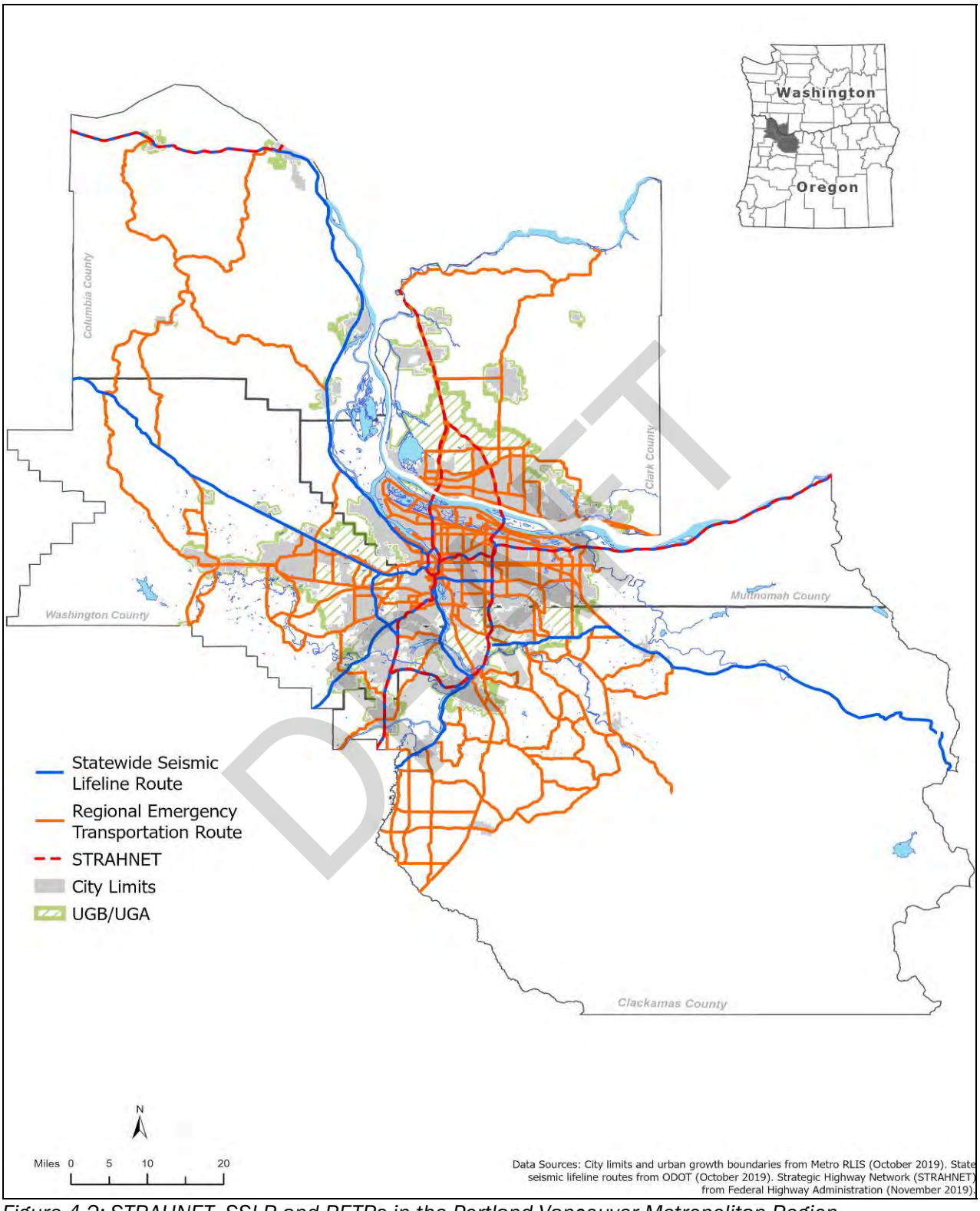

Figure 4.2: STRAHNET, SSLR and RETRs in the Portland-Vancouver Metropolitan Region

4.2 Data Compilation

The geographic scope of this project is the five-county Portland-Vancouver metropolitan area, including Clackamas, Clark, Columbia, Multnomah, and Washington counties (Counties) and their cities.

A regional geospatial data inventory was needed to support the evaluation and update process. The team compiled and aggregated readily available GIS data provided by project stakeholders and publicly available data from authoritative federal, state and regional sources to support the analysis. These data included:

- STRAHNET routes
- ODOT statewide seismic lifeline routes
- 1996/2006 regional Emergency transportation routes
- County and PBOT emergency transportation route designations (local and regional)
- County identified alternative detour routes to ODOT statewide seismic lifeline routes
- Routes and streets
- Tunnels and culverts
- Essential facilities, including:
    - Hospitals, clinics and other medical facilities
    - Police stations and fire stations
    - Critical vehicles and equipment storage facilities
    - Universities, schools, parks, and churches
    - Government buildings
    - Emergency Operations Centers (EOCs) – city, county, regional and state
    - Points of Distribution (PODs)
    - City and utility public works facilities
    - Disaster debris management sites
    - Fairgrounds
- Critical infrastructure, including:
    - Routes and streets within the region
    - River ports, marine terminals, major shipping facilities, and airports
    - Transit locations and infrastructure (bus garages, transit stations/centers, transit maintenance sites)
    - Water infrastructure and fuel PODs
- ODOT bridge Seismic vulnerability (Oregon only)

Additional data collected included.

- Geologic hazard data (including landslide risk) as identified by DOGAMI and Clark County, Washington/Washington State Department of Natural Resources (WADNR)
- Urban growth boundaries (Oregon)
- Urban growth areas (Washington)
- Regional growth distribution to identify current and future population centers (Metro)

- Demographic data to identify vulnerable populations in the region, including race, ethnicity, English language proficiency, access to a vehicle, income, and age (U.S. Census data American Community Survey (2013-17) compiled by Metro)
- Designated over-dimensional freight routes (Metro)
- Utility providers were also consulted through RDPO's Public Works work group and Portland critical water infrastructure was considered in the evaluation.

4.3 Develop Evaluation Framework for RETR Designation

Based on the above definition of RETRs and the background research and stakeholder input received to date, the project team prepared the following recommendations for defining the methodology and criteria for evaluating and updating the RETRs.

The criteria used to establish the existing RETRs in 1996 and 2006 served as a starting point and included:

- State routes serving the metropolitan area were considered primary because of their high capacity and ability to handle oversized vehicles
- Relatively flat routes with few major gradients or potential landslide areas
- Routes serving major population centers
- At-grade level alternative routes at overpasses and underpasses

Additionally, the Counties and the City of Portland included the following additional criteria during their more recent internal reviews of ETRs and participation in ODOT's recent Seismic Lifeline Bridge Detour work described in Section 2.3.2.

- Seismic resilience of routes, including bridge seismic vulnerability and landslide risk
- Ability of roadway to accommodate over-dimensional vehicles and larger volumes of vehicles
- Access to airports, hospitals, and isolated communities

4.4 Evaluate Potential ETRs

The planning effort evaluated existing and potential routes across a range of connectivity, resilience and equity factors, shown in Figure 3.3, to recommend an updated set of designated regional ETRs that:

- Connect Statewide Seismic Lifeline Routes in Oregon.
- Provide connectivity and access to state and regional critical infrastructure and essential facilities within and across the five-county region.
- Provide connectivity and access to the region's population centers, isolated communities and most vulnerable populations.

The evaluation followed a methodology informed by the research conducted by PSU, available data sets and feedback from the EWRG and additional stakeholders. The evaluation addressed three key factors: Connectivity and Access, Route Resilience, and Community and Equity.

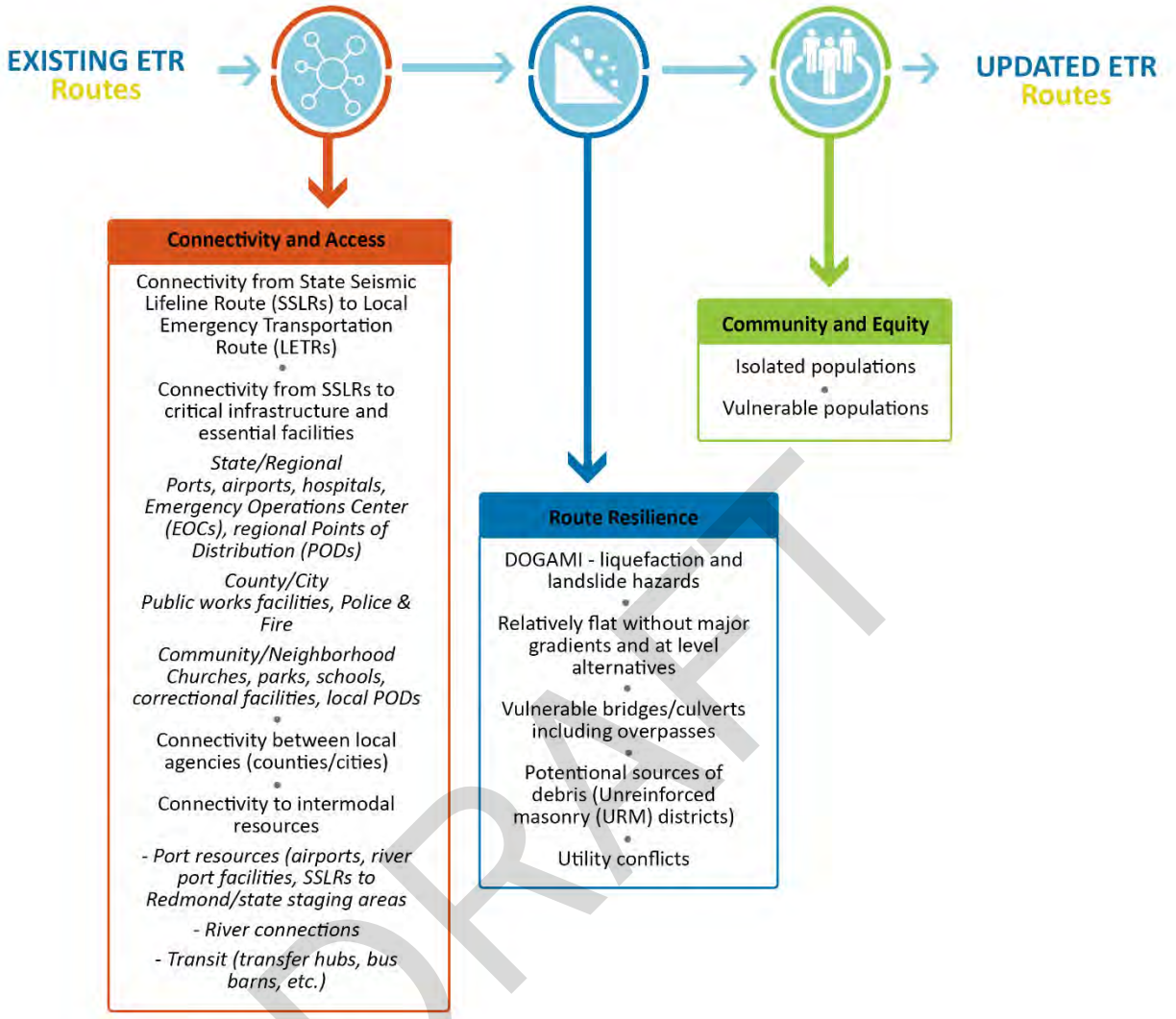

Figure 4.3: Summary of RETR Evaluation Framework Factors

Each of the factors considered in the evaluation are outlined below.

4.4.1 Connectivity and Access Factors

The "Connectivity and Access" category relates to route proximity to key resources that are likely to be essential after a disaster/seismic event.

- Connectivity and Access from SSLRs to LETRs
- Connectivity and Access from SSLRs to critical infrastructure and essential facilities (tiered by level as summarized in Table 1)
  - State/Regional – state, regional and county EOCs and PODs, hospitals, public works facilities
  - County/City – city EOCs and PODs, police and fire, health care facilities
  - Community/Neighborhood – churches, parks, schools, correctional facilities, community PODs (generally accessed through LETRs and LERRs)

- Connectivity and Access between local jurisdictions (counties/cities)
- Connectivity and Access to intermodal resources
  - Connectivity and Access to freight intermodal facilities
    1. SSLRs to Redmond Airport/Pendleton and other state staging areas
    2. Portland International Airport (PDX), Hillsboro and Troutdale Airports
    3. River port facilities and marine terminals (both sides of the Willamette and Columbia Rivers)
    4. Rail yards and rail lines (
  - Connectivity and Access to TriMet/C-TRAN/SMART transit facilities (transfer hubs, bus barns, maintenance facilities, etc.)

4.4.2 Route Resilience Factors

The "Route Resilience" category relates to the vulnerability of the route itself (including tunnels, bridges and culverts) to seismic and other natural hazards.

- Liquefaction and landslide hazards (DOGAMI and WADNR)
- Relatively flat routes without major gradients and at level alternatives
- Vulnerable bridges
- Potential sources of debris (unreinforced masonry (URM) districts)

4.4.3 Community and Equity Factors

The "Community and Equity" category relates to route proximity to population centers; isolated populations; and vulnerable populations after a disaster/seismic event for purposes of equitable rescue operations, emergency response or evacuation and providing equitable access to critical destinations (e.g., hospitals, temporary shelters, etc.).

The project used regional growth distribution data prepared by Metro in consultation with local jurisdictions in the five-county region to identify current populations centers and isolated populations. In addition, Metro compiled U.S. Census American Community Survey (ACS) 5-Year Estimates (2013-2017) data to identify census tracts with above regional average concentrations of potentially vulnerable populations in the five-county region. For this project, vulnerable populations are defined as people of color by race and ethnicity, people under the age of 18, people over the age of 65, households with no vehicle, people with limited English proficiency, and people with low-income. Low-income is defined as incomes equal to or less than 200 percent of the Federal Poverty Level (2016), adjusted for household size. The 2016 federal poverty level for a two-person household was $16,020.

4.4.4 Route Characteristics

Originally, route characteristics were proposed as an additional evaluation factor for the project. This category related to the characteristics of the route itself—pavement width, access control, and ability to accommodate large vehicles and freight and ability to accommodate oversized vehicles and freight vehicles. These characteristics are important in the case of a disaster or seismic event because they can help determine route usability for large volumes of traffic, evacuation purposes, walking and biking to essential facilities, moving emergency response vehicles and freight (including over-dimensional vehicles), and transit to and from populated areas. However, these data are not consistently available

across the region, making an evaluation of this factor infeasible at this time. These considerations are important when operationalization is considered by owner agencies and should be included when additional evaluation and route tiering is developed in Phase 2 as described in *Section 7 Anticipated Applications and Recommendations for Future Work* of this report.

5.0 DATA COLLECTION AND ANALYSES

Project GIS data were collected, aggregated and evaluated by Cascade Consulting, LLC and FLO Analytics. The project resulted in a large amount of aggregated data, both existing data as well as derived through subsequent analysis. A detailed data collection and analysis methodology is included as Appendix E and summarized below. Results of the analysis are presented in *Section 5 Analysis Results and Recommendations*.

5.1 Data Collection

A data request was submitted to EWRG, Metro, and additional stakeholders during the first phase of the project. The project GIS team worked with the stakeholders to gather and identify all readily available and relevant data, including existing designated RETRs, potential new RETRs identified through more recent ODOT and local planning efforts, essential facilities, and critical infrastructure. Data were captured "as-is" from stakeholders and publicly available authoritative federal, state and regional sources, such as FEMA, ODOT, DOGAMI and Metro. Data were collected from July 2019 to December 2020. Table 1 in Appendix E provides a summary of the data by theme, source, date, and file type.

5.2 Data Compilation

The project GIS team developed a working database for use in ETR evaluation. Data stored in a format other than GIS were georeferenced and organized thematically into a geodatabase. Single datasets comprised of various themes were split into their corresponding thematic datasets. For example, police stations were extracted from the dataset of all government buildings. In some cases, features were individually reviewed and attributed before being split and organized thematically. All data were projected to have a common coordinate system, specifically Oregon State Plane HARN NAD83, International Feet, the coordinate system used by the City of Portland and Metro. More detail on data compilation is included in Appendix E.

5.2.1 RETR Network Development

The original RETR layer for this project was created using a combination of the routes designated and compiled in GIS in 1996 and revised in 2006. Where in conflict, precedence was given to the more recent 2006 routes. Note the 2006 routes did not extend into Columbia and Clark counties.

Additional routes were identified as RETRs through a stakeholder review process (see *Section 1.2 Stakeholder Engagement Process*). New routes were identified by Clackamas County, Multnomah County, Washington County, and PBOT during initial data gathering in 2019 and early 2020 as a result of ODOT and local government planning efforts (see *Section 2.3 ODOT and Local Government Document Review*). Additional routes were identified during subsequent jurisdiction-specific meetings

held in summer and early fall 2020, and during EWRG review of the updated draft routes in early 2021.

Road alignments from 1996 and 2006 data layers were merged with current authoritative source data produced by Metro (Clackamas, Multnomah, and Washington counties), Columbia County, and Clark County into one data layer for use in identifying RETRs. This data layer served as the source alignment for the updated RETRs.

5.2.2 Compiling Essential Facilities and Critical Infrastructure Data

Essential facilities and critical infrastructure were consolidated into three GIS layers following the RETR framework categories of state/regional (category 1), city/county (category 2), and community/neighborhood (category 3). As an example, state, regional, county and transit EOCs were combined into a category 1 essential facilities EOC layer, and city EOCs were combined into a category 2 essential facilities EOC layer. See Table 3.1 in *Section 3.0 Overview of Key Concepts and ETR Development Methodology* for the categorization of essential facilities and critical infrastructure.

5.2.3 Compiling Natural Hazard Data

GIS data for natural hazards were collected from several sources, including DOGAMI and Washington State Department of Natural Resources (WADNR). GIS data representing seismic hazards, including seismic liquefaction susceptibility and debris expectations, were provided by DOGAMI. Landslide susceptibility and existing landslide hazards in Oregon were provided by DOGAMI and by WADNR for Clark County. Flood hazard data were provided by Federal Emergency Management Agency (FEMA).

5.2.4 Compiling Population and Demographic Data

Metro provided population and socioeconomic data for the community and equity analysis. The project used population density to identify and map current populations centers and isolated populations.

A number of factors, including race, poverty and lack of access to transportation may contribute to vulnerability. To identify and map communities that will most likely need support before, during an after an emergency event, Metro used the U.S. Census ACS 5-Year Estimates (2013-2017), aggregated to Census tracts to identify census tracts with above the five-county regional average concentrations of vulnerable populations. For purposes of this project, vulnerable populations have been defined as people of color (POC), people with limited English proficiency (LEP), people with low income, households with no vehicles, people under the age of 18, people over the age of 65. People of color are identified as Black or African American, American Indian and Alaska Native, Asian, Native Hawaiian and Other Pacific Islander, some other race, two or more races, and any race combined with Hispanic or Latino ethnicity. Due to significant margins of error in the ACS data, the analysis was not able to account for people with disabilities. This should be addressed in the future planning work.

Metro also prepared a GIS data layer – called RETR Equity Focus Areas (EFAs) – to evaluate providing emergency access to vulnerable populations with a focus on race and income. RETR EFAs are census tracts that represent communities where the rate of POC or LEP or people with low income (i.e., income

equal to or less than 200% of the Federal Poverty Level [2016] adjusted for household size) is greater than the 5-county regional average.

Additional discussion of the analysis and methods is included in Appendix E and *Section 5 Analysis Results and Recommendations* and *Section 7 Anticipated Applications and Recommendations for Future Work*.

6.0 ANALYSIS RESULTS AND RECOMMENDATIONS

6.1 Analysis Discussion

The RETR evaluation analysis was completed in two stages. The first stage included developing GIS mapping layers that included all existing 1996 and 2006 existing RETRs, SSLRs, geologic hazard data, bridge seismic vulnerability data, and all collected critical infrastructure and essential facilities. The project team then consulted with members of the ERWG from each county, the City of Portland, transit agencies, and port districts to review the GIS data to identify missing critical infrastructure, essential facilities, and routes to be included in the analysis. An on-line viewer and static maps were created to support the review. The discussions resulted in the addition of essential facilities and critical infrastructure of regional importance to the dataset. Routes were added to account for new and seismically updated infrastructure, county-identified detour routes that avoid seismically vulnerable bridges, and provide additional connectivity to ports, hospitals, and transit facilities.

Once the additional routes were added and a naming convention designated, the GIS evaluation for connectivity, resilience, and equity was completed. The evaluations and results are described in the sections below.

6.2 Route Naming Convention

During the first phase of evaluation, it was determined that a consistent naming convention should be developed in order to help with route evaluation, identification, and use. With direction from the work group, the team developed a naming convention that provides consistency, as well as the ability to add and update routes during future phases of work and update cycles. The routes identification (IDs) have the format as outlined below and are included in Table 5.1 (attached and end of text) and on Figure 6.1 in *Section 6 Final Updated Route Summary*.

(S/R/L)-#-XXX-00-RouteName

- The “S/R/L” term designates whether it is a state, regional, or local route.
- The “#” term will be the route tier as designated by ODOT or by the region and localities in future phases of work.
- Each route has a three-digit number “XXX” assigned to it as a route ID that reflects the location and direction of the route. Routes with an odd ID are north/south routes and those with even IDs run east/west. These numbers currently run between 100 and 265 for the updated routes.
- The “00” term indicates if a route has segments. Route 101-01 and 101-02 connect to make route 101. Routes with “00” only have one segment.
- The “RouteName” reflects the road name(s) that make up the ETR.

Additionally, included in Table 5.1 (attached) is a designation of each route as a Primary or Alternate Route. Alternate routes were designated in 2020 to provide a detour route where expected failure of vulnerable bridges will close a primary RETR after a seismic event. These were identified by each county when working with ODOT to identify detour routes to SSLRs as described in Section 2.3.2. If vulnerable bridges are seismically retrofitted or replaced, the need for these routes should be evaluated for future RETR updates.

Interstate highways are identified as SSLRs in Oregon however, WSODT has not completed an official route designation process at this time.

6.3 Analysis Results

6.3.1 Assessment of Route Connectivity

Each RETR was evaluated for connectivity visually using the GIS mapping layers as well as using the data analysis methods described in *Section 4 Data Collection and Analysis*. Each evaluation is detailed below.

6.3.1.1 Connection from SSLRs to Region and LETRs

We visually evaluated the ETR network using GIS data mapping in order to evaluate if RETRs provide adequate connection between state and federal routes and facilities and regional facilities and local routes. As shown on Figure 5.1, the proposed RETRs provide adequate connection between state routes and regional areas as well as local routes. Further, the updated RETRs provide good connectivity between the jurisdictions within the region.

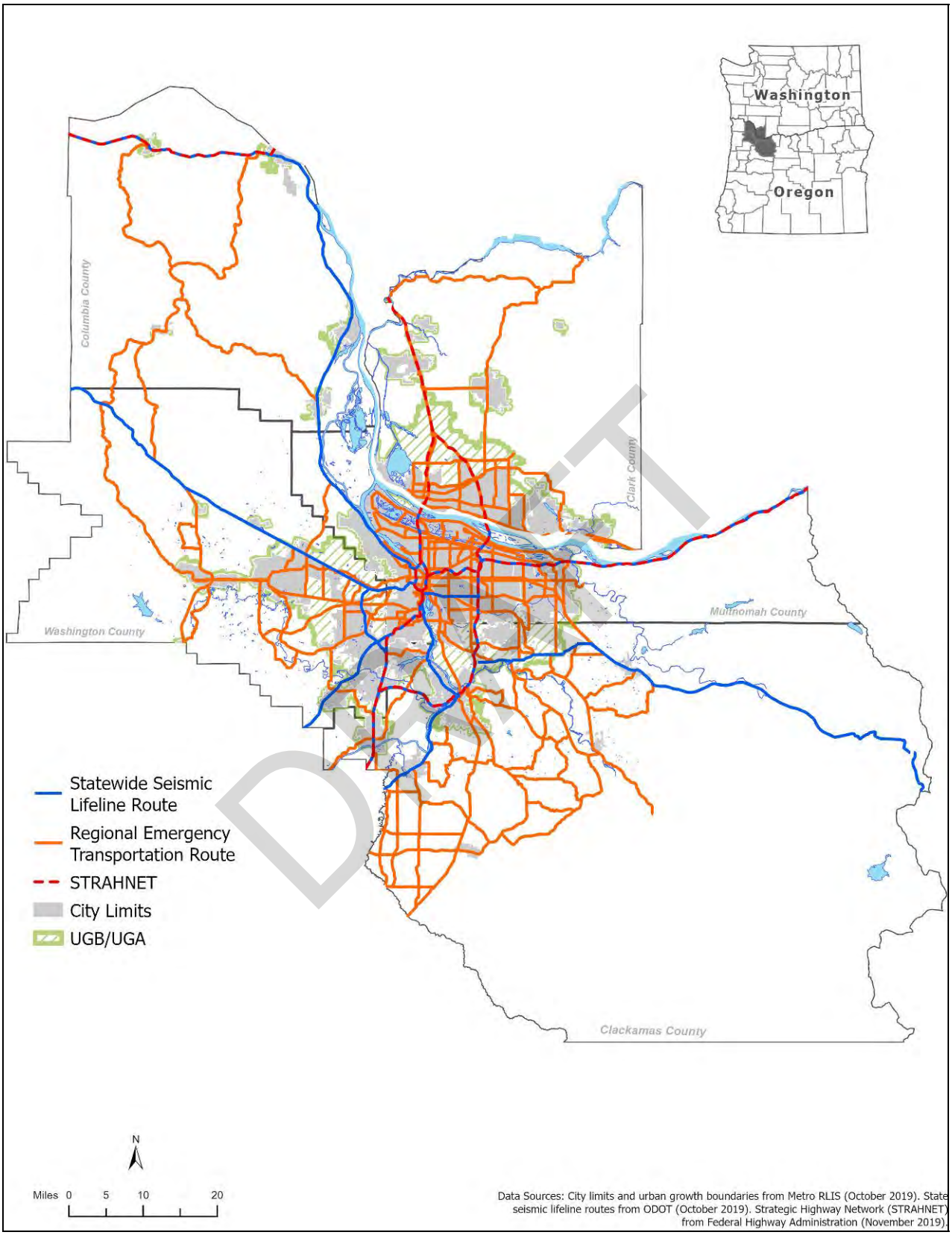

Figure 6.1. STRAHNET, RETRs, SSLRs Relative to City Limits, UGBs and UGAs

6.3.1.2 Population

Population density, city limits, urban growth areas in Washington and urban growth boundaries in Oregon were considered when evaluating if the RETRs provided adequate route connectivity to the region's population centers. These evaluations were conducted visually using the GIS mapped database as shown on Figures 5.2 and 5.3. In general, there is a higher density and redundancy of RETRs in the highest density population areas. One anomaly to this is the western portion of Clackamas County where route redundancy is higher than other areas in the region with similar population densities

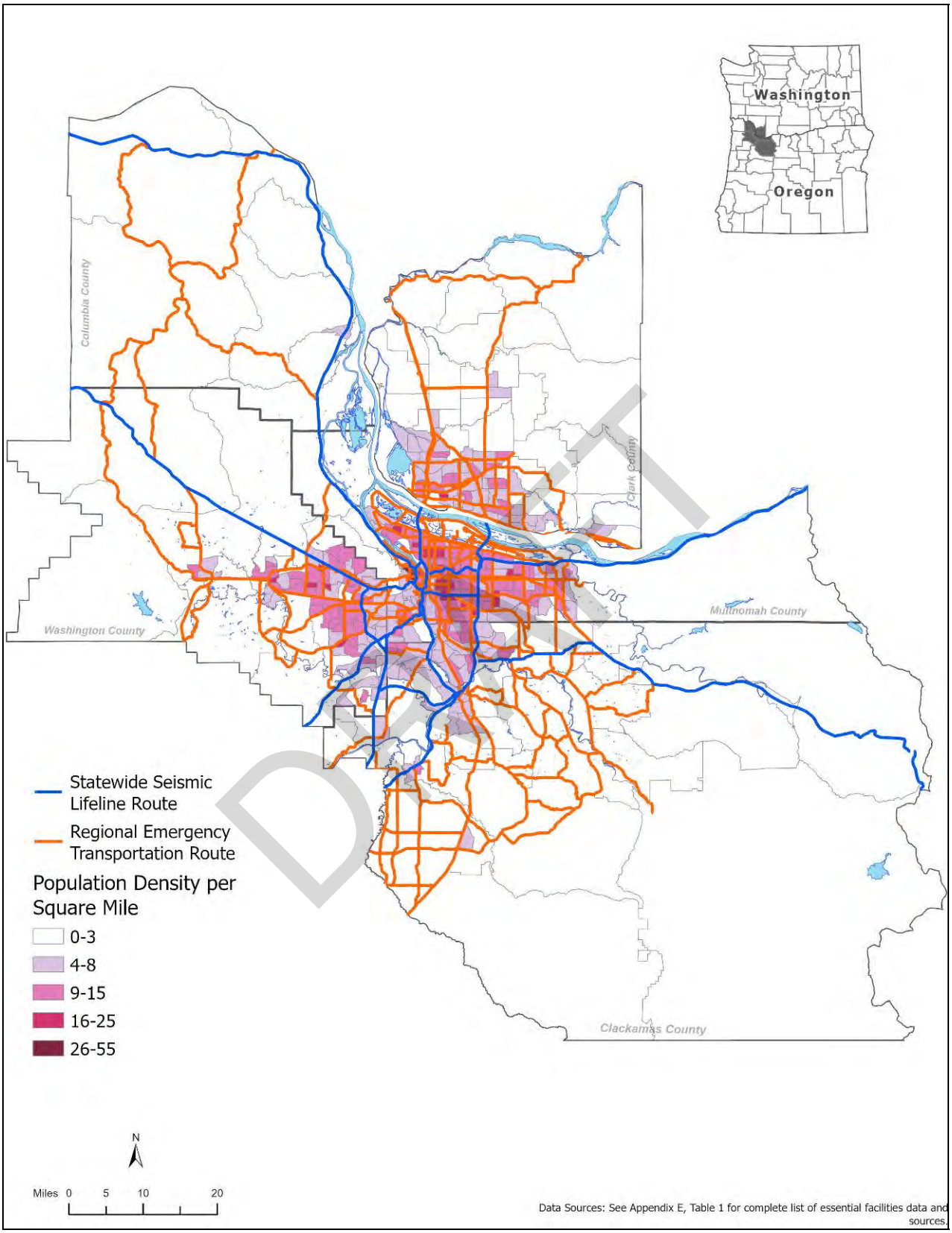

Figure 6.2. RETRs Relative to Population Density

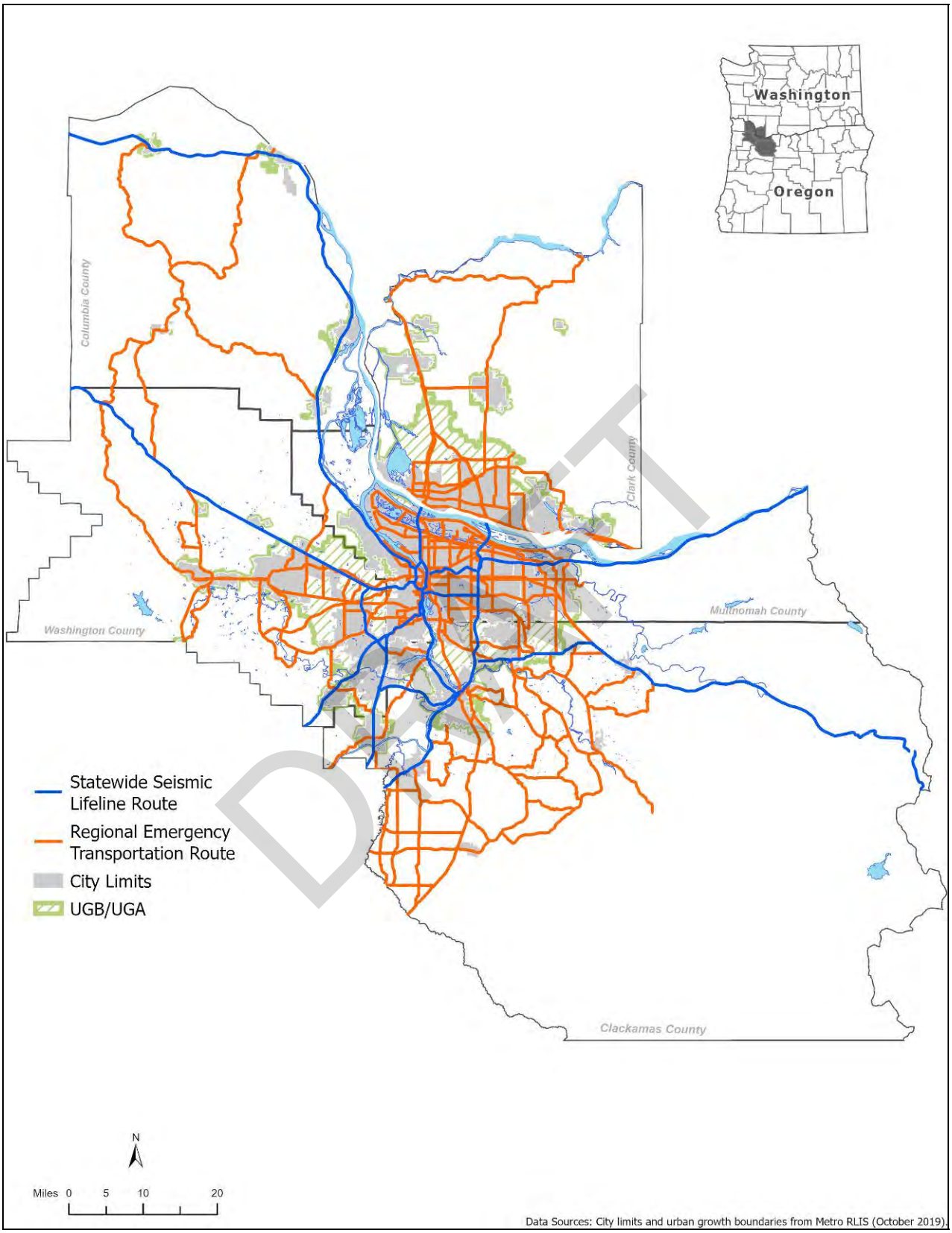

Figure 6.3. RETRs relative to City Limits, Urban Growth Boundaries and Urban Growth Areas

Based on a visual inspection, all major areas of high population density and cities are directly accessed by SSLRs or RETRs with the exception of Yacolt in Clark County. Clark County staff indicated that there are local routes that access Yacolt and a direct RETR connection is not necessary. Future updates should revisit the density and connectivity within the urban growth boundaries (UGBs) in Oregon and designated urban growth areas (UGAs) in Washington to determine if additional regional emergency transportation route designations are warranted based on population growth and community needs.

6.3.1.3 Critical Infrastructure and Essential Facilities

Connectivity to Critical Infrastructure and Essential Facilities categorized as State/Regional, City/County, and Community/Neighborhood as outlined in Table 3.1. Connectively to these facilities was evaluated visually using the GIS mapped database as shown on Figures 6.4 through 6.8.

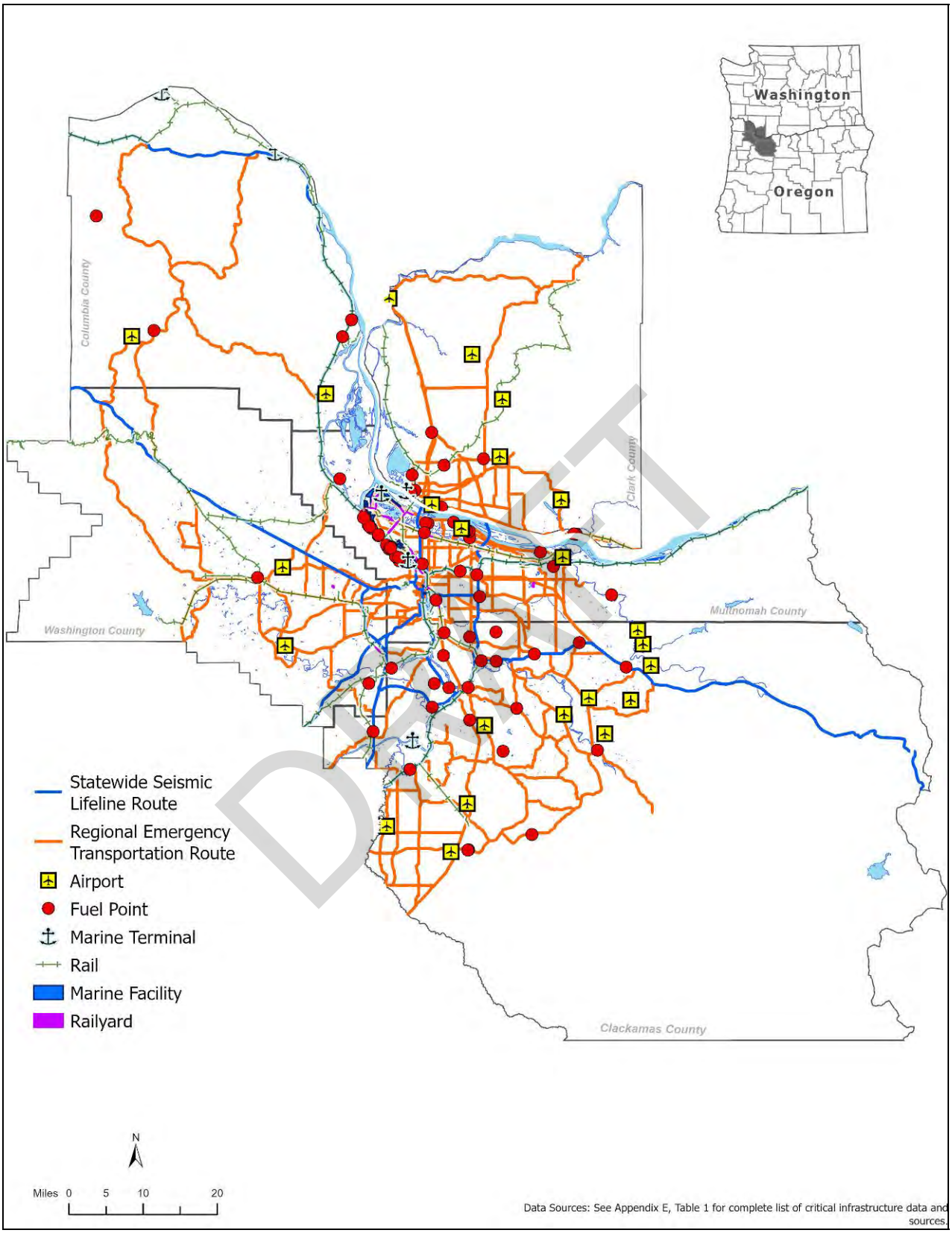

Figure 6.4. RETRs relative to State/Regional Critical Infrastructure

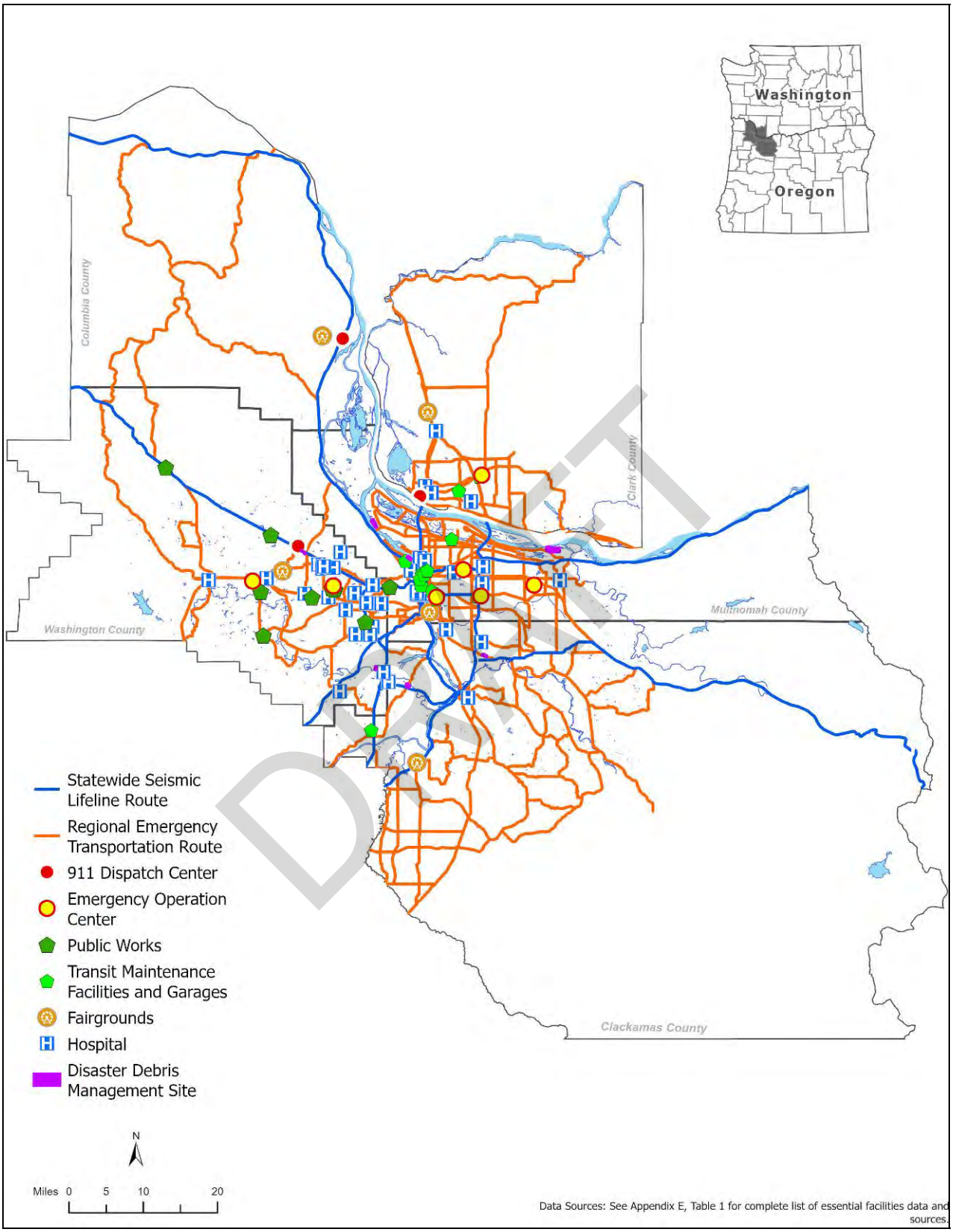

Figure 6.5. RETRs relative to State/Regional Essential Facilities

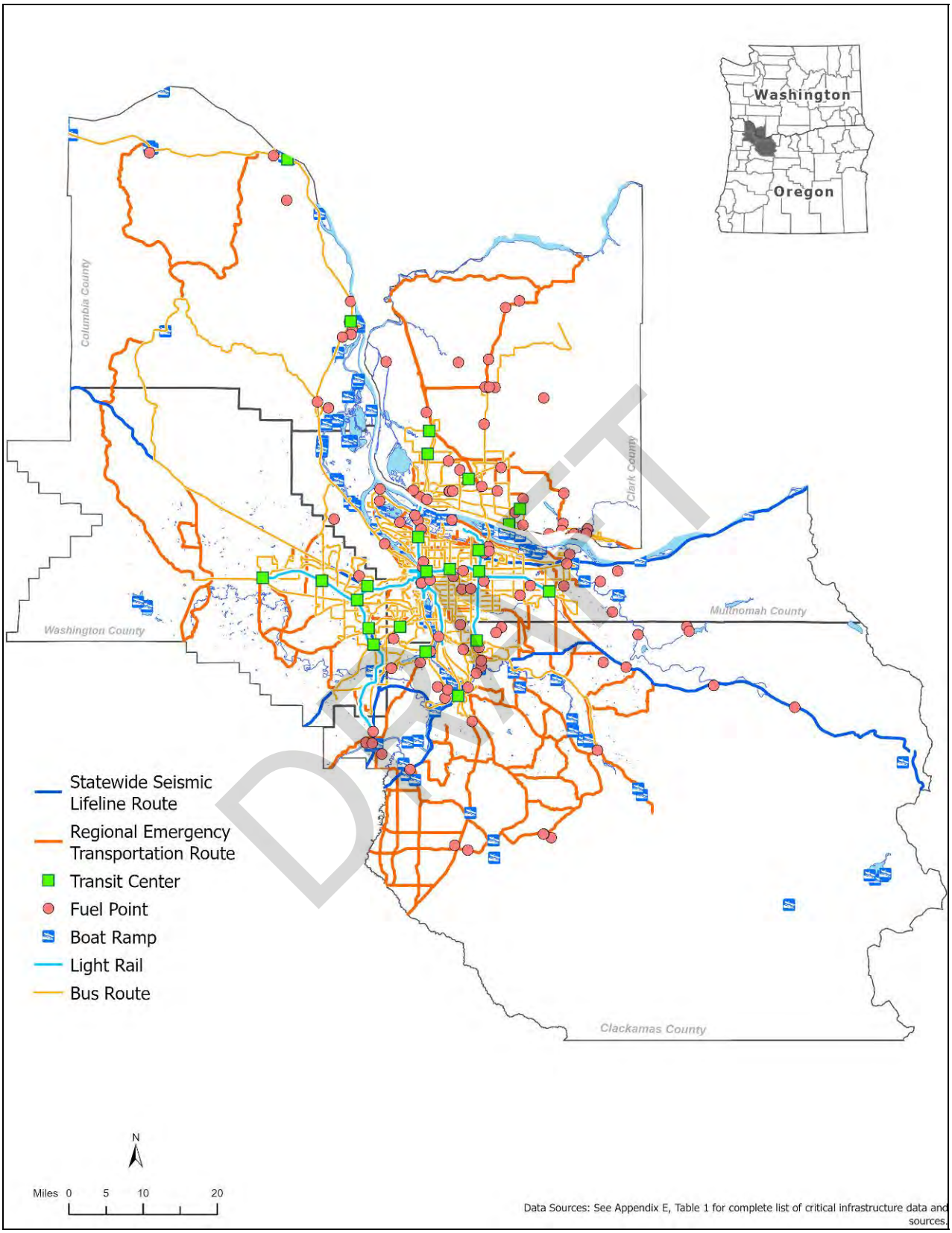

Figure 6.6. RETRs relative to City/County Critical Infrastructure

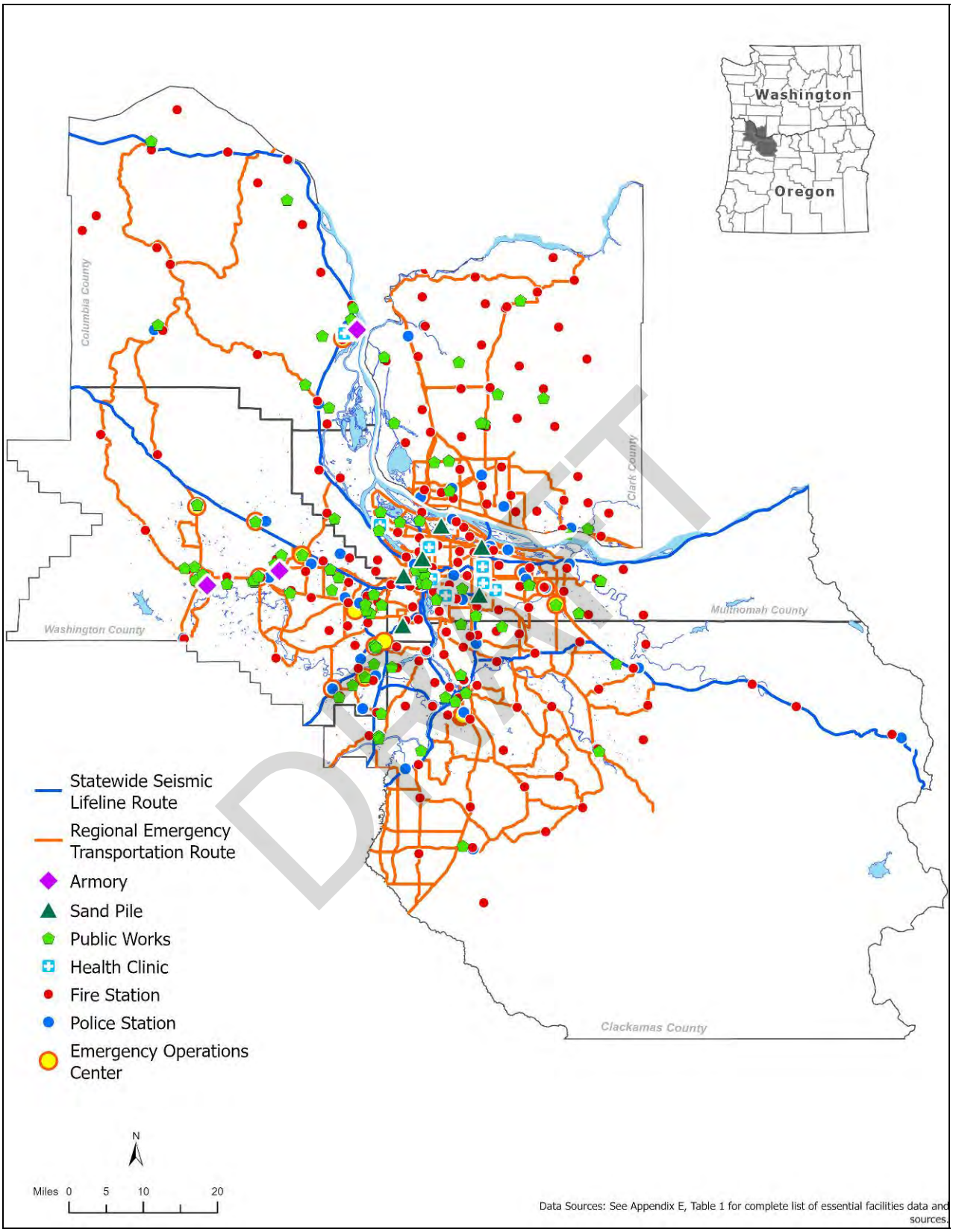

Figure 6.7. RETRs relative to City/County Essential Facilities

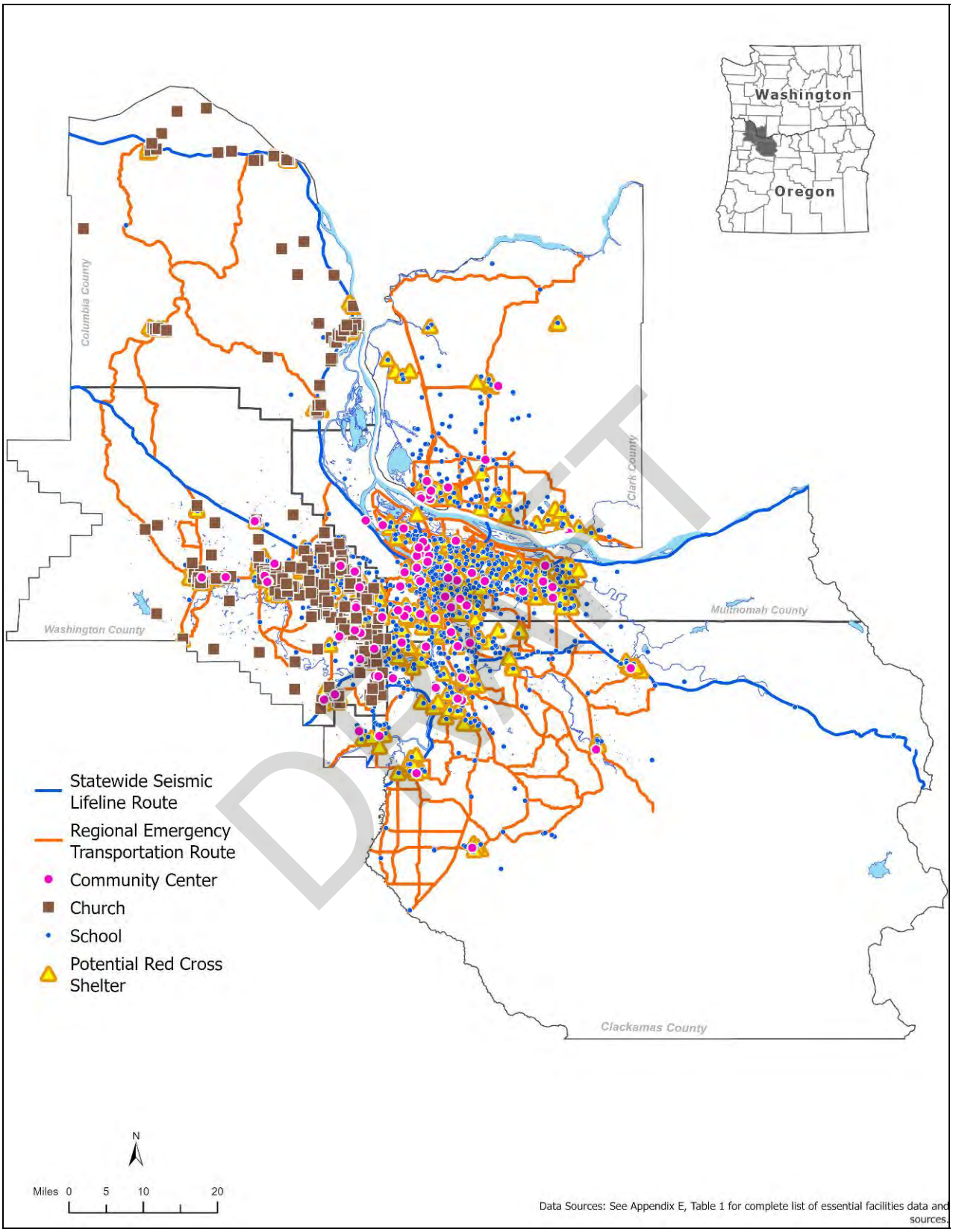

Figure 6.8. RETRs relative to Community/Neighborhood Essential Facilities

In addition to the visual evaluation, the GIS database was used to evaluate how many of each of the six categories were located within one-quarter mile of an RETR and/or SSLR. Results are outlined in Table 6.2 (attached).

Tabular results for State/Regional locations show that the majority of the locations are within a quarter mile of an RETR and/or SSLR. Additions of routes in 2020 increased these percentages for transit and hospital locations, as well as for port facilities. Additional visual evaluation indicates that much of the State/Regional critical infrastructure is composed of larger facilities with dedicated access roads that are accessible from the updated regional ETRs. In general, the updated regional ETRs provide good connectivity to State/Regional locations based on our evaluation; in particular they provide good coverage for access to essential facilities for emergency management and emergency response purposes (their primary function).

Due to variability in local ETR update methodology and the timing of recent updates, there is variability in the number of routes designated by the counties for the regional update. In particular, Clackamas County has a very robust network of regionally designated ETRs. When evaluating connectivity, it is noted that some of the routes do not appear to connect to either critical infrastructure/facilities or to vulnerable populations or higher density population areas. It is therefore recommended that the regional designations are revisited in Phase 2 evaluation when prioritizations are determined. Some of these routes may need to be tiered, or may be more appropriately designated as a local ETR.

6.3.2 Assessment of Route Resilience

The evaluation of route resilience considered seismic, landslides, and flood hazards. The latest data from DOGAMI regarding seismic and landslide hazards, FEMA flood hazard data, and ODOT bridge vulnerability data were used in the analysis. Data references are included in the GIS Methodology document included in Appendix E.

6.3.2.1 Seismic Hazards

The RDPO five-county region is at risk for multiple types of earthquakes, including a shallow crustal event on the order of 6 to 7M and a 9.0M CSZ event. In general, the CSZ event is more frequent and effects a much larger geographic area than a crustal event. Recent work by DOGAMI indicates that localized damage is much greater in the event of a shallow crustal event; however, these events are less likely to occur within the next 50 years. This study concentrated on resilience to a CSZ event mainly because it represents significant damage, is more likely to occur within a 20- to- 50-year planning horizon, and will affect a much larger geographic area, resulting in a larger problem for emergency response and long-term recovery.

Based on the DOGAMI data, significant shaking is anticipated throughout the region such that significant infrastructure damage is expected due to the CSZ event. However, ground shaking does not necessarily result in direct damage to roadways. Shaking directly damages buildings and infrastructure, causing debris to fall into roads; bridges to fail; and soil to soften (liquefy), settle, and move laterally. Liquefaction is the result of seismic shaking causing loose, non-clay soils to lose strength and liquefy resulting in settlement and lateral movement toward slopes and water bodies. This study evaluated RETRS for resilience using liquefaction hazard data. This is generally where roads and embankments can expect the most damage.

As shown in Figure 6.9, large portions of the region are at risk for moderate to severe liquefaction damage. This generally occurs along rivers and in areas of manmade fill. Many of the RETRs are vulnerable to liquefaction damage.

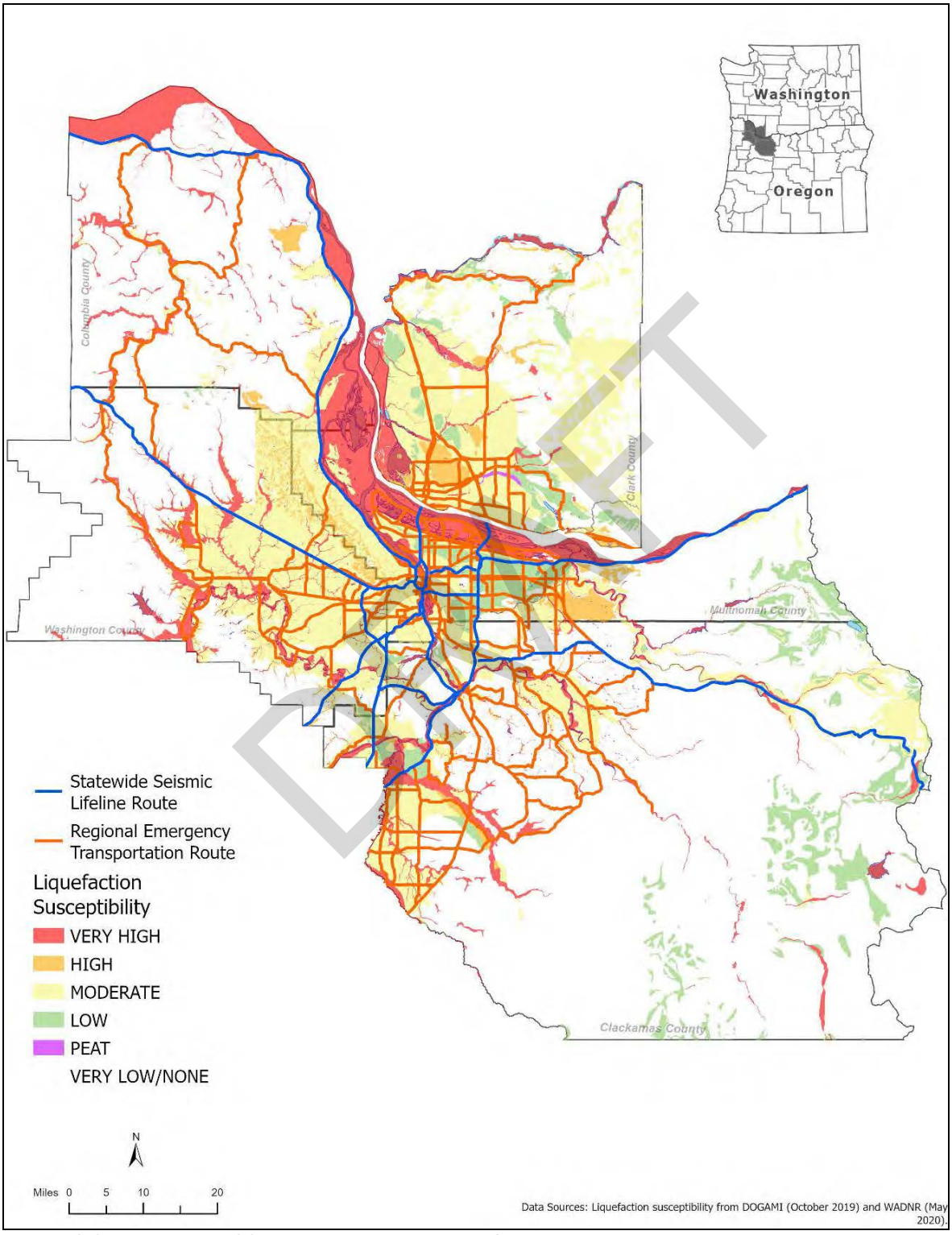

Figure 6.9. RETRs and SSLRs in relation to Liquefaction Hazard

Individual RETRs affected by liquefaction hazard above moderate are highlighted in Table 6.3 (attached). Bridge crossings, Marine Drive and access to the Port of Portland and PDX, access to the Port of Vancouver, rural routes along rivers in Washington and Clackamas counties, and the central area of downtown Portland are most likely to be severely impacted by liquefaction. Future evaluation of RETRs should consider adding redundancy with more resilient routes where possible and potentially eliminating routes where mitigation is unlikely to be completed due to scale and cost.

6.3.2.2 Seismically Vulnerable Bridges

ODOT has completed an extensive study of bridge vulnerability in the state and has worked with the four Oregon counties to identify vulnerable bridges on ETR routes. They have designated bridges as "Vulnerable," "Potentially Vulnerable," and "Not Vulnerable." Based on information from ODOT, single-span bridges were not evaluated and were included as "Not Vulnerable" because they are easier to fix and generally less likely to catastrophically fail. This is an acceptable assumption when considering bridge repair prioritization; however, for the purposes of evaluating ETRs, single-span bridges that fail will close an RETR even if the repairs can be done more quickly due to the simplicity of the bridges. For this reason, single-span bridges are identified as "Not Evaluated." Further, data for overpasses and onramps was not universally included in this evaluation; however, failures of these structures can greatly impede use of an RETR after an earthquake. In general, at grade routes should be considered for redundancy purposes, while ODOT and local agencies are working on bridge retrofits and replacements on all RETRs. Due to the scale of bridge vulnerability on these routes, it is unlikely that mitigation will be completed on all the RETR routes. Regional phasing and tiering that mirrors ODOT's program can help to evaluate the criticality of RETRs and resilience improvements so that available funds can be applied in a manner to increase RETR resilience as quickly as possible.

WSDOT has not evaluated their bridges with the same methodology as ODOT; hence, in the map all WSDOT bridges are marked "Not Evaluated." However, the state of Washington has made significant investments in seismic strengthening of their bridges following the 2001 Nisqually Earthquake. Therefore, some of the bridges in Clark County may have a higher degree of resilience to seismic risk, they just have not been evaluated to be represented in this report together with the ODOT bridges. In the future, an investigation into the seismic resilience of bridges on the RETRs in Clark County together with WSDOT would be beneficial to inform understanding of vulnerabilities and areas to prioritize investment to increase seismic resilience of bridges where needed.

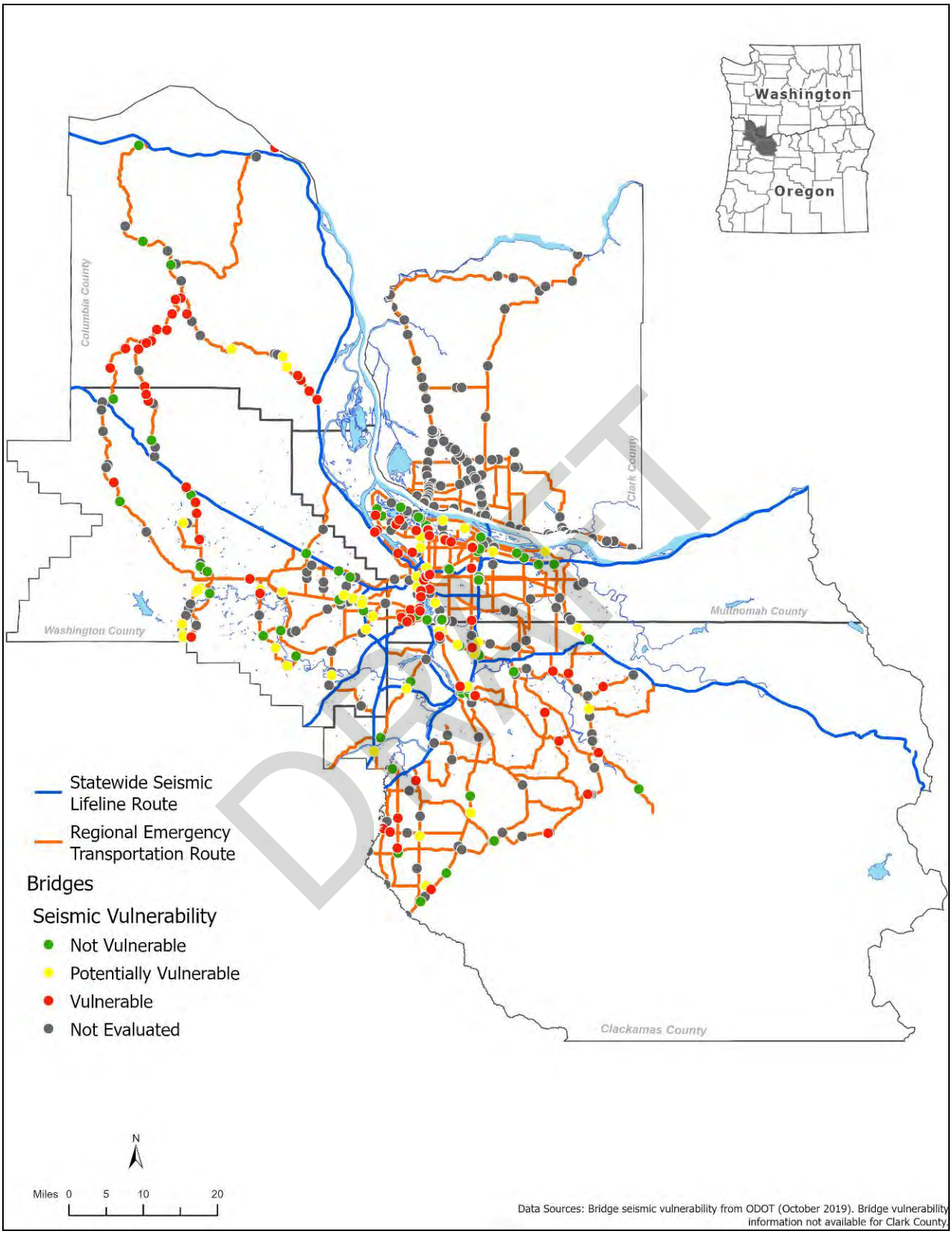

Figure 6.10. RETRS in relation to Seismically Vulnerable Bridges

As shown on Figure 5.11 and in Table 6.4 (attached), vulnerable bridges are one of the larger hazards to the RETR system. In an area with many water crossings and grade changes, bridges will affect a large majority of the RETR system. Routes with multiple river crossings are especially vulnerable. A highlight of this evaluation is the connection across the Willamette and Columbia rivers. Very few river crossings are expected to be operational within weeks to months after an event. Further evaluation of bridge vulnerability as well as prioritization based on RETR needs should be considered in future phases of work; further planning around marine transportation options in emergencies can also support contingency planning for bridge failures in a catastrophic response and recovery.

6.3.2.3 Landslide Hazards

Landslide hazard was evaluated using the latest DOGAMI (Oregon) and WADNR (Washington) data for general landslide risk, as well as existing mapped landsides. Figure 6.11 shows both general risk as well as the locations of existing landslides and Table 5.5 (attached) highlights routes with significant landslide risk. Generally, areas of high risk, (red) and mapped landsides overlap. Landslides can be a hazard during periods of wet weather but should also be expected during a seismic event.

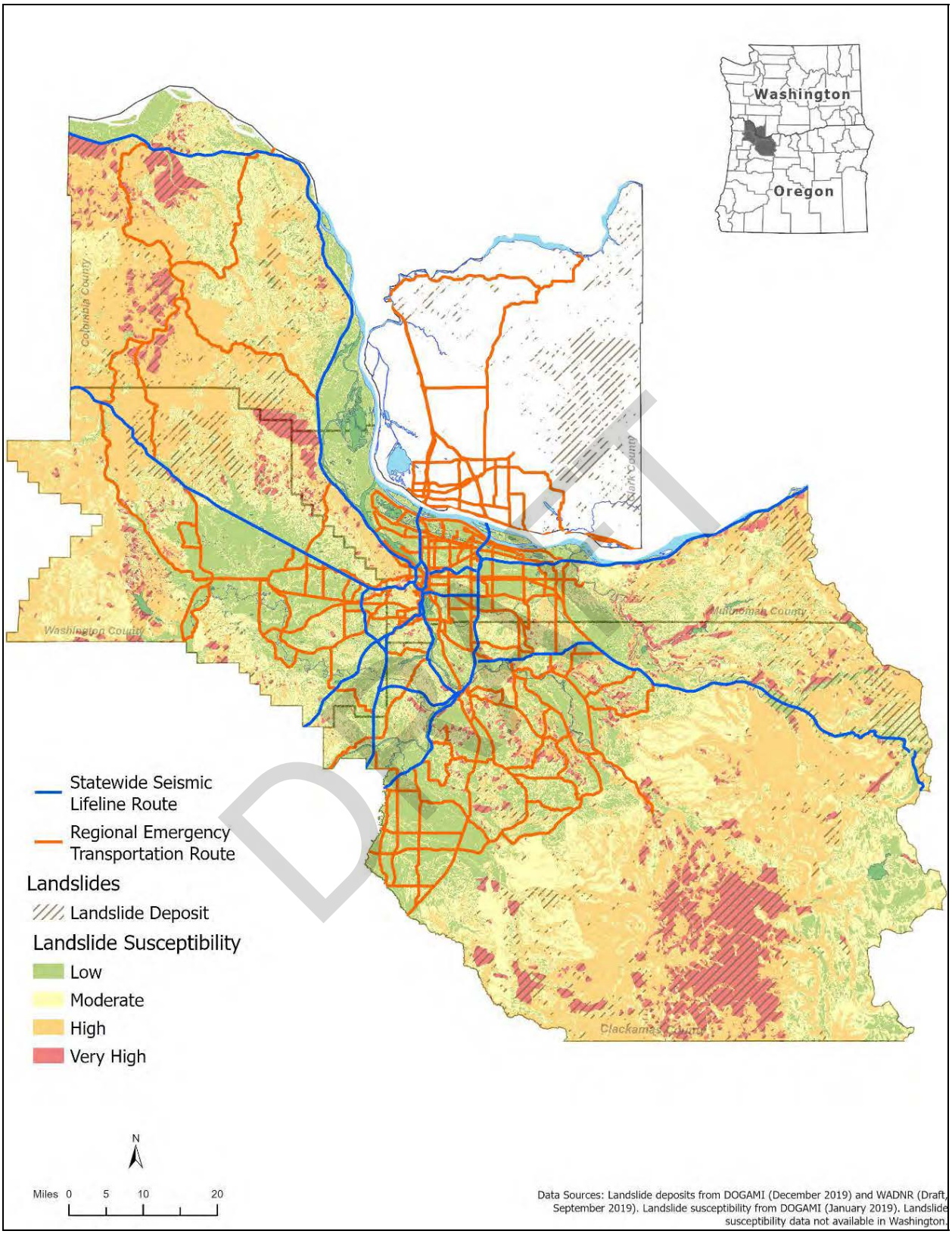

Figure 6.11. RETRs relative to Community/Neighborhood Essential Facilities

Based on the data, there are routes with significant landslide risk. These are generally in rural areas and may not have redundancy in the RETR system to provide access in the event of a landslide. Rural Columbia and Clackamas counties are at the most risk due to landslides that are likely to isolate populations. The Portland west hills are also highly at risk and could cut off Washington County from supplies coming from the east. Landslides during a wet season could result in local isolated communities; however, widespread landslides during a CSZ event will add to the already significant RETR damage due to shaking and liquefaction.

6.3.2.4 Potential Sources of Debris

Debris and debris management can be one of the major issues that can hinder emergency response after an earthquake. Debris from fallen buildings, downed bridges, and landslide or rockfall debris can block roadways and render an RETR unusable. Further, RETRs are needed for debris management functions to continue by providing access for debris removal. In order to evaluate the RETR system from a debris perspective, we used the 2017 DOGAMI debris estimates for the region. These maps provide estimates of tons of debris per area based on census tract areas as shown on Figure 5.13.

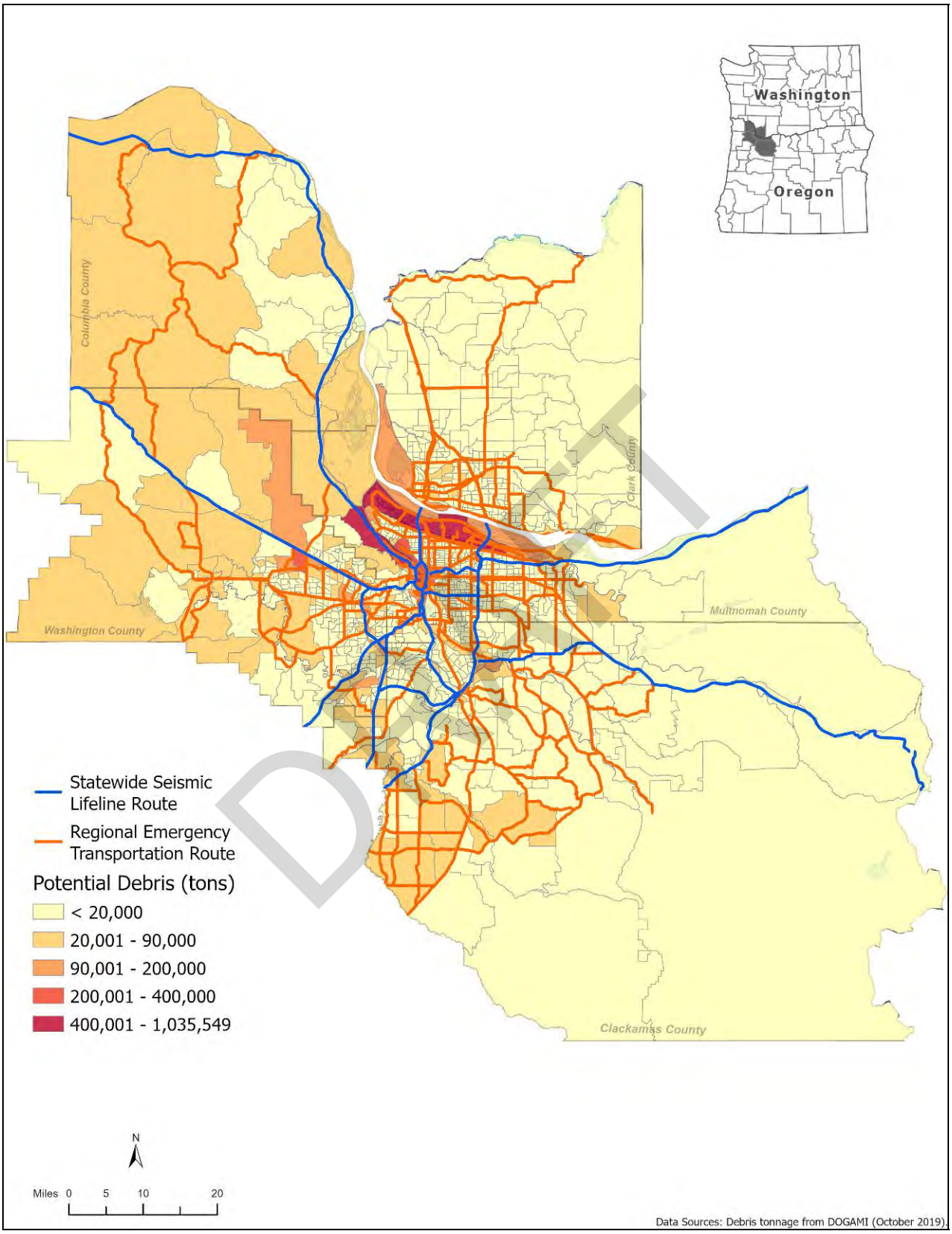

Figure 6.12. RETRS and SSLRS in relation to Potential Debris

For the most part, the highest risk areas (red) are industrial and commercial development areas on liquefiable soils and/or areas of older buildings in city and towns where unreinforced masonry (URM) and older building stock are concentrated will have a higher risk of debris blocking RETRs. The Critical Energy Hub and areas around the ports are all located on liquefiable soils and data indicated they will have large amounts of debris. In both cases, the potential for this debris to be hazardous materials is high. Risk to resilience of ETRs is high in these areas; however, ETRs will also be needed to connect these areas to debris management areas and disaster debris disposal sites.

Further, after a review of this data larger census tract areas that are based on population result in large amounts of debris. This results in larger census tracts of mostly rural land mapped as having a large amount of debris. Upon review, this may not be especially useful for emergency management planning. Large areas of rural land will likely have more spread out debris with significantly less effect on ETRs and access to communities. Future work with DOGAMI is recommended to evaluate this data set to better account for where significant debris is anticipated to affect the usability of the RETRS as well as where access will be required to remove, sort, and dispose of debris.

6.3.2.5 Flood Hazards

FEMA Flood hazard zones for the 100- and 500-year floods are shown in relation to the RETRS on Figure 6.13.

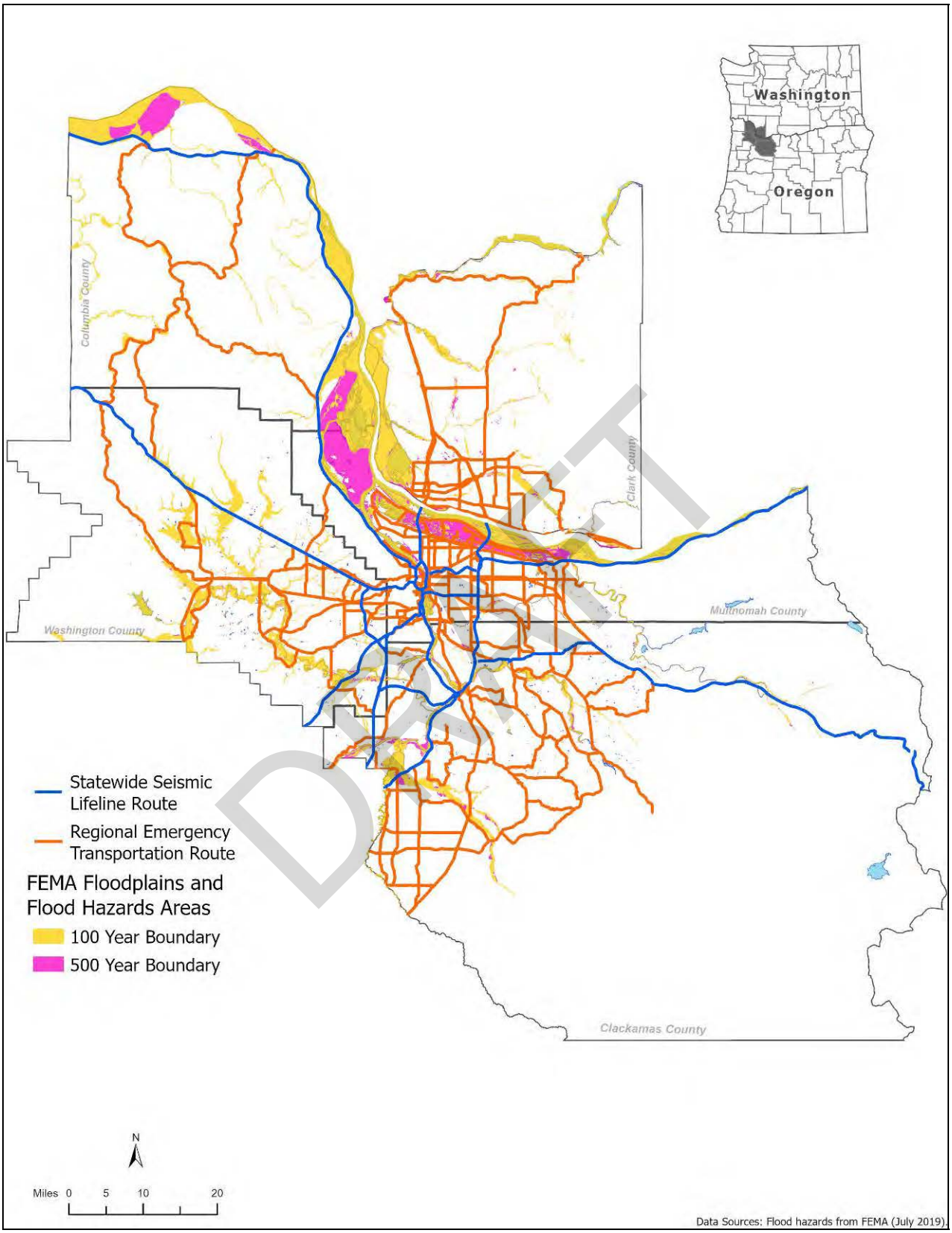

Figure 6.13. RETRs in relation to FEMA Flood Hazards Zones

Flood hazards in the region are located in low lying areas and along rivers. RETR risk as a whole is relatively low; however, areas along the Willamette River are likely to be isolated during a flood event due to a lack of RETR redundancy. RETR routes with high flood risk are outlined in Table 6.6 (attached).

Generally, the most susceptible routes are along the Columbia and Willamette rivers. Access along the Columbia River and near PDX as well as Naito Parkway in downtown Portland are specifically susceptible to flooding based on our analysis. Flooding could also lead to isolated populations in rural areas where RETRs follow rivers. However, based on our evaluation, there is generally sufficient RETR redundancy in the majority of areas within the region to reach populations and assets during a flood event even if detours may be long.

6.3.3 Assessment of Community and Equity

As described in *Section 3.0 Overview of Key Concepts and ETR Development Methodology*, Metro compiled ACS 5-Year Estimates (2013-2017) data aggregated to Census tracts to evaluate RETRs with regards to providing emergency access to vulnerable populations. These populations may be disproportionately affected by an earthquake or other disaster as well as during emergency response. For evaluation purposes, areas with vulnerable populations above the five-county regional average were identified and considered. Definitions and the five-county regional average rates for each vulnerable population by percentage (%) higher than the average in the region are shown in Table 6.7 below. These data in relation to RETRs are presented graphically on Figures 6.14 to 6.19.

Table 6.7 – Vulnerable Population Definitions and Data Sources

	Five-county Regional Average Percent of Population	Description
People of color (POC)	26.0	Persons who identify as non-white Black or African American, American Indian and Alaska Native, Asian, Native Hawaiian and Other Pacific Islander, some other race, two or more races, and any race combined with Hispanic or Latino ethnicity
People under the age of 18 (18)	22.3	Persons who are under the age of 18
People over the age of 65 (65)	13.5	Persons who are over the age of 65
Households with no vehicle (NV)	7.7	Measures level of access to a vehicle for households
People with Limited English proficiency (LEP)	7.2	Persons who identify as unable "to speak English very well".
People with low-income (LI)	28.0	Persons with incomes equal to or less than 200% of the Federal Poverty Level (2016), adjusted for household size. The 2016 federal poverty level for a two-person household was $16,020.

Source: U.S. Census American Community Survey 5-year average estimates (2013-2017).

6.3.3.1 RETR and SSLR Access to Specific Vulnerable Populations

Figures 6.14 through 6.19 show the RETRs and SSLRs in relation to areas of the six identified vulnerable populations in concentrations over the 5-county regional average as described above. Represented in red for map is the percentage higher than average for the region for each respective category (shown in Table 6.7).

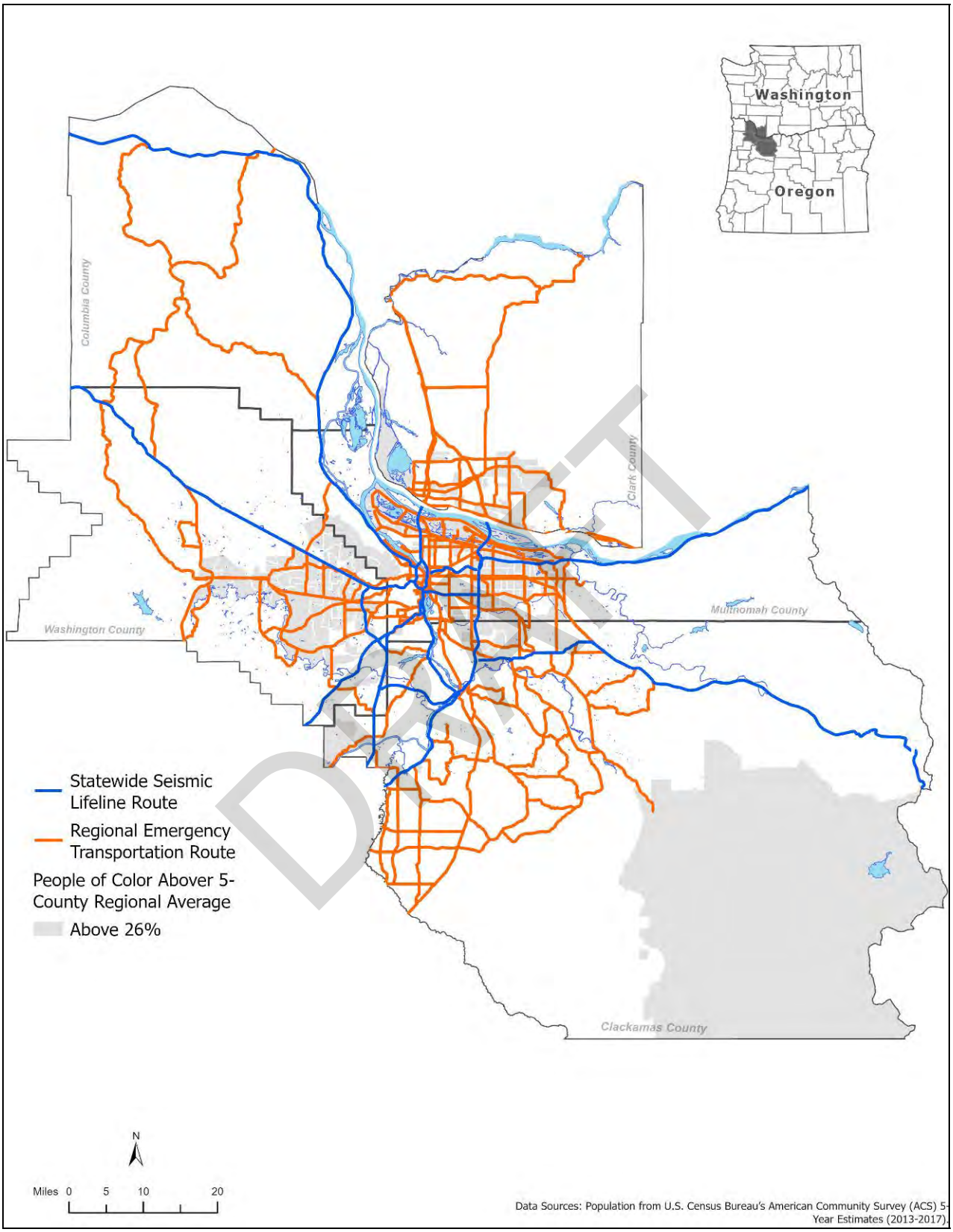

Figure 6.14. RETRs and SSLRs relative to People of Color

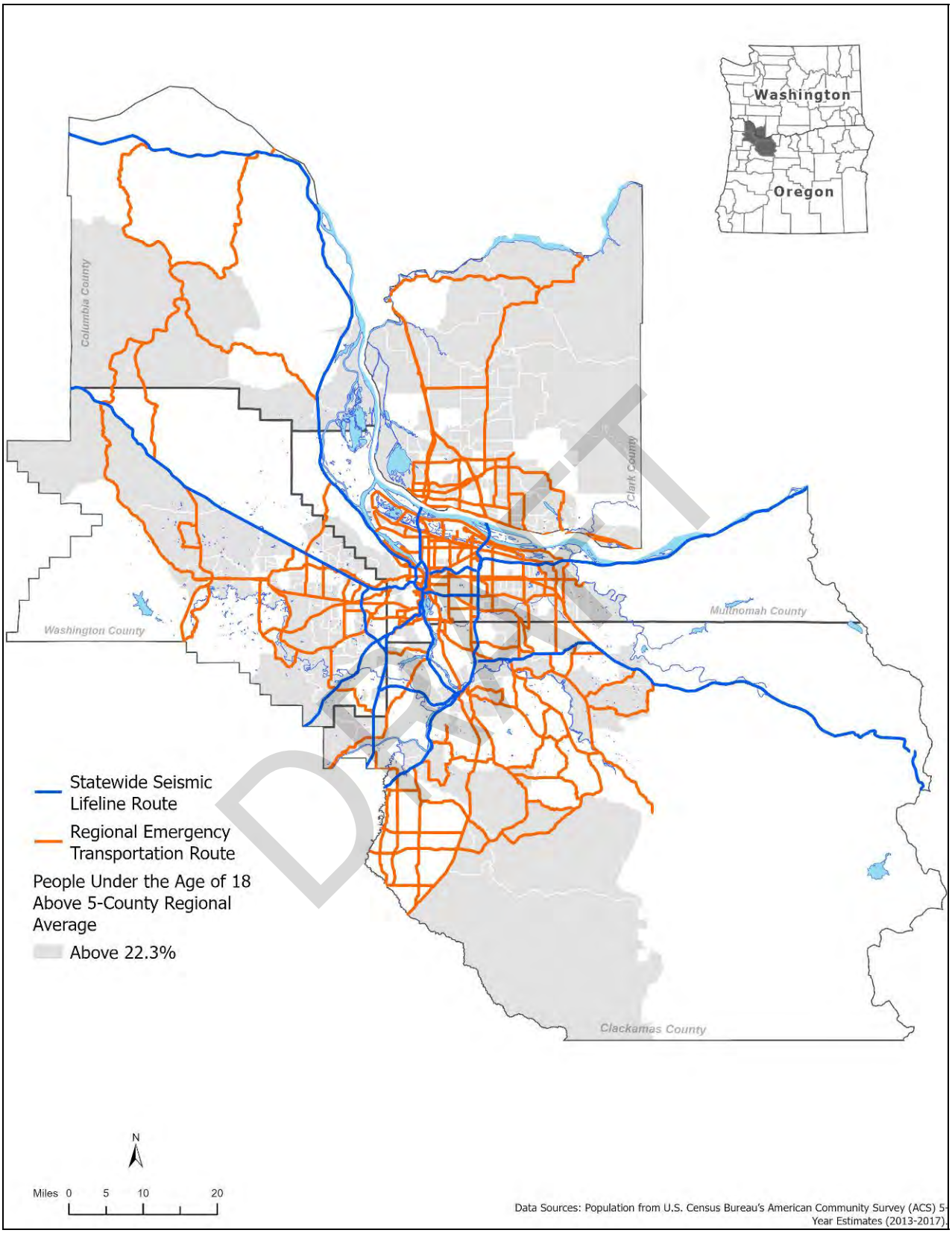

Figure 6.15. RETRs and SSLRs relative to People Under the Age of 18

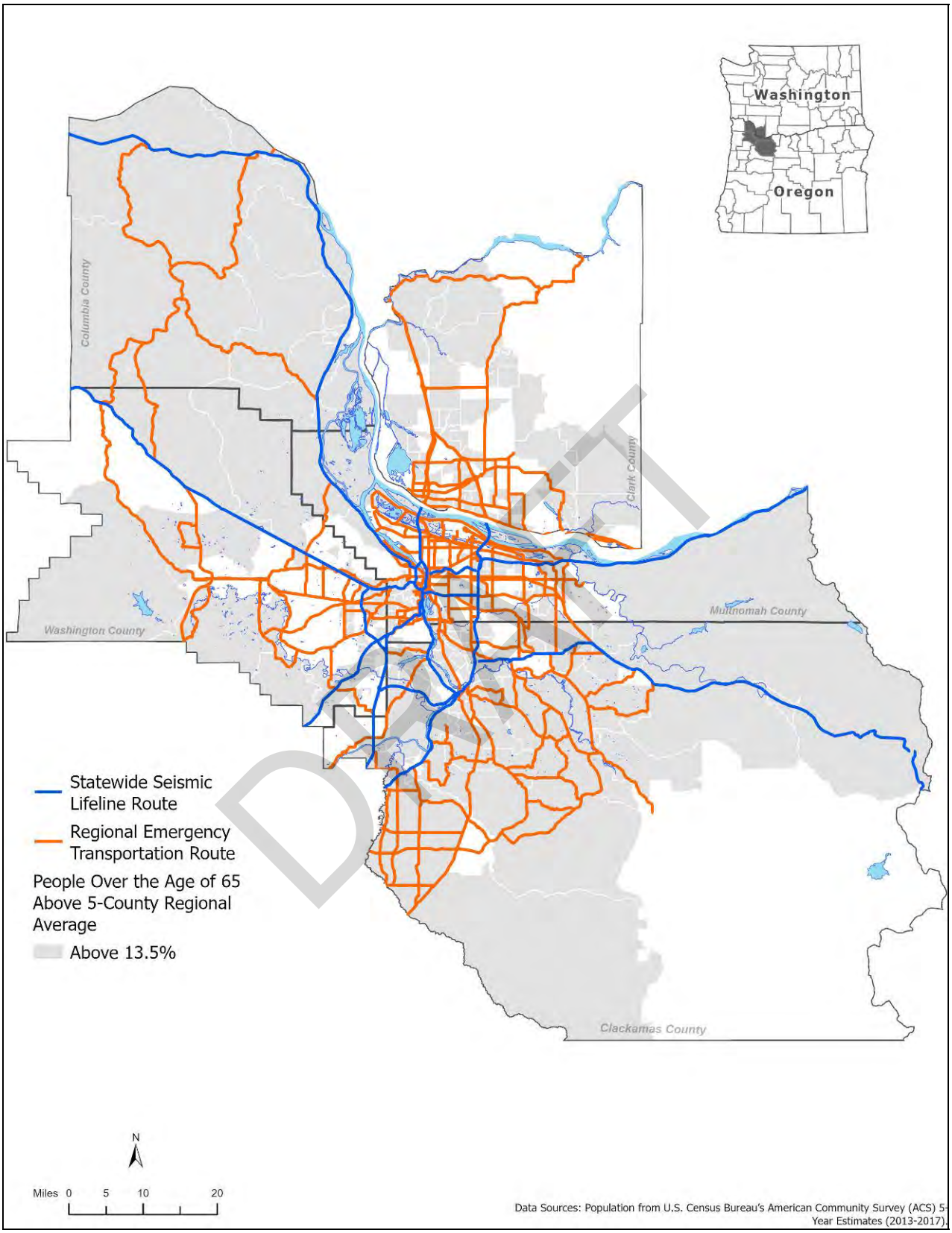

Figure 6.16. RETRs and SSLRs relative to People Over the Age of 65

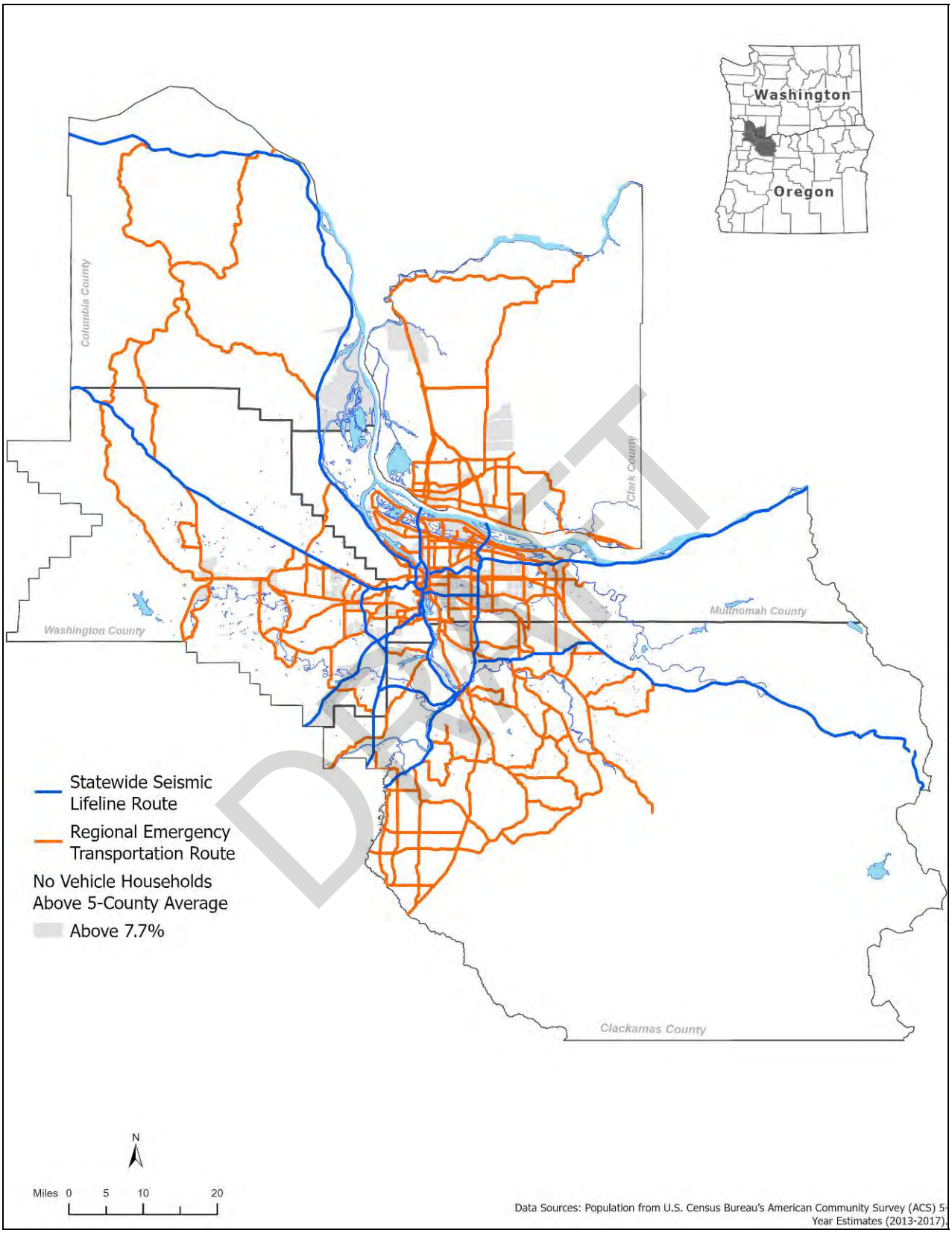

Figure 6.17. RETRs and SSLRs relative to Households with No Vehicle

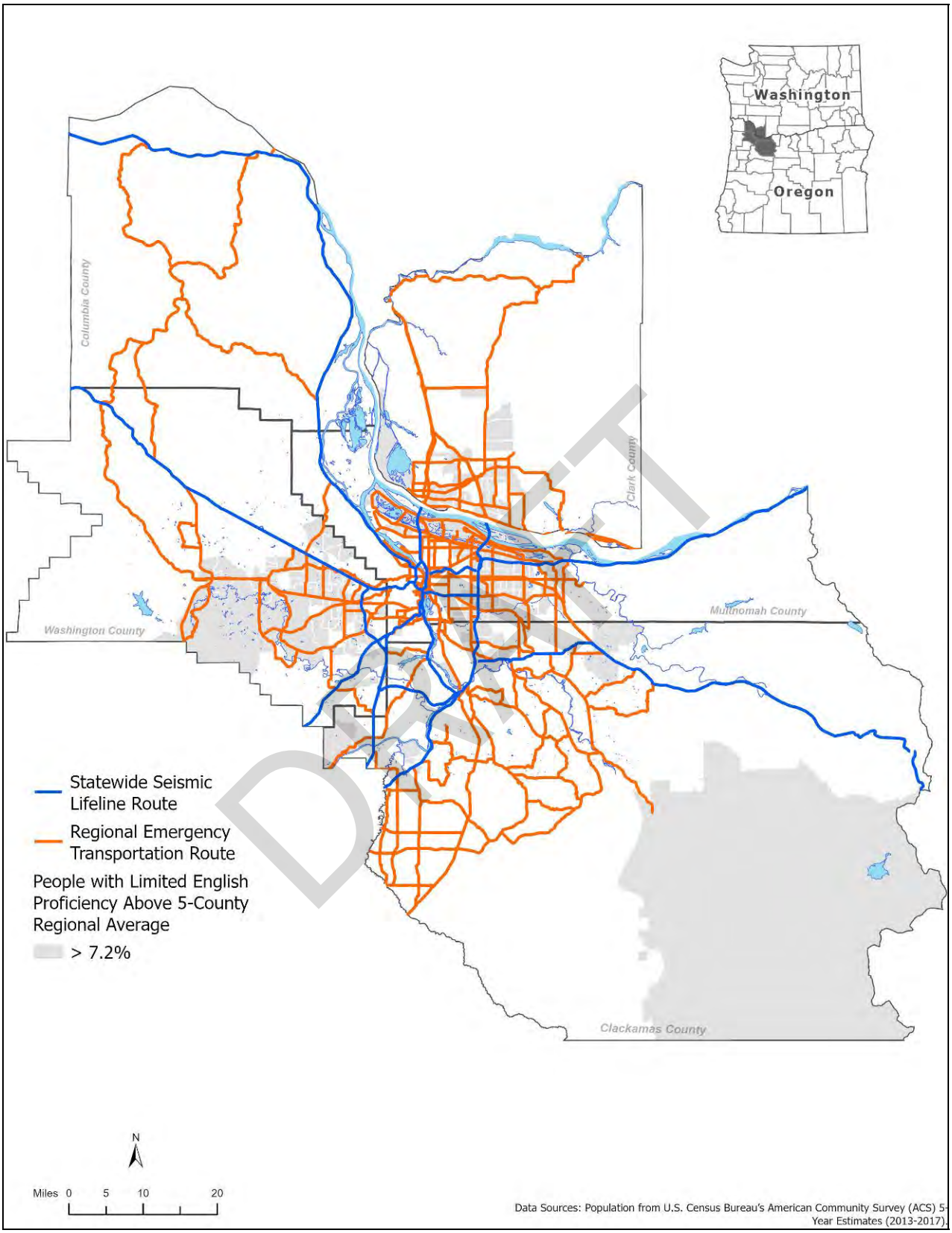

Figure 6.18. RETRs and SSLRs relative to People with Limited English Proficiency

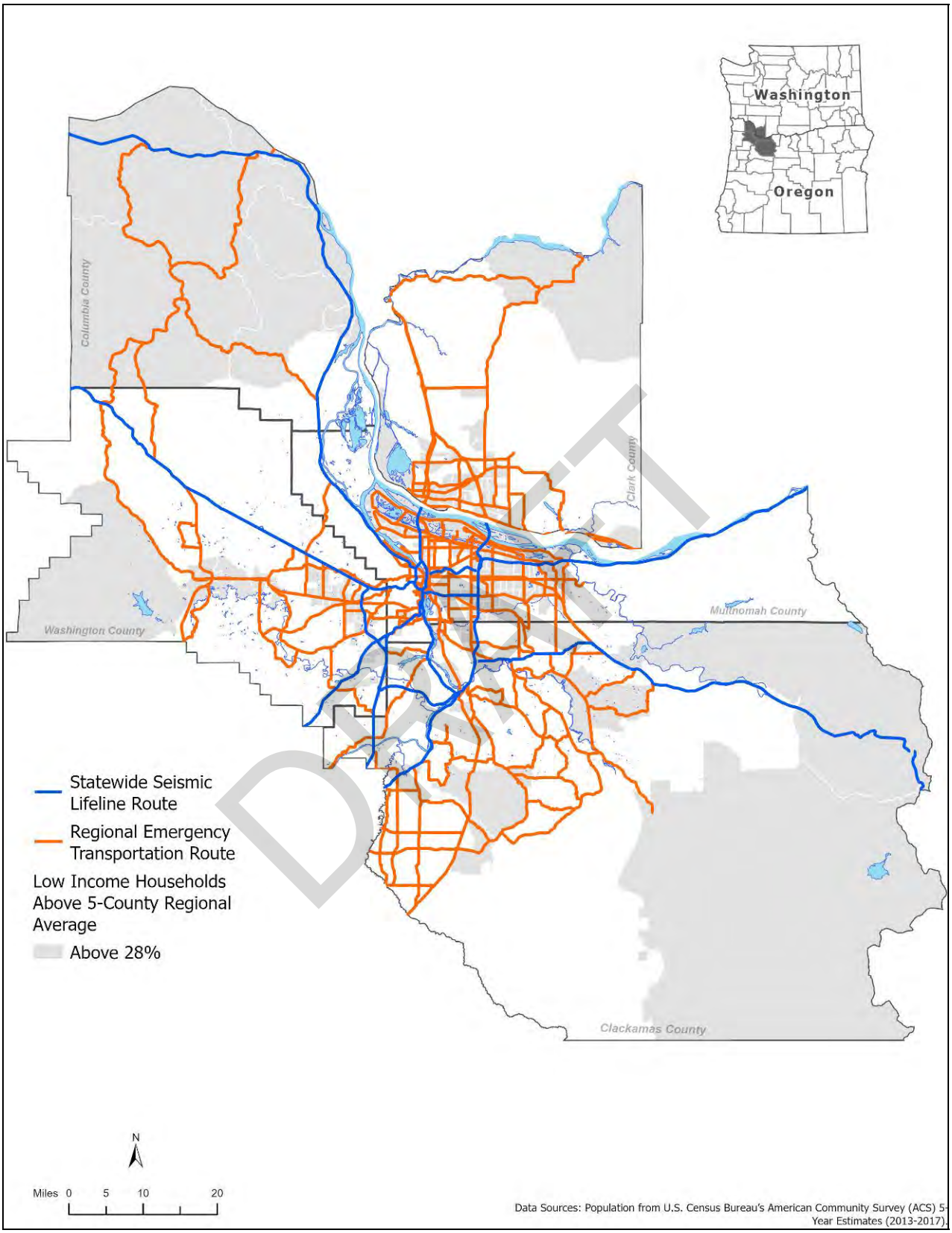

Figure 6.19. RETRs and SSLRs relative to People with Low Income

Based on this evaluation, the updated RETR system provides adequate access to vulnerable populations in the region. Further, vulnerable populations are not only concentrated in urban areas. People with low Income and people over the age of 65 especially are concentrated in rural areas. These populations are more likely to be isolated due to a lack of redundancy of RETRs. The RETRs and SSLRs traverse through vulnerable communities to ensure connectivity and accessibility; however, caution would be applied to those communities to make sure they would not be overburdened by emergency response related service vehicles, such as for debris management, etc. Connectivity and accessibility needs for urban and rural communities vary greatly; for example, access to transit would likely be of more importance to in more urban contexts and access to fuel PODs would likely be higher priority for rural communities. The accessibility needs for people with low-income, people over the age of 65, and people under the age of 18 is of significance and should be addressed through future community-based emergency preparedness and debris management planning and engagement.

6.3.3.2 Additional Social Vulnerability Evaluations

In addition to individual vulnerable population evaluations, it is valuable to consider where multiple vulnerable populations intersect and are concentrated. Figures 6.20 through 6.22 present these evaluations.

To support this evaluation, Metro identified census tracts in the five-county region with above regional average concentrations of the following three categories of vulnerable populations: people of color (POC) by race and ethnicity, people with limited English proficiency (LEP), and people with low-income (LI). Called RETR Equity Focus Areas (EFAs), the EFAs do not account for population density, but only when a census tract exceeds the 5-county regional average rates for POC, LEP or LI. To better account for concentrations of these populations in urban and rural areas, Metro applied a separate population density screen to the EFAs at the block group level using the ACS 5-year estimates (2013-2017). Block groups are enumeration units used by the U.S. Census that are smaller than census tracts.

While the RETR EFAs were identified using demographic data at the census tract level (because the margins of error are too large at the block group level), block groups were used to determine the density of total population to better account for concentrations of people of color, people with limited English proficiency and people with low income in urban and rural areas. The five-county regional average population density is 0.76 people per acre. Higher population density is defined as equal to or more than 0.76 people per acre per block group and lower population density means less than 0.76 people per acre per block group.

Figure 6.20 shows RETR EFAs in the region defined above in *Section 4.0 Overview of Key Concepts and ETR Development Methodology* as areas with one or more of the POC, LEI, and LI populations above the five-county regional averages for each population.

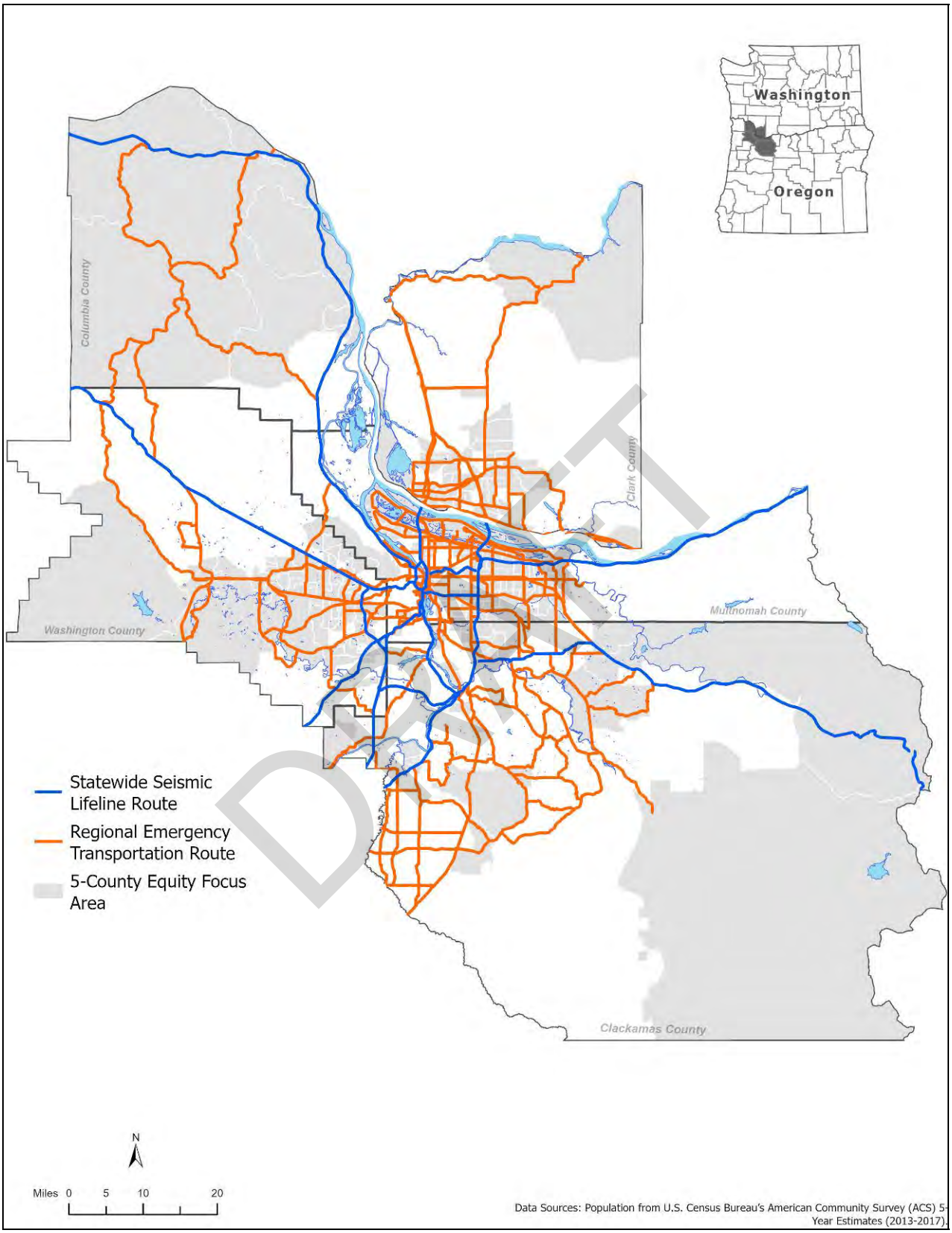

Figure 6.20.RETRs and SSLRs Relative to Equity Focus Areas

Figure 6.21 presents the RETRs relative to EFA census tracts further screened by areas with above the regional average population density. Higher density equity focus areas are defined as block groups within EFA census tracts with more than 0.76 people per acre. The analysis shows RETRs and SSLRs provide connectivity and service to equity focus areas with higher population densities in both for urban and rural areas.

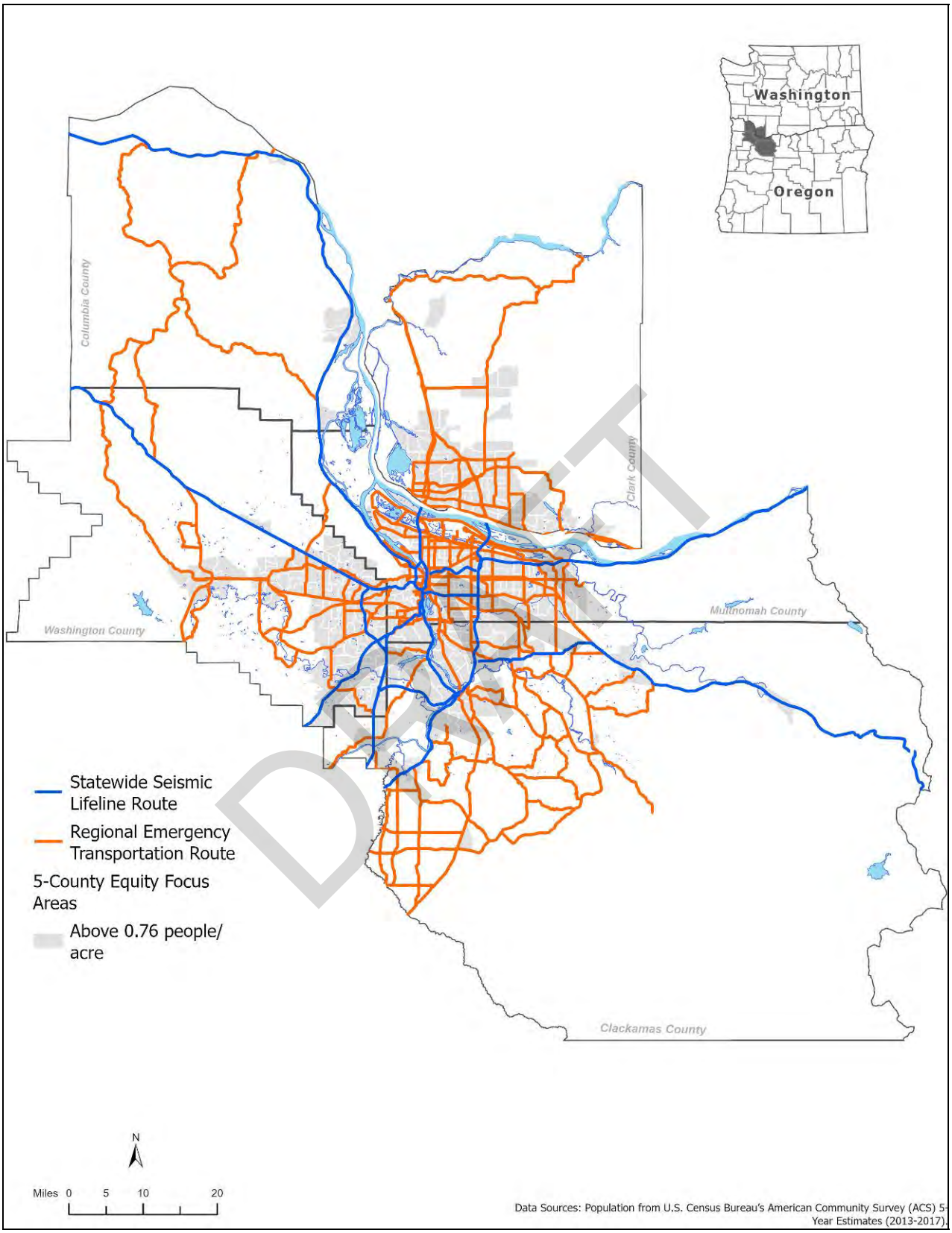

Figure 6.21. RETRs Relative to Equity Focus Areas Above the 5-County Density Rate

Figure 6.22 shows census tracts with concentrations of vulnerable populations with show shading to indicate how many types of vulnerabilities are present in each tract (0 through 6).

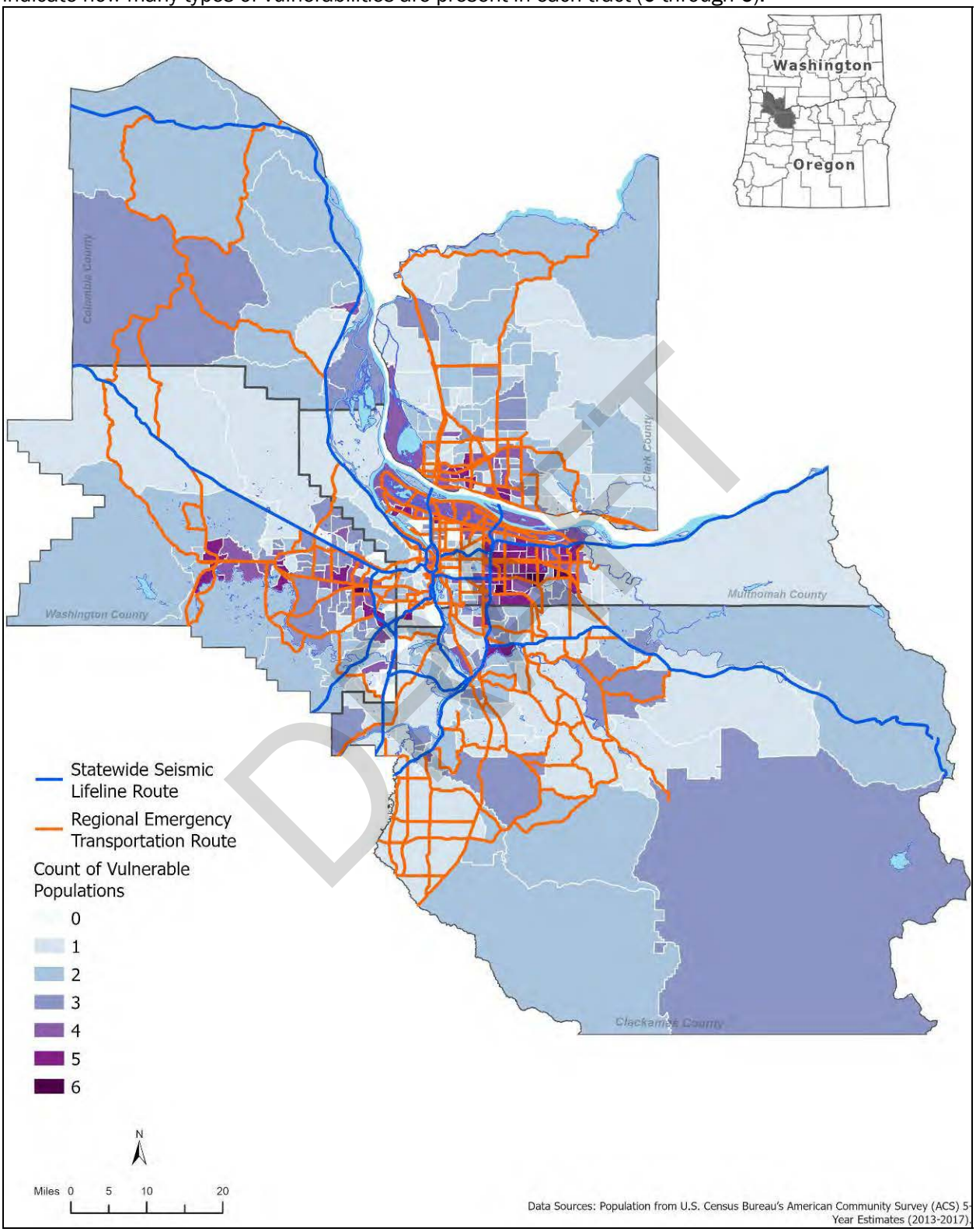

Figure 6.22. Areas of Vulnerable Populations with High Density Screen

This work provides a preliminary assessment of considering community and social equity factors to evaluate the potential benefits and burdens of the RETRs and SSLRs routes. Based on the demographic mapping for the EFAs with a higher density screen (Figure 5.22) and the mapping that shows census tracts that include higher than average concentrations of multiple vulnerable populations (Figure 5.24), the RETRs and SSLRs provide adequate connectivity and accessibility for vulnerable populations in urban and rural communities. However, when screened with route resilience, many of the rural populations may become isolated from emergency response resources during seismic, flood, or landslide events. Further, these areas are less likely to be accessed quickly after an event. Therefore, work building resilience and emergency supplies within these communities will be important.

In disaster planning for social vulnerabilities and connectivity to emergency routes, an in-depth look at the demographics and socioeconomics attributes, such as poverty, income, education, gender, age, race, ethnicity, housing, health, and physical abilities, are all critical factors to consider for evaluating whether distribution of benefits and burdens is equitable. Social vulnerability factors to consider in future planning efforts include:

- Diversity and composition of families and households (e.g., single head of households, government-assisted households)
- Race/ethnicity/language
- Socioeconomic status (income, employment and education)
- Special needs of people without vehicles, older adults, people with disabilities or people who do not understand English well
- Lack of access to resources by those most in need of assistance (medical, housing, food, affordability, disability, etc.)
- Networks to provide access to economic resources

A more thorough analysis of these factors in combination with direct engagement of potentially vulnerable populations is recommended to provide a more in-depth look at the equity implications and help planners better prepare for an respond to emergency events. *Section 7.0 Anticipated Applications and Recommendations for Future Work* describes potential upcoming work to address these needs.

6.4 RETR Update Key Findings

6.4.1 Overall Findings

Based on our evaluation, the currently proposed system of RETRs provides adequate connectivity and access to routes and facilities identified during the methodology development. However, the route resilience evaluation highlighted significant weaknesses that will likely result in isolated populations and issues connecting critical infrastructure used for response and recovery to the populations and responders that need access. Supply distribution into the region via the ground vehicle transportation network from the east (PDX/Ports/Redmond Airport) and the west (ships off the coast) will be difficult if not impossible in the event of a large earthquake. The Willamette and Columbia rivers will be barriers to emergency response traffic due to areas of liquefaction and landslide, potential petroleum product

pollution from the CEI Hub, as well as significant bridge vulnerability. Bridge vulnerability and landslides are also likely to contribute to isolated populations in rural areas due to a lack of ETR redundancy. These weaknesses highlight the need to plan and mitigate for areas of low resilience to natural hazards without adequate route redundancy, and to develop guidelines operationalization use of the routes during an emergency. Some specific observations are included below and future work is discussed in *Section 7.0 Anticipated Applications and Recommendations for Future Work*.

The vulnerabilities of the ETR network are significant and will likely require billions of dollars to adequately mitigate hazards to the full ETR system. Due to the limited availability of funding for transportation in the state and region, this makes the development of a tiered or phased system of ETRs like ODOTs system critical. Prioritization of routes can help local agencies better plan for improvements to higher priority infrastructure and seek funding for resilience improvements to increase the resilience of the ETR system as quickly as possible. This prioritization should include not only resilience considerations, but a cost/benefit analysis that can develop the most efficient and cost effective way to increase resilience as quickly as possible. Phase 2 of this effort that will include some of this work is outlined in more detail in *Section 7.0 Anticipated Applications and Recommendations for Future Work.*

6.4.2 Connectivity and Access Findings

- Route redundancy in the east side of Portland and in the SW corner of the region is high in the current RETR system when compared to the critical infrastructure and essential facilities mapped in these areas. Prioritization of routes should be considered and some of the current RETRs may be able to be designated LETRs.

- Further refinement of critical infrastructure and essential facilities designations within the region would be beneficial before the next phase the of RETR update. Due to variability in the classifications (between jurisdictions and disciplines), a working definition was established for this project as outlined in *Section 3.0 Overview of Key Concepts and ETR Development Methodology*. Additional facilities and services could be incorporated in future updates.

- Areas of Clark County outside of the Vancouver area have UGB areas that are serviced by fewer RETRs than other areas of similar population/urban growth in the region. Furthermore, the majority of the routes are state routes. It may be prudent to increase RETR redundancy in these areas with more RETRs on local agency facilities.

6.4.3 Route Resilience Findings

- In the event of a large earthquake, bridge vulnerability and expected damage due to liquefaction will greatly hinder the connectivity of the RETRs and the region. Seismically induced landslides will further disrupt the system. This is particularly an issue in rural areas where route redundancy is not sufficient to avoid isolated populations and in areas where river crossings are imperative for emergency response. Based on information from emergency management, the majority of the supplies for the region will be coming from the east and the Redmond Airport. Crossings of the Willamette and Columbia rivers are imperative to distribute supplies within the region.

- As mentioned with the bridge vulnerability map, information about bridge resilience is available from ODOT, but is not available from WSDOT. However, WSDOT has invested in seismic resilience of facilities statewide; therefore, the lack of information available to compile with the ODOT data should not be taken to indicate deficiency of infrastructure, just lack of available comparable data at this time. Further information about WSDOT bridge resilience should be incorporated when available.

- Lack of regional ETR redundancy results in Columbia County being especially vulnerable in both earthquake and flood events.

- Landslides outside of an earthquake event generally occur as singular events or as a small group. However, increased wildfires will develop increased risk for landslide events during wet weather periods and increased storm events may results in more landslides at a time. Additional mapping and considerations for landslide and wildfire events should be considered in future updates.

- As mentioned above, the DOGAMI debris data should be further evaluated to better reflect expected damage to the regional ETRs as well as where access will be needed to manage and remove debris within the region.

6.4.4 Community and Equity Findings

- The evaluation of vulnerable populations highlighted prevalence of over 65, under 18, and low-income populations in rural areas where there is less redundancy of regional ETRs and fewer travel options are available.

- The evaluation demonstrated different vulnerabilities in the rural and urban contexts; particularly the aging population in rural areas and more reliance on public transit or alternate modes of transportation in the urban areas.

- Ultimately, this was an evaluation of existing data; however, no conversations were held with communities classified as vulnerable within the data criteria. Future work needs to take these mapped results back to communities for discussion about how well the data represents their experience, and what additional information is needed to better represent their unique vulnerabilities and needs for the purposes of RETR planning (and others). Fortunately, the RDPO/Metro Social Vulnerability Tool (SVT) project will conduct outreach to a wide range of communities in 2021 to validate and explore factors for just such incorporation into future planning.

7.0 FINAL UPDATED ROUTE SUMMARY

The final updated RETR network as described above is detailed in Table 6.1 and shown on Figure 6.1 (*map with legend to be provided with large format*) below and attached in Appendix F as large format. This effort resulted in 192 RETR segments in addition to the 35 SSLR segments identified by ODOT.

8.0 ANTICIPATED APPLICATIONS AND RECOMMENDATIONS FOR FUTURE WORK

This section summarizes recommended future work that emerged during this two-year first phase of the regional ETR update project. Recommendations address topics raised by project stakeholders and/or were identified during the evaluation that fell outside the scope and budget for the initial phase of work (2019-2021). It is important to note that all future project work is contingent upon funding. Many of the proposed projects require further partnership between emergency management, planning organizations, and owner/operators of transportation facilities. The RDPO Steering Committee should continue to leverage the Urban Areas Security Initiative (UASI) federal grant to the region to continue immediate planning needs; it is also important that transportation stakeholders and entities with capital investment responsibilities for facilities similarly prioritize funding to accelerate our region's transportation resilience and preparedness.

Table 8.1 – Summary of Recommendations

	Recommendation	Level	Lead / Key Partners
1	Integrate RETRs into other planning and investment decision-making processes	State, Regional, and Local	Various
2	Prioritize or tier the regional ETRs	Regional	RDPO & Metro (RETR Phase 2)
3	Develop RETR management plans to include: RETR operations in an emergency, evaluation of specific hazard events, maintenance and coordination between jurisdictions, and transition to recovery	Local with regional facilitation	Local jurisdictions with facilitation by RDPO & Metro (RETR Phase 2)
4	Better address vulnerable populations	Regional and Local	RDPO & Metro (RETR Phase 2 and Social vulnerability Tool (SVT)
5	Integrate RETR and LETRs into evacuation planning	Local and regional	TBD
6	Formalize the RETRs and agree to a plan for consistent updates	Regional	RDPO & Metro (RETR Phase 2)
7	Engineering evaluation of top priority routes for seismic upgrades	Local and regional	TBD
8	Evaluate river routes	Regional/State	Ports and Coast Guard, State Resilience Office
9	Develop equity-centered public messaging for transportation in emergencies	Regional	RDPO Public Messaging TF
10	Evaluate bike and pedestrian options for emergency transportation	Local	Various

8.1 Integration of ETR Work in Planning (Ongoing – Continuous)

Recommendation 1. Integrate RETRs into other planning and investment decision-making processes

As with all planning, the RETR work ties to many other efforts. The Table 8.2 below is a summary of those interrelated plans, projects and initiatives. Most are likely to be referenced throughout the detailed near and longer-term recommendations sections. RETRs and the local routes that serve the regional routes should be incorporated into many future planning efforts, including emergency response plans and exercises, natural hazards mitigation planning, master planning, local and regional transportation system plan updates, and capital improvement planning.

The RETRs should be prioritized for resilience upgrades as projects are planned by local, regional, and state agencies as well as transportation providers. Based on understanding of upcoming federal grant opportunities, including the need for transportation resilience upgrades, these planning efforts will help demonstrate the urgency and necessity when applying for mitigation grants.

Table 8.2 – Other State, Regional, and Local Plans that Connect to the RETR Update Project

#	PROJECT / PLAN	OWNER / LEAD	FOCUS AREA	STATUS / DATE	RELATION TO RETRs
1	Social Vulnerability Toolkit (SVT)	RDPO and Metro	An enhanced GIS data platform for analysis of social vulnerabilities in the region	Initiated 2020, due by 2022	Key input for equity analysis. To be incorporated with RETR Phase 2 roll-out with local jurisdictions.
2	Transportation Recovery Planning	RDPO with Portland State University's Transportation Research and Education Center (PSU TREC)	Dissemination of PSU/PBEM/PBOT developed transportation recovery toolkit and plan; to promote further plans in region	Portland Toolkit and Plan established 2017, dissemination project 2020-2022	RETRs should be evaluated for recovery purposes with this toolkit, and recommendations made for any recovery-specific additions/changes.
3	Emergency Fuel Planning	RDPO with the Oregon Department of Energy (ODOE) and CAN Research	Assessment of emergency fuel needs for continuity of essential services in a catastrophic event, and plan development for fuel management in a large-scale emergency	Initiated in 2019, to be completed in early 2021. TBD on local or regional exercises to follow.	Fuel distribution in a catastrophic event will be reliant on the RETRs (along with SSLRs). Primary locations of fuel storage and distribution need to be accessible from SSLR/RETRs.

#	PROJECT / PLAN	OWNER / LEAD	FOCUS AREA	STATUS / DATE	RELATION TO RETRs
4	Regional Critical Facilities Project	RDPO	Consistent designation of critical facilities region-wide and a toolkit to help prioritize use during a real-world event	2017- PAUSED	A consistent designation of critical facilities that support essential services is needed to further refine connectivity criteria of the RETRs for Phase 2 operationalizing with local jurisdictions.
5	Regional Transportation Plan (RTP)	Metro	Coordinates and plans investments in the regional transportation system (Portland tri-county urban area)	Updated every 5 years; Next RTP update due in Dec. 2023	RETRs can inform updates to regional transportation policies and criteria for prioritizing projects and programs in the plan.
6	Regional Disaster Debris Management Planning	Metro	Designates disaster debris management sites and provides guidance for Metro on how to manage and coordinate debris operations and system disruptions following a debris-generating event.	Periodically updated; last update completed in 2018	RETRs provide important connections for moving debris and to access disaster debris disposal sites.
7	Regional Transportation Plan	SW RTC	Coordinates and plans investments in the regional transportation system (Clark County, WA)	Updated every 5 years; Next update due late 2023	RETRs can inform updates to regional transportation policies and criteria for prioritizing projects and programs in the plan.
8	Regional Resiliency Assessment Program (RRAP)	Cybersecurity and Infrastructure Security Agency (CISA) with Oregon Governor's Resilience Office	Assessment of multi-modal transportation solutions for a catastrophic earthquake	In progress since 2018. Estimated completion summer 2021.	Incorporate the "islands" created by a catastrophic earthquake (disruptions in the transportation networks) into the Phase 2 RETR operational planning with counties/cities.

#	PROJECT / PLAN	OWNER / LEAD	FOCUS AREA	STATUS / DATE	RELATION TO RETRs
9	Earthquake Ready Burnside Bridge Project (EQRBB)	Multnomah County	Project to seismically upgrade the Burnside Bridge to establish a downtown river crossing that will be available for immediate use for life safety following a catastrophic earthquake	2017-2030	RETR designation of Burnside as a key east-west route for emergency response is an important support for this effort; likewise, if successful this seismic investment is an important reinforcement of a central RETR for the regional transportation capacity.
10	Oregon Highway Plan Update	ODOT	Statewide Seismic Lifeline Routes (SSLRs) are designated in this plan	2021-22	The connection between SSLRs and LETRs drive a large part of the RETR designations.
11	Port of Portland Resilience Program	Port of Portland	Prepare the Port to support emergency response and return to operations after catastrophic events or disruptions through physical and operational actions and partnerships. Design and construct a seismically resilient runway at PDX to support immediate response and long-term recovery.	TBD	RETRs are critical connections between PDX and Marine Terminal 6, which have the potential to serve as essential aid, transportation and logistics connection points between the Portland metropolitan region and areas outside the region within and beyond Oregon.
12	Portland Bureau of Transportation (PBOT) Transportation Resilience Strategy	PBOT, City of Portland	Outline social and physical impacts to natural hazards; begin identifying mitigation solutions	Jan-June 2021	Recent efforts in transportation resilience and recovery, and social equity will be inputs into this plan

#	PROJECT / PLAN	OWNER / LEAD	FOCUS AREA	STATUS / DATE	RELATION TO RETRs
13	Local hazard-specific evacuation plans	TBD	Geographic and hazard specific plans to evacuate populations at risk	TBD	Use of RETRs for evacuations came into question in 2020 wildfire season and needs to be clarified
14	City and County Transportation System Plans (TSPs)	Cities/Counties	Long-range plans identify transportation needs for at least a 20-year period and define priority capital projects and programs (including maintenance of the system & funding)	Periodically each 7-10 years (varies)	Regional ETRs should be considered for resilience investments.
15	City and County Roadway Capital Improvement Plans (CIPs)	Cities/Counties	Defines near-term priority capital projects (including maintenance of the system and funding); draws from TSP and other plans/studies.	Periodically updated every 3-5 years	Regional ETRs should be considered for resilience investments.

8.2 Project Second Phase: Prioritizing, Operational Planning, and Formalizing the RETRs (Near Term – Next 1 to 5 Years)

A project concept was successfully submitted to the 2021 UASI pipeline of the RDPO in November 2020. The project concept for a second phase of work, if approved, will be funded in late 2021 for implementation in 2022-2024. The project proposal addresses most of the recommended near-term priorities.

Recommendation 2. Prioritize or tier the RETRs

An immediate next step will be to prioritize or tier the 192 RETR segments. With the phase 1 updated in 2021, 87 of routes were added to the 104 of 2006 established routes. With this most recent update, the network of RETRs is more robust, providing enhanced connectivity. However, for capital investment planning purposes, it will be most useful to determine key routes for seismic and other natural hazard resilience investment. It will also be important to make operational distinctions between different RETRs for prioritization in a real-world event.

For example, ODOT established a 3-tier system for their SSLRs, which could be emulated or adapted for the RETRs. ODOT's tiered system is based on the desired time required to get the routes open. As shown in Appendix D, Tier 1 routes are prioritized to be cleared and repaired first, then Tier 2 and so forth. Tiering and prioritization can also be helpful when planning capital improvements and applying for state and federal funding to improve resilience. Funding can be applied according to prioritization so that the most critical ETRs are retrofitted first.

The proposed Phase 2 project will develop a methodology for prioritization or tiering, work with owners/operators of the RETR facilities, as well as the elected leadership and local officials, whose ultimate decision it will be to endorse recommended tiering/prioritization for future investment and operational planning.

RETR OPERATIONAL CONSIDERATIONS

- Active landslides and high-risk landslide areas
- Areas of expected high liquefaction and flood zones
- Route geometry for emergency and large vehicle access
- Road grade and bridge vulnerability including overpasses and overcrossings.
- Route access restrictions for first responders and public
- Pedestrian access and alternate transit alternatives
- Public messaging regarding use of RETRs
- Debris management plans, equipment access, and temporary storage sites
- Coordination on multi-jurisdictional routes
- Planned jurisdictional transfers (State to local ownership)
- SSLR alternative regional and local routes identified by seismic resilience assessments (2019-2020)
- Local responsibilities for SSLR route damage assessment and debris clearance (if any)

Input from the following:

- Oregon Department of Transportation (ODOT) Tiering
- Regional Resiliency Assessment Program (RRAP) Study, Oregon
- Metro Regional Transportation Plan (RTP)
- Metro Regional Debris Management Plan
- RDPO Transportation Recovery project
- Local capital improvement plans
- Transit infrastructure investments

Recommendation 3. Develop RETR management plans to include: RETR operations in an emergency, evaluation of specific hazard events, and maintenance and coordination between jurisdictions, and transition to recovery.

Local Ownership

The proposed next phase of the project will focus on operationalizing the RETRS with local jurisdictions. Road and bridge facilities in the RETRs are owned and operated by the counties or state, and as such, planning can be coordinated with regional partners, but is ultimately owned by the local jurisdictions. We anticipate that due to equipment and personnel availability, local agencies will likely be responsible for clearing select ODOT routes and will have full responsibility for clearing regional and local routes.

All Hazards Approach

Local jurisdictions should consider the use of their tiered/prioritized RETRs against potential regional hazard risks, including snow and ice events, landslide or flooding events, and wildfire. Different disasters may require activating different routes suited to unique events and/or types of hazards. Future evaluation efforts should consider other hazards due to the effects of climate change, such as increased landslides and wildfires, damage to bridges and culverts due to washouts and flash flood events, increased and prolonged storm events, and flooding and water level rise.

Develop Detailed Operational Plans for ETRs and/or Incorporate into Existing Emergency Plans

It is recommended that detailed emergency transportation plans and response procedures are developed to better define concepts, such as ETR use, users, priorities and responsibilities for route maintenance, debris clearance, and repair. A coordinated plan with a timeline and associated responsibilities for federal, state, regional, and local emergency responders would provide the framework for developing emergency transportation response plans for varying levels of government. It would also be prudent to incorporate management and use of ETRs during future preparedness exercises.

The use of ETRs immediately after disaster in the region will depend on event-specific damage and needs, and knowing that it will be difficult to limit access to ETRs in the event of a large-scale disaster before federal and state aid and personnel are able to supplement local law enforcement. Currently, there are no plans to limit or restrict the use of ETRs by law enforcement.

Debris Management and Route Restoration

All levels of ETRs will need to be accessed and cleared of debris and potential obstructions, as well as damaged bridges, bridge approaches, or slope and embankment failures will have to be repaired. ETRs should be cleared according to the operational planning developed in future phases of this project. An example would be to clear based on order of importance from SSLRs to LERRs. Emergency debris management plans for the RETRs should be coordinated with the Metro Debris Management Plan that includes debris management site locations.

Cross-Jurisdiction Coordination

Part of the next phase of planning will be to evaluate LETRs and LERRs at jurisdictional boundaries, including those outside the region, to assess where they cross into a neighboring jurisdiction, district and/or community. In such instances, it is prudent to coordinate with the neighboring jurisdiction to ensure the road's designation as a local or RETR is consistent across jurisdictional boundaries and operational plans for real-world events will be coordinated.

Response to Recovery

It is inevitable that ETRs, designated to facilitate immediate response priorities, will also be used for post-emergency recovery. As such, plans should include a timeline that details how the use of these routes will vary across jurisdictions and change after an event and during the recovery phase. Further, a better definition of federal, state, regional, and local responsibilities for recovery and repair of the routes is warranted.

In 2021 the RDPO, in partnership with PSU's TREC will disseminate a toolkit developed by PBOT, PBEM, and PSU in 2018 to facilitate real-time decision-making about route restoration for recovery purposes. This dissemination project will provide important input on recovery considerations that can be applied in the Phase 2 RETR project to better address the transition of ETRs from emergency response to recovery purposes.

Recommendation 4. Better address vulnerable populations

This project evaluates districts and neighborhoods where ETRs intersect with vulnerable communities that may be disproportionately affected by an earthquake or other disaster (e.g., more heavily damaged areas or limited access to medical care facilities). Future planning will need to acknowledge where the inequities in emergency preparedness and response would occur, and therefore, specifically address diversity, equity, and inclusion in transportation aspects of emergency response and recovery planning.

Input from community leaders identified the need to ensure this body of work is relevant to community disaster preparedness activities and that there are clear lines of communication about how ETRs are implemented in the overall disaster planning at the regional and local levels. Though most leaders understand the need for the RETR project, many emphasized that there are current infrastructure improvements in communities that need to be addressed, and future infrastructure improvement plans should balance the local needs of these emergency routes with helping local communities to prepare for disasters. This is an opportunity to consider current community needs when improving the resilience of RETRs.

RDPO Project to Develop Social Vulnerability Analysis Tools and Data (2020-22)

The RDPO received funding from the Urban Areas Security Initiative (UASI) to support development of tools and data to identify social vulnerability across the five-county region as well as within each of the five counties.

The tools will help identify people in the region who are most likely to experience barriers to services and programs before, during and after disasters. Factors that will be considered in this effort include race, income, houseless, functional and access needs, limited English proficiency, among others.

Tools are expected to include:

- A regional definition for social vulnerability.
- A set of common social vulnerability indicator datasets (including national and available local data) that will be compiled into a regional and county-level social vulnerability index.
- Maps and GIS data that geospatially display the data for each index.

The overarching concern brought up by community leaders was to adequately evaluate who would be served by these prioritized RETRs and to ensure that future planning prioritizes serving those with less access to resources in a disaster. To this end, the RDPO/Metro Social Vulnerability Tool (SVT) project advancing in 2021 will provide important up-to-date data for deeper evaluation of these considerations with local communities in the proposed Phase 2 project.

Recommendation 5. Integrate RETR and LETR into evacuation planning

Currently, each local jurisdiction maintains evacuation plans for specific vulnerable geographies and communities depending on their specific hazard risks. It is important that local jurisdictions integrate the RETR and LETR into their evacuation plans, and wherever possible, coordinate across jurisdictional boundaries to plan contingencies for evacuations that may rely on RETRs spanning boundaries.

2020 Wildfire Evacuations

During September 2020 when all of Clackamas County was on evacuation notice due to four simultaneous wildfire events within their boundaries, affordable housing partners in the region reached out to the RETR project team to get input on evacuation contingencies for their vulnerable populations. The RETR planning team directed inquiries back to the Clackamas and Multnomah County EOCs. This highlights the need for clarity about the purpose of ETRs and decision-making authority in a real-world incidents.

Recommendation 6. Formalize the RETRs and agree to a plan for consistent updates

The regional partners will likely benefit from an updated formalized agreement (MOUs or other types of agreement, etc.) between agencies, including ODOT, which defines a plan for clearing debris and repairing RETRs based on their prioritization/tiering and in line with local operational and emergency plans.

As roadway and capital improvement programs progress and infrastructure ages, routes should be updated to reflect the current state of infrastructure resilience against the hazard risks. Further, improvements to route corridors or new roadway corridors should be included in any route program updates on a regular basis.

It is recommended that the RETRs be updated at a minimum on a 10-year cycle: next update to commence in 2028 (anticipated 3-year timeframe to complete update by 2031).

It is recommended the regional partners, RDPO and Metro, conduct a shorter 5-year update to capture changes in the GIS data layers for any updated infrastructure, new critical facilities, and any updated or refreshed social vulnerability data.

8.3 Additional Follow-On Work to Advance Emergency Transportation Plans and Resilience (Longer-Term – 5 to 10 Years)

Recommendation 7. Engineering evaluation of top priority routes for seismic upgrades

Conducting a detailed engineering evaluation of all RETRs is not practical from a resource investment perspective. However, stakeholders should consider further investment in conducting site specific geotechnical and structural evaluations on a select group of RETRs (including bridges) to make informed investments to maximize seismic resilience and connectivity between LETRs, RETRs, and SSLRs in a catastrophic earthquake scenario. Details of the considerations to harden infrastructure include bridge/crossing age and vulnerability evaluations, including structural and geotechnical analyses and evaluation of the vulnerability of the route in general between crossings for liquefaction, lateral spread, and/or landslides. Route priority should also be considered. The system as a whole should be evaluated as well for both engineering and emergency response considerations. This will help identify areas where a lower tiered route may be considerably cheaper to harden than a higher priority route and still provide adequate connectivity.

> Caltrans recently commissioned a ***vulnerability study*** of its State Highway System (SHS) to climate-change and extreme weather events. The result will identify transportation assets at risk of damage from these events, and will assist in future planning, design and funding decisions for adaption actions.

Recommendation 8. Evaluate river routes

The definitions in this study are related to ground transportation routes and do not include river routes. While the ETR project considered access to ports and shipping facilities, based on the numerous rivers in the region and the general expectation of large-scale bridge damage, we anticipate that ground transportation will be significantly affected. We recommend that RDPO and Metro consider a follow-up project that examines the potential use of river routes, including how river debris will be managed and what options are available for using watercraft for supply and freight distribution as well as public evacuation from damaged areas.

If a major earthquake occurs during daytime hours when most of the population is at their place of work or school, then a major issue for the immediate response phase is to help the public return home and/or reunite with family after an event, especially in the case where they are across a river from home and/or family. It would be prudent to develop a plan to facilitate public crossings of both the Willamette and the Columbia rivers after an event assuming that neither the I-5 nor I-205 bridges are functional.

Future efforts to better determine where ETRs intersect with vulnerable communities that may be disproportionately affected by an earthquake or other disaster (more heavily damaged areas or limited access to medical care facilities, etc.). Future planning will need to acknowledge where the inequities in emergency response would occur, and therefore, specifically address diversity, equity, and inclusion in emergency response and recovery planning.

Recommendation 9. Develop equity-centered public information and messaging about transportation systems in emergencies

Further pursuing equity on ETRs as discussed above means incorporating clear communication with communities about where ETRs are, how they should factor into preparedness planning, and how improving ETRs would impact their community. This also includes communication in different languages, using culturally-appropriate approaches and longer planning timeframes to incorporate voices less familiar with these planning processes. Future planning work should provide opportunities for community outreach and education, including people of different language groups, ages, socio-economic class, communities of color, and abilities to ensure that a broad cross section of community voices are represented and provided meaningful opportunities to shape the outcomes.

Develop a messaging campaign and information that helps communicate the role of ETRs and their uses prior to an incident. An example would be to include education about walking, biking, or other methods of transportation in lieu of driving to keep roads clear and promote public responsibility to keep RETRs available for emergency services.

Recommendation 10. Evaluate bike and pedestrian options for emergency transportation

In alignment with the equity information approach, future joint transportation and emergency planning at local levels should incorporate bike and pedestrian access to their LETRs and LERRs. An option could include isolated lanes on main LETRs or separate facilities that are provided specifically for non-motorized uses and transit vehicles.

REFERENCES

Clackamas County, 2018. Clackamas County Lifeline Seismic Bridge Priority Detour Recommendations Final Report, November 2018.

Clark Regional Emergency Services Agency 2013. Clark Regional Comprehensive Emergency Management Plan, The Emergency Operations Plan for Clark County, its Seven Cities, and Partnering Agencies, December 2013.

Clark Regional Emergency Services Agency 2011. Clark County Hazard Identification Vulnerability Analysis, 2011.

Metro 2018a. Regional Transportation Plan, 2018.

Metro 2018b. Metro Disaster Debris Management Plan, August 2018.

Metro 1996. Regional Emergency Transportation Routes, March 1996.

Multnomah County 2020. Draft Multnomah County Resilient Detour Routes: Recommendations to Oregon Department of Transportation, December 2020.

Multnomah County Department of Community Services – Transportation Division 2016a. Multnomah County Transportation System Plan, June 2016

Multnomah County Department of Community Services – Transportation Division 2016b. Road & Bridge Incident Response Inspection Plan, 2016.

Multnomah County Emergency Management 2017. Multnomah County Multi-Jurisdictional Natural Hazards Mitigation Plan, July 2017.

Oregon Department of Transportation (ODOT) 2015. Oregon Highway Plan, Oregon Department of Transportation, 2015.

Oregon Department of Transportation (ODOT) 2014. Oregon Highways Seismic Plus Report, Oregon Department of Transportation, October 2014. https://www.oregon.gov/ODOT/Bridge/Docs_Seismic/Seismic-Plus-Report_2014.pdf

Oregon Department of Transportation (ODOT) 2013. Oregon Highway Seismic Options Report, Oregon Department of Transportation, March 2013.

Oregon Department of Transportation (ODOT) 2012. Seismic Lifelines Evaluation, Vulnerability Synthesis, and Identification, Oregon Department of Transportation, May 2012. https://www.oregon.gov/ODOT/Planning/Documents/Seismic-Lifelines-Evaluation-Vulnerability-Synthese-Identification.pdf

Oregon Seismic Safety Policy Advisory Commission 2013. The Oregon Resilience Plan, February 2013.

Oregon, State of, 2017. Oregon State Infrastructure Protection Plan, March 2017.

Port of Portland 2019. Hillsboro Airport Seismic Resilience Assessment, February 2019.

Port of Portland 2018. Hillsboro Airport Master Plan Update, June 2018.

Port of Portland 2015. Port of Portland Corporate Seismic Risk Assessment Study, May 2015.

Portland Bureau of Emergency Management 2018. Portland Transportation Recovery Plan, July 2018.

Portland Bureau of Emergency Management 2017a. Preparedness Report, June 2017.

Portland Bureau of Emergency Management 2017b. Annex D|Evacuation Plan, October 2017.

Portland Bureau of Planning and Sustainability 2012. Portland Local Energy Assurance Plan, June 2012.

Portland Bureau of Transportation 2019. Portland 2035 Transportation System Plan, 2019 Minor Update.

Portland Bureau of Transportation 2018. Designing a Methodology for Portland's Emergency Transportation Routes, August 2018.

Portland Bureau of Transportation 2015. Post-Earthquake Bridge Inspection Response Plan, 2015.

Portland State University (PSU) 2019. Background and Considerations for Updating the Regional Emergency Transportation Routes in the Portland-Vancouver Metropolitan Region, Transportation Research and Education Center, Portland State University, August 2019. https://drive.google.com/file/d/1BG1JKogOW1njE7ynr_0MzOCMQ7WCb99r/view

Portland State University 2018. Resilient Infrastructure Planning Exercise (RIPE) Summary of Findings, City of Portland, Institute for Sustainable Solutions, June 2018

Regional Disaster Preparedness Organization 2017. Regional Facility Assessment Project, Site Identification and Criteria Report, November 2017.

Regional Disaster Preparedness Organization 2017 – 2021 Strategic Plan/ Portland Homeland Security Strategy.

Washington County 2019. Memorandum on Washington County Bridge Seismic Resiliency Detour Recommendation Priorities, July 1, 2019.

Washington Military Department of Emergency Management Division 2016. Comprehensive Emergency Management Plan, June 2016.

Washington State Department of Transportation (WSDOT) 2015. Washington Transportation Plan, Washington State Transportation Commission, State's Metropolitan Planning Organizations, Regional Transportation Planning Organization, January 2015.

Washington State Department of Transportation (WSDOT) 2007. 2007 – 2026 Highway System Plan, High Benefit Low Cost, December 2007.

GLOSSARY OF TERMS

Accessibility
The ability or ease to reach desired goods, services, activities and destinations with relative ease, within a reasonable time, at a reasonable cost and with reasonable choices.

Arterial
Arterials provide direct, relatively high speed service for longer trips and large traffic volumes. Mobility is emphasized, and access is limited. These facilities form the primary connections between the central city, regional centers, industrial areas and intermodal facilities, as well as between neighboring cities and the metro region. Arterials generally span several jurisdictions and often are designated to be of statewide importance and serve as major freight routes.

Capacity
A transportation facility's ability to accommodate moving people or vehicles in a given place during a given time period.

Climate Change
Any change in global or regional climate patterns over time, whether due to natural variability or as a result of human activity that persists for an extended period, that is attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels.

Collector
Collectors provide a bridge between arterials and local roads. Collectors link small towns to arterials as well as collect traffic from local roads.

Community Centers
Key local destinations such as schools, libraries, grocery stores, pharmacies, hospitals and other medical facilities, general stores, and other places, which provide key services and/ or daily needs.

Connectivity
The degree to which the local and regional street, pedestrian, bicycle, transit and freight systems in a given area are interconnected.

Critical Infrastructure
Lifelines other than the roadway transportation network such as water, wastewater, electricity, fuel, communications, and intermodal transportation such as transit, rail, air, and waterway. Critical infrastructure and services of state and regional importance during a disaster include intermodal port facilities, such as river ports, airports and marine terminals, and transfer points.

Debris Clearance
Debris removal is defined as the clearance, removal, and/or disposal of items such as trees, sand, gravel, building components, wreckage, vehicles, and personal property.

Essential Facilities
Hospitals and health care facilities, Emergency Operation Centers, police and fire, public works facilities, state, regional, and local points of distribution, designated debris management sites, and shelters and community centers.

Emergency Transportation Route
Routes used during and after a major regional emergency or disaster to transport resources and materials including first responders (e.g., police, fire and emergency medical services), fuel, essential supplies, debris, equipment, patients and personnel.

Equity Focus Area
Equity focus areas are Census tracts that represent communities where the rate of people of color or people with limited English proficiency is greater than the five-county regional average, or people with low income, i.e., incomes equal to or less than 200% of the Federal Poverty Level.

Functional Classification
Functional classification is the process by which streets and highways are grouped in classes (systems) according the character of service provided. There are three main functional classes as defined by the United States Federal Highway Administration: arterial, collector, and local. Throughways and freeways fall under arterial in the federal classification system.

Geospatial Data
Geographic information is the data or information that identifies the geographic location of features and boundaries on Earth, such as natural or constructed features, oceans, and more. Spatial data is usually stored as coordinates and topology, and is data that can be mapped.

Intermodal Facilities
A transportation element that allows passenger and/or freight connections between modes of transportation. Examples include airports, rail stations, marine terminals, and rail yards that facilitate the transfer of containers or trailers.

Isolated Populations
Vulnerable populations in urban and rural areas are particularly at risk of isolation. People with disabilities, youth, and the elderly are often left out entirely in urban planning. Many cannot leave their homes or do not have access to transportation, and therefore, suffer from isolation.

Local Streets or Roads
Local streets primarily provide direct access to adjacent land. Streets are designed as multi–modal facilities that accommodate bicycles, pedestrians and transit, with an emphasis on vehicle mobility and special pedestrian infrastructure on transit streets.

Network
Connected routes forming a cohesive system.

Population Centers
In demographics, the center of population (or population center) of a region is a geographical point that describes areas of concentration of people within a region.

Rapid Damage Assessment
Damage Assessment is a preliminary onsite evaluation of damage or loss caused by an accident or natural event. Damage assessments record the extent of damage, what can be replaced, restored or salvaged. It may also estimate the time required for repair, replacement and recovery. Rapid Damage Assessment is critical during the response phase of a natural or human-caused disaster. This information is used to measure the amount of damage, the area of damage, and to determine the resources necessary to mitigate and recover from a disaster.

Regional Transportation Plan
A long-range transportation plan that is developed and adopted for a metropolitan planning area (MPA) covering a planning horizon of at least 20 years. Usually RTPs are updated every five years through the metropolitan transportation planning process. The plan identifies and analyzes transportation needs of the metropolitan region and creates a framework for implementing policies and project priorities.

Route Maintenance
Route Maintenance or road maintenance involves remedying defects such as potholes that occur in the carriageway from time to time (corrective maintenance) and providing treatments such as crack sealing which will slow the rate of deterioration (preventative maintenance).

Single Occupancy Vehicle
Motor vehicles occupied and privately operated where the occupant is the driver. The drivers of SOVs use their vehicles primarily for personal travel, daily commuting and for running errands.

Slope and/or Embankment Failures
A slope failure is when a slope collapses abruptly due to weakened self-retainability of the earth under the influence of a rainfall or an earthquake. Embankments are constructed by placing and compacting successive layers of a fill material onto a foundation soil. Steeper slopes have greater risks for instability, hence more prone for slope failure. Excessive water in slopes is never good as it destabilizes the slope by adding weight, destroying cohesion between grains, and reducing friction.

Traffic
Movement of motorized vehicles, non–motorized vehicles and pedestrians on transportation facilities. Often traffic levels are expressed as the number of units moving over or through a particular location during a specific time period.

Users
A motorist, passenger, public transportation operator or user, truck driver, bicyclist, motorcyclist, or pedestrian, including a person with disabilities.

Vulnerable Populations

Vulnerable populations are groups and communities at a higher risk for poor health or longer recovery as a result of the barriers they experience to social, economic, political and environmental resources, as well as limitations due to illness or disability.

ACRONYMS

18- Under the Age of 18

65 – Over the Age of 65

ACS - U.S. Census Bureau's American Community Survey

ADT – Average Daily Traffic

C-TRAN – Clark County Public Transit Benefit Area Authority

CIP – Capital Improvement Plan

CISA – Cybersecurity & Infrastructure Security Agency

COVID-19 – Coronavirus disease of 2019

CRESA – Clark Regional Emergency Services Agency

CSZ – Cascadia Subduction Zone

DOD – Department of Defense

DOGAMI – Department of Geology and Mineral Industries

EFA – Equity Focus Area

EOC – Emergency Operations Center

EQRBB – Earthquake Ready Burnside Bridge Project

ETR – Emergency Transportation Route

EWRG – ETR Work Group

FEMA – Federal Emergency Management Agency

FHWA – Federal Highway Administration

GIS – Geographic Information System

ID – Route Identification

JPACT – Joint Policy Advisory Committee on Transportation

LERR – Local Emergency Response Route

LEP – Limited English Proficiency

LETR – Local Emergency Transportation Route

LI – Low Income

NV – No Vehicle

MOU – Memorandum of Understanding

MTAC – Metro Technical Advisory Committee

ODOE – Oregon Department of Energy

ODOT – Oregon Department of Transportation

OHSU – Oregon Health Sciences University

PBOT – Portland Bureau of Transportation

PDX – Portland International Airport

POC – People of Color

POD – Point of Distribution

PSU – Portland State University

PWB – Portland Water Bureau

RDPO – Regional Disaster Preparedness Organization

REMTEC –RDPO Emergency Managers Work Group

RETR – Regional Emergency Transportation Route

RRAP – Regional Resiliency Assessment Program

RTP – Regional Transportation Plan

SHS – State Highway System

SMART - South Metro Area Regional Transit

SOV – Single Occupancy Vehicle

SRAHNET – Federal Strategic Highway Network

SSLR – Statewide Seismic Lifeline Route (Oregon only)

SVT – Social Vulnerability Tool

SW RTC – Southwest Washington Regional Transportation Council

TPAC – Transportation Policy Alternatives Committee

TREC – Transportation Research and Education Center

TriMet – Tri-County Metropolitan Transportation District of Oregon.

TSP – Transportation System Plan

UGA – Urban Growth Area (Washington only)

UGB – Urban Growth Boundary (Oregon only)

UASI – Urban Areas Security Initiative

UPRR – Union Pacific Railroad

URM – Unreinforced Masonry

WADNR – Washington State Department of Natural Resources

WSDOT – Washington Department of Transportation

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Table 6.1 - ETR IDs for RETRS and SSLRs

ETR_ID_2020	From	To	Tier	VERSION	Route Length (miles)
R-X-100-00-MonteCristo	HWY 213	Meridian Rd		2005	4.7
R-X-101-01-Timber_GalesCreek	HWY 26	HWY 47		2005	10.2
R-X-101-02-Timber_GalesCreek	HWY 26 (Sunset HWY)	HWY 8 (Tualatin Valley HWY)		2020	22.5
R-X-102-00-Highway211	Marion Co Line	HWY 26		2005	42.3
R-X-103-00-Greenville_KansasCity_Kemper	HWY 47	HWY 47		2020	6.0
R-X-104-00-Barnards	HWY 213	Marion Co Line		2020	7.9
R-X-105-00-Highway47	Yamhill Co Line	HWY 30		2005	60.1
R-X-106-00-Macksburg	HWY 211	HWY 170 (Marquam Canby HWY)		2005	8.6
R-X-107-00-FernHill_SpringHill_Gaston	HWY 47	HWY 47		2020	7.4
R-X-108-00-LoneElder	S Meridian Rd	HWY 170		2020	2.9
R-X-109-00-Apirary	HWY 30	HWY 47		2005	20.7
R-X-110-00-Carus_Mulino	HWY 99E	Beavercreek Rd		2020	11.9
R-X-111-00-Highway219	HWY 8	HWY 210		2005	10.1
R-X-112-00-Wilsonville	I-5	Clackamas Co Line		2020	5.9
R-X-113-00-River	Scholls Ferry Rd	HWY 8 (Tualatin Valley HWY)		2005	8.2
R-X-114-00-Unger	Beavercreek Rd	HWY 211		2020	5.2
R-X-115-01-Brookwood	HWY 26	Shute Rd		2005	2.2
R-X-115-02-Brookwood	Cornell Rd	Shute Rd		2005	2.9
R-X-116-00-UpperHighland	HWY 211	Beavercreek Rd		2005	8.2
R-X-117-01-CorneliusPass	HWY 8	Multnomah Co Line		2005	7.1
R-X-117-02-CorneliusPass	Multnomah Co Line	HWY 30		2005	4.9
R-X-118-00-NewEra_Penman	HWY 99E	S Carus Rd / Mulino Rd		2020	4.1
R-X-119-00-185th	HWY 26	HWY 8 (Tualatin Valley HWY)		2005	3.3
R-X-120-01-SchollsFerry	Multnomah Co Line	HWY 26		2005	1.4
R-X-120-02-SchollsFerry	River Rd	Multnomah Co Line		2005	12.7
R-X-121-00-RoyRogers_TualatinSherwood	Scholls Ferry Rd	I-5 (Or)		2020	10.0
R-X-122-00-Redland	Springwater Rd	HWY 213		2005	12.3
R-X-123-00-Murray	Scholls Ferry Rd	HWY 26		2005	6.0
R-X-124-00-Holcomb_Bradley	HWY 213	Redland Rd		2020	5.2
R-X-125-00-CedarHills	HWY 26	HWY 8 (Tualatin Valley HWY)		2005	2.1
R-X-126-00-BoonesFerry_CountryClub_Kruse	I-5 (Or)	Or-43		2020	4.4
R-X-127-00-Stafford	I-5 (Or)	I-205 (Or)		2020	6.3
R-X-127-00-Stafford_McVey	HWY 43	I-205 (Or)		2005	3.7
R-X-128-00-WildcatMountain	HWY 211	SE Firwood Rd		2020	6.6
R-X-129-00-Arndt_Airport_Barlow	99E	I-5		2005	4.6
R-X-129-00-Barlow	HWY 99E	S Monte Cristo Rd		2020	10.5

ETR_ID_2020	From	To	Tier	VERSION	Route Length (miles)
R-X-130-00-Springwater	HWY 211	HWY 224		2005	11.8
R-X-131-00-Meridian	S Monte Cristo Rd	99E		2005	10.1
R-X-132-01-Sunnyside	I-205	HWY 212		2005	5.9
R-X-132-02-Sunnyside	SE 82nd Ave	I-205		2020	1.5
R-X-133-01-Highway170	HWY 211	99E		2005	7.9
R-X-133-02-Kropf	HWY 213	HWY 211		2005	5.7
R-X-134-00-Kelso	Amisigger Rd / Kelso Rd / Richey Rd	HWY 26		2020	2.9
R-X-135-00-Highway213	Marion Co Line	I-205		2005	27.5
R-X-137-00-Molalla	HWY 213	7th Ave		2005	2.2
R-X-138-00-Allen_GardenHome_Multnomah	Murray Blvd	I-5 (Or)		2020	6.8
R-X-139-00-7th	Washington St	Molalla Ave		2005	0.5
R-X-140-00-TaylorsFerry	I-5 (Or)	HWY 43		2020	2.5
R-X-141-00-Washington	7th St	HWY 213		2005	1.4
R-X-142-00-Dolph	SW Allen Rd/Garden Home Rd/Multnomah Blvd	SW 26th Ave		2020	0.6
R-X-142-00-Sellwood_Tacoma	HWY 43	HWY 99E		2020	2.2
R-X-143-01-Highway99E	HWY 99E	Multnomah Co Line		2005	8.7
R-X-143-02-Highway99E	NE Lombard St (HWY 30)	I-5		2005	4.1
R-X-143-03-Highway99E	Multnomah Co Line	SE Division St Structure		2005	7.0
R-X-143-04-Highway99E	SE Division St Structure	NE Lombard St		2005	6.9
R-X-143-05-Highway99E	W Mill Plain Blvd	I-205		2020	6.1
R-X-144-00-JohnsonCreek	SE 39th Ave	HWY 99E		2020	1.8
R-X-145-00-Highway99W	SW 60th Ave	SW Naito Pkwy		2005	5.0
R-X-146-00-Flavel	82nd Ave	SE 92nd Ave		2020	0.5
R-X-146-00-Highway224	SE 82nd Ave	HWY 212		2020	2.2
R-X-146-01-Highway224	HWY 212	HWY 211 (Eagle Creek - Sandy HWY)		2005	9.4
R-X-146-02-Highway224	HWY 99E	I-205		2005	4.2
R-X-146-03-Highway224	Estacada	Ripplebrook		2005	8.4
R-X-147-00-Terwilliger	SW Taylors Ferry Rd	I-5 (Or)		2020	0.6
R-X-148-00-Farmington	Cedar Hills Blvd	HWY 219		2005	9.7
R-X-149-00-Beavercreek	HWY 213	HWY 211		2005	15.2
R-X-150-00-Highway8	HWY 47	HWY 26		2005	24.2
R-X-151-00-Fellows	Redland Rd	Upper Highland Rd		2020	4.5
R-X-152-01Cornell	Main St	HWY 26		2005	7.4
R-X-152-02-Cornell_Barnes	HWY 26 (Sunset HWY)	HWY 217		2020	3.5
R-X-153-00-Hattan	Springwater Rd	Redland Rd		2020	3.5
R-X-154-00-Barnes	HWY 217	W Burnside Rd		2005	1.8
R-X-154-01-Burnside	Brg	Brg		2005	0.3
R-X-154-02-Burnside	Burnside Bridge	160th Ave E 330ft		2005	11.4

ETR_ID_2020	From	To	Tier	VERSION	Route Length (miles)
R-X-154-03-Burnside	Burnside Bridge	SW Barnes Rd		2005	3.9
R-X-155-00-LowerHighland_Ridge	Beavercreek Rd	Springwater Rd		2020	9.5
R-X-156-01-Highway10	SW 65th Ave	SW Barbur Blvd (99W)		2005	3.5
R-X-156-02-Highway10	SW 65th Ave	Cedar Hills Rd		2005	3.3
R-X-157-00-232nd	HWY 224	HWY 212		2005	1.9
R-X-158-00-Woodstock	SE 39th Ave	SE Foster Rd		2020	2.7
R-X-159-00-Amisigger_Kelso_Richey	HWY 224	HWY 212		2005	3.5
R-X-160-01-Foster	SE Jenne Rd	Multnomah Co Line		2005	1.2
R-X-160-02-Foster	SE Powell Blvd	SE Jenne Rd		2005	6.8
R-X-161-00-Firwood	SE Wildcat Mountain Dr	HWY 26		2020	3.3
R-X-162-00-AerialTram	Brg	Brg		2020	0.6
R-X-163-00-CapitolHighway	HWY 10	I-5 (Or)		2020	2.5
R-X-164-01-Powell	SE Powell Blvd	SE 174th Ave		2005	3.8
R-X-164-02-Powell	SE 174th Ave	SE Burnside Rd		2005	4.2
R-X-164-03-Powell	HWY 99E	SE Powell Blvd		2020	4.9
R-X-165-00-45th_Vermont	SW Allen Rd/Garden Home Rd/Multnomah Blvd	SW Capitol HWY		2020	1.4
R-X-167-00-Moody	SW Naito Pkwy	SW Lowell St		2020	1.6
R-X-168-00-Hawthorne	HWY 99E	SE 39th Ave		2020	1.8
R-X-169-01-Naito	W Burnside Rd	NW 15th Ave		2005	1.6
R-X-169-02-Naito	SW Barbur Blvd	685ft N Of I-405		2005	2.1
R-X-169-03-Naito	685 Ft N Of I-405	W Burnside Rd		2005	1.1
R-X-170-00-Madison	HWY 99E	SE Hawthorne Blvd		2020	0.4
R-X-171-00-Broadway_Terwilliger	SW Market And SW Clay	Ohsu		2020	2.5
R-X-172-00-Tilikum	Brg	Brg		2020	0.7
R-X-174-00-Washington	NE 82nd Ave	SE Stark St		2020	1.3
R-X-176-01-Highway26	SE Powell Blvd	Multnomah Co Line		2005	11.1
R-X-176-02-Highway26	Multnomah Co Line	HWY 212		2005	5.4
R-X-178-01-Sandy	E Burnside Rd	NE Columbia Blvd		2005	5.7
R-X-178-01-Stark	82nd Ave	242nd Ave / Hogan Rd / 238th Dr		2020	8.1
R-X-178-02-Sandy	NE Columbia Blvd	NE 181st Ave		2005	4.2
R-X-178-02-Stark	242nd Ave / Hogan Rd / 238th Dr	Stark St Brg		2020	3.2
R-X-178-03-Sandy	NE 181st Ave	I-84		2005	2.9
R-X-180-00-Glisan	NE Cesar E Chavez Blvd	NE 53rd Ave		2020	0.7
R-X-182-00-Broadway_Weidler	I-5 (Or)	NE Sandy Blvd		2020	3.8
R-X-183-00-23rd_Vaughn	NW Nicolai St	W Burnside St		2020	1.6
R-X-184-00-Nicolai	NW Front Ave	NW St Helens Rd @ Kittridge		2005	2.5
R-X-185-00-Murray	W Burnside St	SW Canyon Rd		2020	1.2
R-X-186-00-Front	NW Naito Parkway	NW 61st Ave		2020	4.1

ETR_ID_2020	From	To	Tier	VERSION	Route Length (miles)
R-X-187-00-17th	HWY 99E	SE Powell Blbvd		2020	1.1
R-X-188-00-RockyButte	NE 82nd Ave	Joseph Wood Hill Park		2020	1.9
R-X-189-00-32nd_Harrison	Johnson Creek Blvd	HWY 224		2020	1.2
R-X-190-00-SwanIsland	I-5 (Or)	I-5 (Or)		2020	3.1
R-X-191-01-CesarChavez	E Burnside Rd	I-84		2005	1.0
R-X-191-02-CesarChavez	SE Crystal Springs Blvd	E Burnside Rd		2005	4.0
R-X-192-00-Killingsworth	I-5 (Or)	N Lombard St		2020	4.3
R-X-193-01-82nd	SE Clatsop St	NE Holman St		2005	9.1
R-X-193-02-82nd	NE Alderwood	NE Airport Way		2005	0.7
R-X-193-03-82nd	NE Holman St	NE Alderwood Rd		2005	1.1
R-X-193-04-82nd	I-205	SE Clatsop St		2005	4.4
R-X-194-00-StJohnsBridge	Brg	Brg		2005	0.4
R-X-195-01-172nd	Sunnyside Rd	HWY 212		2020	1.6
R-X-195-02-172nd	SE Foster Rd	Sunnyside Rd		2020	2.8
R-X-196-00-Highway20Bypass	HWY 30 (Nw St Helens Rd)	N Lombard Blvd		2005	0.4
R-X-197-00-Foster	Multnomah Co Line	HWY 212		2005	3.6
R-X-198-00-Dekum	HWY 99E	NE Columbia Blvd		2020	2.0
R-X-200-00-Lombard	N Kelley Point Park Rd	N Columbia Blvd		2005	13.5
R-X-201-00-242nd_Hogan_238th	HWY 212	I-84		2005	9.2
R-X-202-00-Columbia	N Lombard St	NE Sandy Blvd		2005	11.3
R-X-203-01-122nd	E Burnside Rd	NE Marine Dr		2005	3.2
R-X-203-02-122nd	SE Foster Rd	E Burnside Rd		2005	3.2
R-X-204-00-ColumbiaRamp	NE Columbia Blvd	N Portland Rd		2020	0.4
R-X-205-00-Highland-190th-Tillstrom	SE Powell Blvd	SE Foster Rd		2020	3.4
R-X-206-01-Alderwood	NE 82nd Ave	Airport Way		2020	1.9
R-X-206-02-Alderwood	NE Columbia Bllvd	NE 82nd Ave		2020	0.9
R-X-207-00-112th-CherryBlossom	SE Stark St	SE Powell Blvd		2020	2.0
R-X-208-01-Marine	N Portland Rd	I-5		2005	1.3
R-X-208-02-Marine	N Kelley Point Park Rd	N Portland Rd		2005	3.4
R-X-208-03-Marine	NE 185th Dr	I-84		2005	3.9
R-X-208-04-Marine	I-5	NE 185th Ave		2005	11.0
R-X-209-00-182nd	SE Powell Blvd	E Burnside Rd		2005	2.2
R-X-210-01-Airport	I-205	NE 181st Ave		2005	4.7
R-X-210-02-Airport	Pdx	I-205		2005	5.1
R-X-211-00-Fairview_Glisan_223	NE Sandy Blvd	SE Powell Blvd		2020	4.7
R-X-212-00-SR14	I-5	Skamania Co. Line		2005	52.1
R-X-213-00-257th_Kane	I-84	HWY 26		2020	4.3
R-X-214-00-WashougalRiver_Evergreen	SR-14	SR-14		2020	3.1

ETR_ID_2020	From	To	Tier	VERSION	Route Length (miles)
R-X-215-00-Albina_Mississippi	N Lombard St	Kerby Ave		2020	2.3
R-X-216-01-MillPlain	I-5	SE 164th Ave		2005	8.2
R-X-216-02-MillPlain	I-5	Port Of Vancouver		2005	2.9
R-X-217-00-15th	NE Dekum St	NE Broadway / NE Weidler St		2020	2.6
R-X-218-00-FourthPlain	I-5 (Wa)	I-205 (Wa)		2020	4.8
R-X-219-00-11th	NE Columbia Blvd	N Lombard St		2020	0.1
R-X-220-00-18th	162nd / 164th Ave	192nd Ave		2020	1.5
R-X-221-00-42nd	NE Columbia Blvd	NE Broadway / Weidler St		2020	3.4
R-X-222-00-SR500	SR-14	I-5		2005	36.5
R-X-223-00-Cully	NE Sandy Blvd	NE Columbia Blvd		2020	1.9
R-X-224-00-SR502	I-5	SR-503		2005	11.3
R-X-225-00-Portland	N Columbia Blvd	N Marine Dr		2005	1.7
R-X-226-00-78th_Padden	I-5	NE 172nd Ave		2005	13.9
R-X-227-00-DeltaPark	I-5 (Or)	HWY 99E		2020	1.3
R-X-228-00-ScapooseVernonia	HWY 30	HWY 47		2005	20.1
R-X-229-00-Vancouver	HWY 99E	NE Columbia Blvd		2020	0.5
R-X-230-00-Haynes_CedarCreek	I-5	SR-503		2005	16.5
R-X-231-00-33rd	NE Columbia Blvd	NE Marine Dr		2020	2.6
R-X-233-00-47th_Cornfoot_Airtrans	NE Columbia Blvd	Airtrans Way		2020	1.6
R-X-235-00-FruitValley_FourthPlain	Lakeshore / Fruit Valley / 39th / 78th	I-5 (Wa)		2020	2.0
R-X-237-00-FruitValley_39th_78th	I-5	NE 78th / Padden Pkwy		2020	4.5
R-X-239-00-Andresen	SR-14	NE 78th / Padden Pkwy		2020	4.9
R-X-241-00-136th_137th	NE 78th / Padden Pkwy	Mill Plain (Vancouver)		2020	5.4
R-X-243-00-162nd_164th	SR-14	Ward Rd		2005	6.7
R-X-245-00-192nd	18th Ave	SR-14		2020	3.6
R-X-247-00-SR503	Cowlitz Co. Line	SR-500		2005	27.8
R-X-249-00-Chautauqua	NE Columbia Blvd	N Lombard St		2020	1.0
R-X-251-00-Dewitt	HWY 10	HWY 10		2020	0.3
R-X-253-00-Sandy122Ramp	NE 122nd Ave	NE Sandy Blvd		2020	0.3
R-X-255-00-40th	SW Allen Rd/Garden Home Rd/Multnomah Blvd	SW Capitol HWY		2020	0.2
R-X-257-00-CentralPoint	S New Era Rd / Penman Rd	Parrish Rd		2020	1.9
R-X-259-00-26th	SW Taylors Ferry Rd	HWY 99W		2020	0.7
R-X-261-00-181st	E Burnside Rd	NE Sandy Blvd		2005	1.6
R-X-263-00-MarketClay	I-405 / HWY 26	SW Naito Parkway		2005	1.3
R-X-265-00-LewisClarkBridge	Brg	Brg		2005	0.7
R-X-267-00-Gideon	SE 17th	Tilikum Crossing		2020	0.9
S-0-108-02-I84	I-205	US-197	1	2013	33.9
S-0-113-01-I205	I-84	US-26	1	2013	2.4

ETR_ID_2020	From	To	Tier	VERSION	Route Length (miles)
S-0-113-02-I205	US-26	OR-224	1	2013	5.5
S-0-113-03-I205	OR-224	OR-212	1	2013	0.9
S-0-113-04-I205	OR-212	OR-99E	1	2013	3.3
S-0-113-05-I205	OR-99E	OR-43	1	2013	0.5
S-0-113-06-I205	OR-43	I-5	1	2013	8.8
S-0-113-07-I205	WA Border	I-84	1	2013	5.1
S-1-101-01-I5	WA Border	I-405	1	2013	5.3
S-1-102-00-US30	US-101	I-405	1	2013	67.2
S-1-103-01-I405	I-5	US-30	1	2013	1.2
S-1-103-02-I405	US-30	US-26	1	2013	1.4
S-1-103-03-I405	US-26	I-5/OR-43/US-26	1	2013	1.6
S-1-109-01-OR99W	I-5	OR-217	1	2013	1.1
S-1-109-02-OR99W	OR-217	OR-219	1	2013	11.2
S-2-101-02-I5	I-405	I-84	2	2013	1.4
S-2-101-03-I5	I-84	I-405/OR 43/US-26	2	2013	1.9
S-2-101-04-I5	I-405/OR 43/US-26	OR-99W	1	2013	6.0
S-2-101-05-I5	I-205	OR-214	1	2013	7.6
S-2-101-06-I5	OR-217	I-205	1	2013	3.8
S-2-101-07-I5	OR-99W	OR-217	1	2013	1.5
S-2-104-01-US26	OR-103	OR-47	2	2013	16.0
S-2-104-02-US26	OR-47	OR-217	2	2013	18.8
S-2-104-03-US26	OR-217	I-405	2	2013	4.8
S-2-104-04-US26	OR-212	US-97	2	2013	41.2
S-2-106-00-OR212	I-205	US-26	2	2013	12.5
S-2-107-01-OR99E	I-205	OR-43	2	2013	0.5
S-2-107-02-OR99E	OR-43	OR-214	2	2013	12.3
S-2-108-01-I84	I-5	I-205	2	2013	5.0
S-3-104-05-US26	OR-43	OR-99E	3	2013	0.7
S-3-104-06-US26	OR-99E	I-205	3	2013	8.3
S-3-105-01-OR217	OR-99W	I-5	3	2013	1.6
S-3-105-02-OR217	US-26 to	OR-99W	3	2013	5.9
S-3-111-00-OR43	US-26	I-205	3	2013	11.1
S-X-101-08-I5	Or / Wa Border	Hayes Rd		2005	64.2
S-X-113-23-I205	I-5	SR-14		2005	35.6

Table 6.2 Connectivity to Critical Infrastructure and Essential Facilities

Category	Type	CI/EF	Percent Within 1/4 Mile of RETR/SSLR
State/Regional	CI	Public Works	78
State/Regional	CI	Public Works	67
State/Regional	CI	Transit Facilities	70
State/Regional	CI	Fuel Points	85
State/Regional	CI	Airports	48
State/Regional	CI	Marine Facilities	75
State/Regional	CI	Marine Terminals	50
State/Regional	CI	Rail	59
State/Regional	CI	Railyards	91
State/Regional	EF	911 Dispatch Centers	100
State/Regional	EF	DDMS	86
State/Regional	EF	Hospitals	91
City/County	CI	Boat Ramps	7
City/County	CI	Bus Lines	100
City/County	CI	Light Rail	95
City/County	CI	Light Rail	95
City/County	CI	Transit Centers	91
City/County	CI	Fuel Points	60
City/County	EF	Armories	67
City/County	EF	EOC	22
City/County	EF	Fire	35
City/County	EF	Health Care Clinics	91
City/County	EF	Police	61
City/County	EF	Public Works	54
City/County	EF	Sand Piles	100
Community/Neighborhood	CI	Trails	46
Community/Neighborhood	EF	Churches	58
Community/Neighborhood	EF	Community Centers	58
Community/Neighborhood	EF	Parks	53
Community/Neighborhood	EF	Schools	58
Community/Neighborhood	EF	Shelters	60

Table 6.3 RETRs Subject to Liquefaction Hazards

ETR ID 2021	From	To	Very High	High	Moderate	Total	At least 25% Above High Risk	At Least 50% At Risk
R-X-169-01-Naito	W Burnside Rd	NW 15th Ave	100	0	0	100	High Risk	High Risk
R-X-172-00-Tilikum	Brg	Brg	100	0	0	100	High Risk	High Risk
R-X-186-00-Front	NW Naito Parkway	NW 61st Ave	100	0	0	100	High Risk	High Risk
R-X-193-02-82nd	NE Alderwood	NE Airport Way	100	0	0	100	High Risk	High Risk
R-X-193-03-82nd	NE Holman St	NE Alderwood Rd	100	0	0	100	High Risk	High Risk
R-X-194-00-StJohnsBridge	Brg	Brg	100	0	0	100	High Risk	High Risk
R-X-206-01-Alderwood	NE 82nd Ave	Airport Way	100	0	0	100	High Risk	High Risk
R-X-208-01-Marine	N Portland Rd	I-5	100	0	0	100	High Risk	High Risk
R-X-208-02-Marine	N Kelley Point Park Rd	N Portland Rd	100	0	0	100	High Risk	High Risk
R-X-208-03-Marine	NE 185th Dr	I-84	100	0	0	100	High Risk	High Risk
R-X-208-04-Marine	I-5	NE 185th Ave	100	0	0	100	High Risk	High Risk
R-X-210-02-Airport	Pdx	I-205	100	0	0	100	High Risk	High Risk
R-X-227-00-DeltaPark	I-5 (Or)	HWY 99E	100	0	0	100	High Risk	High Risk
R-X-265-00-LewisClarkBridge	Brg	Brg	100	0	0	100	High Risk	High Risk
R-X-233-00-47th_Cornfoot_Airtrans	NE Columbia Blvd	Airtrans Way	96	0	4	100	High Risk	High Risk
R-X-229-00-Vancouver	HWY 99E	NE Columbia Blvd	93	0	7	100	High Risk	High Risk
R-X-231-00-33rd	NE Columbia Blvd	NE Marine Dr	93	0	7	100	High Risk	High Risk
R-X-143-02-Highway99E	NE Lombard St (HWY 30)	I-5	92	0	8	100	High Risk	High Risk
R-X-225-00-Portland	N Columbia Blvd	N Marine Dr	92	0	8	100	High Risk	High Risk
R-X-167-00-Moody	SW Naito Pkwy	SW Lowell St	90	0	10	100	High Risk	High Risk
R-X-206-02-Alderwood	NE Columbia Blvd	NE 82nd Ave	86	0	14	100	High Risk	High Risk
R-X-169-03-Naito	685 Ft N Of I-405	W Burnside Rd	65	0	35	100	High Risk	High Risk
R-X-239-00-Andresen	SR-14	NE 78th / Padden Pkwy	48	0	52	100	High Risk	High Risk
R-X-184-00-Nicolai	NW Front Ave	NW St Helens Rd @ Kittridge	42	0	58	100	High Risk	High Risk
R-X-103-00-Greenville_KansasCity_Kemper	HWY 47	HWY 47	39	0	61	100	High Risk	High Risk
R-X-111-00-Highway219	HWY 8	HWY 210	37	0	63	100	High Risk	High Risk
R-X-170-00-Madison	HWY 99E	SE Hawthorne Blvd	34	0	66	100	High Risk	High Risk
R-X-267-00-SEGideon	SE 17th	Tilikum Crossing	28	0	72	100	High Risk	High Risk
R-X-100-00-MonteCristo	HWY 213	Meridian Rd	26	0	74	100	High Risk	High Risk
R-X-154-03-Burnside	Burnside Bridge	SW Barnes Rd	16	14	70	100	High Risk	High Risk
R-X-106-00-Macksburg	HWY 211	HWY 170 (Marquam Canby HWY)	0	72	28	100	High Risk	High Risk
R-X-146-02-Highway224	HWY 99E	I-205	24	0	76	100		High Risk
R-X-162-00-AerialTram	Brg	Brg	23	0	77	100		High Risk
R-X-142-00-Sellwood_Tacoma	HWY 43	HWY 99E	21	0	79	100		High Risk
R-X-117-01-CorneliusPass	HWY 8	Multnomah Co Line	19	0	81	100		High Risk
R-X-171-00-Broadway_Terwilliger	SW Market And SW Clay	Ohsu	17	0	83	100		High Risk
R-X-115-02-Brookwood	Cornell Rd	Shute Rd	15	0	85	100		High Risk
R-X-129-00-Barlow	HWY 99E	S Monte Cristo Rd	15	0	85	100		High Risk
R-X-119-00-185th	HWY 26	HWY 8 (Tualatin Valley HWY)	12	0	88	100		High Risk
R-X-196-00-Highway20Bypass	HWY 30 (Nw St Helens Rd)	N Lombard Blvd	12	0	88	100		High Risk

ETR ID 2021	From	To	Very High	High	Moderate	Total	At least 25% Above High Risk	At Least 50% At Risk
R-X-138-00-Allen_GardenHome_Multnomah	Murray Blvd	I-5 (Or)	11	0	89	100		High Risk
R-X-150-00-Highway8	HWY 47	HWY 26	10	4	86	100		High Risk
R-X-235-00-FruitValley_FourthPlain	Lakeshore / Fruit Valley / 39th / 78th	I-5 (Wa)	10	8	82	100		High Risk
R-X-115-01-Brookwood	HWY 26	Shute Rd	9	0	91	100		High Risk
R-X-117-02-CorneliusPass	Multnomah Co Line	HWY 30	9	9	82	100		High Risk
R-X-131-00-Meridian	S Monte Cristo Rd	99E	9	0	91	100		High Risk
R-X-148-00-Farmington	Cedar Hills Blvd	HWY 219	9	0	91	100		High Risk
R-X-152-01Cornell	Main St	HWY 26	9	0	91	100		High Risk
R-X-160-01-Foster	SE Jenne Rd	Multnomah Co Line	6	0	94	100		High Risk
R-X-182-00-Broadway_Weidler	I-5 (Or)	NE Sandy Blvd	6	0	94	100		High Risk
R-X-259-00-26th	SW Taylors Ferry Rd	HWY 99W	6	0	94	100		High Risk
R-X-143-03-Highway99E	Multnomah Co Line	SE Division St Structure	5	0	95	100		High Risk
R-X-168-00-Hawthorne	HWY 99E	SE 39th Ave	5	0	95	100		High Risk
R-X-165-00-45th_Vermont	SW Allen Rd / Garden Home Rd / Multnomah Blvd	SW Capitol HWY	3	0	97	100		High Risk
R-X-132-02-Sunnyside	SE 82nd Ave	I-205	2	0	98	100		High Risk
R-X-140-00-TaylorsFerry	I-5 (Or)	HWY 43	2	0	98	100		High Risk
R-X-147-00-Terwilliger	SW Taylors Ferry Rd	I-5 (Or)	2	0	98	100		High Risk
R-X-202-00-Columbia	N Lombard St	NE Sandy Blvd	2	0	98	100		High Risk
R-X-183-00-23rd_Vaughn	NW Nicolai St	W Burnside St	1	0	99	100		High Risk
R-X-226-00-78th_Padden	I-5	NE 172nd Ave	1	20	79	100		High Risk
R-X-108-00-LoneElder	S Meridian Rd	HWY 170	0	0	100	100		High Risk
R-X-120-01-SchollsFerry	Multnomah Co Line	HWY 26	0	0	100	100		High Risk
R-X-125-00-CedarHills	HWY 26	HWY 8 (Tualatin Valley HWY)	0	0	100	100		High Risk
R-X-142-00-Dolph	SW Allen Rd/Garden Home Rd/Multnomah Blvd	SW 26th Ave	0	0	100	100		High Risk
R-X-144-00-JohnsonCreek	SE 39th Ave	HWY 99E	0	0	100	100		High Risk
R-X-154-01-Burnside	Brg	Brg	0	0	100	100		High Risk
R-X-156-01-Highway10	SW 65th Ave	SW Barbur Blvd (99W)	0	0	100	100		High Risk
R-X-156-02-Highway10	SW 65th Ave	Cedar Hills Rd	0	0	100	100		High Risk
R-X-163-00-CapitolHighway	HWY 10	I-5 (Or)	0	0	100	100		High Risk
R-X-169-02-Naito	SW Barbur Blvd	685ft N Of 1-405	0	0	100	100		High Risk
R-X-180-00-Glisan	NE Cesar E Chavez Blvd	NE 53rd Ave	0	0	100	100		High Risk
R-X-185-00-Murray	W Burnside St	SW Canyon Rd	0	0	100	100		High Risk
R-X-187-00-17th	HWY 99E	SE Powell Blbvd	0	0	100	100		High Risk
R-X-189-00-32nd_Harrison	Johnson Creek Blvd	HWY 224	0	0	100	100		High Risk
R-X-191-01-CesarChavez	E Burnside Rd	I-84	0	0	100	100		High Risk
R-X-191-02-CesarChavez	SE Crystal Springs Blvd	E Burnside Rd	0	0	100	100		High Risk
R-X-204-00-ColumbiaRamp	NE Columbia Blvd	N Portland Rd	0	0	100	100		High Risk
R-X-216-01-MillPlain	I-5	SE 164th Ave	0	2	98	100		High Risk
R-X-218-00-FourthPlain	I-5 (Wa)	I-205 (Wa)	0	7	93	100		High Risk
R-X-219-00-11th	NE Columbia Blvd	N Lombard St	0	0	100	100		High Risk
R-X-220-00-18th	162nd / 164th Ave	192nd Ave	0	0	100	100		High Risk
R-X-237-00-FruitValley_39th_78th	I-5	NE 78th / Padden Pkwy	0	12	88	100		High Risk

ETR ID 2021	From	To	Very High	High	Moderate	Total	At least 25% Above High Risk	At Least 50% At Risk
R-X-251-00-Dewitt	HWY 10	HWY 10	0	0	100	100		High Risk
R-X-253-00-Sandy122Ramp	NE 122nd Ave	NE Sandy Blvd	0	0	100	100		High Risk
R-X-255-00-40th	SW Allen Rd / Garden Home Rd / Multnomah Blvd	SW Capitol HWY	0	0	100	100		High Risk
R-X-263-00-MarketClay	I-405 / HWY 26	SW Naito Parkway	0	0	100	100		High Risk
R-X-216-02-MillPlain	I-5	Port Of Vancouver	2	34	63	99	High Risk	High Risk
R-X-190-00-SwanIsland	I-5 (Or)	I-5 (Or)	89	0	9	98	High Risk	High Risk
R-X-113-00-River	Scholls Ferry Rd	HWY 8 (Tualatin Valley HWY)	6	0	92	98		High Risk
R-X-198-00-Dekum	HWY 99E	NE Columbia Blvd	0	0	98	98		High Risk
R-X-210-01-Airport	I-205	NE 181st Ave	97	0	0	97	High Risk	High Risk
R-X-214-00-WashougalRiver_Evergreen	SR-14	SR-14	0	7	90	97		High Risk
R-X-107-00-FernHill_SpringHill_Gaston	HWY 47	HWY 47	36	0	59	95	High Risk	High Risk
R-X-145-00-Highway99W	SW 60th Ave	SW Naito Pkwy	7	0	88	95		High Risk
R-X-112-00-Wilsonville	I-5	Clackamas Co Line	5	0	89	94		High Risk
R-X-129-00-Arndt_Airport_Barlow	99E	I-5	46	0	47	93	High Risk	High Risk
R-X-143-05-Highway99E	W Mill Plain Blvd	I-205	0	31	62	93	High Risk	High Risk
R-X-200-00-Lombard	N Kelley Point Park Rd	N Columbia Blvd	17	0	76	93		High Risk
R-X-146-00-Highway224	SE 82nd Ave	HWY 212	5	0	88	93		High Risk
R-X-241-00-136th_137th	NE 78th / Padden Pkwy	Mill Plain (Vancouver)	0	1	92	93		High Risk
R-X-243-00-162nd_164th	SR-14	Ward Rd	0	0	92	92		High Risk
R-X-120-02-SchollsFerry	River Rd	Multnomah Co Line	17	0	74	91		High Risk
R-X-178-02-Sandy	NE Columbia Blvd	NE 181st Ave	0	0	91	91		High Risk
R-X-224-00-SR502	I-5	SR-503	0	0	90	90		High Risk
R-X-146-01-Highway224	HWY 212	HWY 211 (Eagle Creek - Sandy HWY)	5	0	84	89		High Risk
R-X-152-02-Cornell_Barnes	HWY 26 (Sunset HWY)	HWY 217	7	0	81	88		High Risk
R-X-212-00-SR14	I-5	Skamania Co. Line	1	42	40	83	High Risk	High Risk
R-X-143-04-Highway99E	SE Division St Structure	NE Lombard St	8	0	75	83		High Risk
R-X-101-01-Timber_GalesCreek	HWY 26	HWY 47	77	0	3	80	High Risk	High Risk
R-X-195-02-172nd	SE Foster Rd	Sunnyside Rd	1	0	77	78		High Risk
R-X-133-02-Kropf	HWY 213	HWY 211	3	0	73	76		High Risk
R-X-193-04-82nd	I-205	SE Clatsop St	12	0	63	75		High Risk
R-X-141-00-Washington	7th St	HWY 213	70	0	4	74	High Risk	High Risk
R-X-222-00-SR500	SR-14	I-5	2	23	49	74		High Risk
R-X-245-00-192nd	18th Ave	SR-14	0	0	72	72		High Risk
R-X-105-00-Highway47	Yamhill Co Line	HWY 30	54	0	17	71	High Risk	High Risk
R-X-126-00-BoonesFerry_CountryClub_Kruse	I-5 (Or)	Or-43	0	0	71	71		High Risk
R-X-249-00-Chautauqua	NE Columbia Blvd	N Lombard St	0	0	71	71		High Risk
R-X-139-00-7th	Washington St	Molalla Ave	0	0	70	70		High Risk
R-X-118-00-NewEra_Penman	HWY 99E	S Carus Rd / Mulino Rd	11	0	57	68		High Risk
R-X-130-00-Springwater	HWY 211	HWY 224	4	0	63	67		High Risk
R-X-121-00-RoyRogers_TualatinSherwood	Scholls Ferry Rd	I-5 (Or)	11	0	55	66		High Risk
R-X-201-00-242nd_Hogan_238th	HWY 212	I-84	13	13	38	64	High Risk	High Risk
R-X-178-02-Stark	242nd Ave / Hogan Rd / 238th Dr	Stark St Brg	11	0	53	64		High Risk

ETR ID 2021	From	To	Very High	High	Moderate	Total	At least 25% Above High Risk	At Least 50% At Risk
R-X-132-01-Sunnyside	I-205	HWY 212	3	0	61	64		High Risk
R-X-164-03-Powell	HWY 99E	SE Powell Blvd	0	0	60	60		High Risk
R-X-143-01-Highway99E	HWY 99E	Multnomah Co Line	13	0	46	59		High Risk
R-X-133-01-Highway170	HWY 211	99E	8	0	51	59		High Risk
R-X-178-01-Sandy	E Burnside Rd	NE Columbia Blvd	0	0	59	59		High Risk
R-X-101-02-Timber_GalesCreek	HWY 26 (Sunset HWY)	HWY 8 (Tualatin Valley HWY)	40	0	18	58	High Risk	High Risk
R-X-135-00-Highway213	Marion Co Line	I-205	29	3	25	57	High Risk	High Risk
R-X-217-00-15th	NE Dekum St	NE Broadway / NE Weidler St	0	0	54	54		High Risk
R-X-228-00-ScapooseVernonia	HWY 30	HWY 47	47	0	6	53	High Risk	High Risk
R-X-221-00-42nd	NE Columbia Blvd	NE Broadway / Weidler St	4	0	49	53		High Risk
R-X-176-01-Highway26	SE Powell Blvd	Multnomah Co Line	17	20	12	49	High Risk	
R-X-213-00-257th_Kane	I-84	HWY 26	8	24	17	49	High Risk	
R-X-153-00-Hattan	Springwater Rd	Redland Rd	1	0	48	49		
R-X-176-02-Highway26	Multnomah Co Line	HWY 212	47	0	0	47	High Risk	
R-X-257-00-CentralPoint	S New Era Rd / Penman Rd	Parrish Rd	5	0	41	46		
R-X-102-00-Highway211	Marion Co Line	HWY 26	27	2	16	45	High Risk	
R-X-104-00-Barnards	HWY 213	Marion Co Line	7	0	37	44		
R-X-205-00-Highland-190th-Tillstrom	SE Powell Blvd	SE Foster Rd	6	16	20	42		
R-X-127-00-Stafford	I-5 (Or)	I-205 (Or)	2	0	40	42		
R-X-203-01-122nd	E Burnside Rd	NE Marine Dr	24	0	16	40		
R-X-211-00-Fairview_Glisan_223	NE Sandy Blvd	SE Powell Blvd	21	0	19	40		
R-X-164-02-Powell	SE 174th Ave	SE Burnside Rd	14	21	3	38	High Risk	
R-X-247-00-SR503	Cowlitz Co. Line	SR-500	1	5	32	38		
R-X-154-00-Barnes	HWY 217	W Burnside Rd	0	2	36	38		
R-X-110-00-Carus_Mulino	HWY 99E	Beavercreek Rd	24	0	13	37		
R-X-230-00-Haynes_CedarCreek	I-5	SR-503	23	2	11	36		
R-X-193-01-82nd	SE Clatsop St	NE Holman St	6	0	30	36		
R-X-215-00-Albina_Mississippi	N Lombard St	Kerby Ave	3	0	32	35		
R-X-109-00-Apirary	HWY 30	HWY 47	32	0	1	33	High Risk	
R-X-128-00-WildcatMountain	HWY 211	SE Firwood Rd	1	0	31	32		
R-X-146-03-Highway224	Estacada	Ripplebrook	16	0	15	31		
R-X-122-00-Redland	Springwater Rd	HWY 213	11	4	15	30		
R-X-127-00-Stafford_McVey	HWY 43	I-205 (Or)	7	0	23	30		
R-X-154-02-Burnside	Burnside Bridge	160th Ave E 330ft	1	0	29	30		
R-X-223-00-Cully	NE Sandy Blvd	NE Columbia Blvd	0	0	30	30		
R-X-124-00-Holcomb_Bradley	HWY 213	Redland Rd	13	0	11	24		
R-X-197-00-Foster	Multnomah Co Line	HWY 212	3	0	18	21		
R-X-123-00-Murray	Scholls Ferry Rd	HWY 26	16	0	0	16		
R-X-192-00-Killingsworth	I-5 (Or)	N Lombard St	0	0	16	16		
R-X-155-00-LowerHighland_Ridge	Beavercreek Rd	Springwater Rd	5	0	10	15		
R-X-159-00-Amisigger_Kelso_Richey	HWY 224	HWY 212	1	0	14	15		
R-X-160-02-Foster	SE Powell Blvd	SE Jenne Rd	2	0	12	14		

ETR ID 2021	From	To	Very High	High	Moderate	Total	At least 25% Above High Risk	At Least 50% At Risk
R-X-157-00-232nd	HWY 224	HWY 212	0	0	14	14		
R-X-151-00-Fellows	Redland Rd	Upper Highland Rd	0	0	5	5		
R-X-149-00-Beavercreek	HWY 213	HWY 211	4	0	0	4		
R-X-158-00-Woodstock	SE 39th Ave	SE Foster Rd	0	0	4	4		

Table 6.4 Bridge Vulnerabilities on RETRs and SSLRs

ETR_ID_2020	ROUTENAME	Not Evaluated	Not Vulnerable	Potentially Vulnerable	Vulnerable
R-X-100-00-MonteCristo	S Monte Cristo Rd	1	0	2	0
R-X-101-01-Timber_GalesCreek	Timber / Vernonia Rd	1	1	0	4
R-X-101-02-Timber_GalesCreek	Timber / Gales Creek Rd	6	1	0	1
R-X-102-00-Highway211	HWY 211	14	2	1	4
R-X-103-00-Greenville_KansasCity_Kemper	Greenville / Kansas City / Kemper Rd	1	0	1	0
R-X-104-00-Barnards	S Barnards Rd	1	0	0	3
R-X-105-00-Highway47	HWY 47	18	8	9	17
R-X-107-00-FernHill_SpringHill_Gaston	Fern Hill / Spring Hill Rd / Gaston Rd	1	1	1	1
R-X-108-00-LoneElder	S Lone Elder Rd	1	0	0	0
R-X-109-00-Apirary	Apiary Rd	2	1	0	0
R-X-110-00-Carus_Mulino	S Carus Rd / Mulino Rd	2	0	0	0
R-X-111-00-Highway219	HWY 219 (Hillsboro HWY)	1	1	3	1
R-X-113-00-River	River Rd	1	1	0	0
R-X-117-01-CorneliusPass	Cornelius Pass Rd	5	1	0	0
R-X-118-00-NewEra_Penman	S New Era Rd / Penman Rd	3	0	0	0
R-X-119-00-185th	NW 185th Ave	2	0	0	0
R-X-120-02-SchollsFerry	Scholls Ferry Rd	5	1	2	0
R-X-121-00-RoyRogers_TualatinSherwood	SW Roy Rogers / Tualatin Sherwood Rd	4	0	1	0
R-X-122-00-Redland	Redland Rd	0	2	0	3
R-X-123-00-Murray	Murray Blvd	1	2	1	0
R-X-124-00-Holcomb_Bradley	S Holcomb Blvd / Bradley Rd	0	1	0	0
R-X-125-00-CedarHills	SW Cedar Hills Blvd	0	0	1	0
R-X-127-00-Stafford	SW Stafford Rd	0	1	1	0
R-X-127-00-Stafford_McVey	Mcvey Ave / SW Stafford Rd	1	1	1	0
R-X-128-00-WildcatMountain	SE Wildcat Mountain Dr	0	0	1	0
R-X-129-00-Arndt_Airport_Barlow	Arndt Rd / Airport Rd / Barlow Rd	1	1	1	0
R-X-129-00-Barlow	S Barlow Rd	0	0	0	2
R-X-130-00-Springwater	Springwater Rd	1	1	0	0
R-X-131-00-Meridian	S Meridian Rd	2	0	0	0
R-X-132-01-Sunnyside	Sunnyside Rd	2	0	1	0
R-X-132-02-Sunnyside	Sunnyside Rd	1	0	1	0
R-X-133-01-Highway170	HWY 170	1	0	1	1
R-X-133-02-Kropf	Kropf Rd	1	0	0	0
R-X-135-00-Highway213	HWY 213	6	6	2	1

ETR_ID_2020	ROUTENAME	Not Evaluated	Not Vulnerable	Potentially Vulnerable	Vulnerable
R-X-138-00-Allen_GardenHome_Multnomah	SW Allen Rd / Garden Home Rd / Multnomah Blvd	1	1	1	2
R-X-141-00-Washington	Washington St	2	2	1	0
R-X-142-00-Dolph	Dolph Ct	0	0	0	1
R-X-142-00-Sellwood_Tacoma	Sellwood Brg / Tacoma St	5	4	0	0
R-X-143-01-Highway99E	HWY 99E	5	6	2	2
R-X-143-02-Highway99E	HWY 99E	0	5	0	2
R-X-143-03-Highway99E	HWY 99E	7	4	1	1
R-X-143-04-Highway99E	HWY 99E	0	1	0	5
R-X-143-05-Highway99E	Main St / HWY 99	11	0	0	0
R-X-144-00-JohnsonCreek	SE Johnson Creek Blvd	6	3	0	0
R-X-145-00-Highway99W	HWY 99W	1	1	2	4
R-X-146-00-Highway224	HWY 224	1	3	3	0
R-X-146-01-Highway224	HWY 224	2	1	0	1
R-X-146-02-Highway224	HWY 224	1	3	6	0
R-X-146-03-Highway224	HWY 224	0	1	0	1
R-X-147-00-Terwilliger	SW Terwilliger Blvd	1	1	0	0
R-X-148-00-Farmington	Farmington Rd	5	2	0	0
R-X-149-00-Beavercreek	Beavercreek Rd	2	0	0	0
R-X-150-00-Highway8	HWY 8 (Tualatin Valley HWY)	2	3	2	1
R-X-151-00-Fellows	S Fellows Rd	0	0	0	1
R-X-152-01Cornell	Cornell Rd	2	1	0	0
R-X-152-02-Cornell_Barnes	NW Cornell / Barnes Rd	1	1	0	0
R-X-153-00-Hattan	S Hattan Rd	1	0	0	0
R-X-154-01-Burnside	Burnside Brg	0	0	0	3
R-X-154-02-Burnside	E Burnside Rd	0	1	0	4
R-X-154-03-Burnside	W Burnside St	1	0	1	2
R-X-155-00-LowerHighland_Ridge	S Lower Highland Rd / Ridge Rd	0	0	0	1
R-X-156-01-Highway10	HWY 10	2	0	3	2
R-X-156-02-Highway10	HWY 10 (Beaverton Hillsdale HWY)	2	1	1	0
R-X-157-00-232nd	232nd Ave	0	0	0	1
R-X-159-00-Amisigger_Kelso_Richey	Amisigger Rd / Kelso Rd / Richey Rd	0	0	0	1
R-X-160-01-Foster	SE Foster Rd	1	0	0	0
R-X-160-02-Foster	SE Foster Rd	2	0	0	0
R-X-162-00-AerialTram	Aerial Tram	2	1	1	0
R-X-163-00-CapitolHighway	SW Capitol HWY	0	0	0	2
R-X-164-02-Powell	SE Powell Blvd	2	0	0	0

ETR_ID_2020	ROUTENAME	Not Evaluated	Not Vulnerable	Potentially Vulnerable	Vulnerable
R-X-164-03-Powell	SE Powell Blvd	1	0	0	0
R-X-169-01-Naito	NW Naito Parkway	0	1	0	2
R-X-169-02-Naito	SW Naito Pkwy	2	2	1	2
R-X-169-03-Naito	SW Naito Pkwy	0	0	0	3
R-X-171-00-Broadway_Terwilliger	SW Broadway / Terwilliger Blvd	1	0	2	0
R-X-172-00-Tilikum	Tilikum Crossing	0	1	0	1
R-X-174-00-Washington	SE Washington St	2	2	0	0
R-X-176-01-Highway26	HWY 26	3	0	0	0
R-X-176-02-Highway26	HWY 26	0	1	1	0
R-X-178-01-Sandy	NE Sandy Blvd	1	3	0	3
R-X-178-01-Stark	SE Stark St	2	2	0	0
R-X-178-02-Sandy	NE Sandy Blvd	1	2	1	0
R-X-178-02-Stark	SE Stark St	2	0	0	0
R-X-178-03-Sandy	NE Sandy Blvd	0	2	0	0
R-X-182-00-Broadway_Weidler	NE Broadway / NE Weidler St	1	1	2	0
R-X-185-00-Murray	SW Murray St	1	0	0	0
R-X-186-00-Front	NW Front Ave	0	0	0	1
R-X-187-00-17th	SE 17th Ave	0	0	1	0
R-X-189-00-32nd_Harrison	32nd Ave / SE Harrison	1	0	0	0
R-X-190-00-SwanIsland	Swan Island	2	0	0	1
R-X-191-01-CesarChavez	NE Cesar E Chavez Ave	1	1	0	0
R-X-192-00-Killingsworth	NE Killingsworth St	0	0	1	0
R-X-193-01-82nd	82nd Ave	1	1	1	4
R-X-193-04-82nd	SE 82nd Ave	4	1	3	2
R-X-194-00-StJohnsBridge	St Johns Brg	0	0	0	2
R-X-196-00-Highway20Bypass	HWY 30 Bypass	0	0	0	1
R-X-197-00-Foster	SE Foster Rd	1	0	0	0
R-X-198-00-Dekum	NE Dekum St	1	0	2	1
R-X-200-00-Lombard	N Lombard St	3	1	4	5
R-X-201-00-242nd_Hogan_238th	242nd Ave / Hogan Rd / 238th Dr	1	1	0	0
R-X-202-00-Columbia	NE Columbia Blvd	4	5	5	6
R-X-203-01-122nd	NE 122nd Ave	3	0	1	0
R-X-204-00-ColumbiaRamp	Columbia Ramp	0	1	2	1
R-X-206-01-Alderwood	NE Alderwood Rd	2	0	0	0
R-X-208-01-Marine	N Marine Dr	2	1	0	0
R-X-208-02-Marine	N Marine Dr	2	1	0	0

ETR_ID_2020	ROUTENAME	Not Evaluated	Not Vulnerable	Potentially Vulnerable	Vulnerable
R-X-208-03-Marine	NE Marine Dr	0	0	1	0
R-X-208-04-Marine	NE Marine Dr	0	2	1	0
R-X-210-01-Airport	Airport Way	2	2	0	0
R-X-210-02-Airport	NE Airport Way	2	1	1	0
R-X-211-00-Fairview_Glisan_223	NE Fairview Pkwy / Glisan St / 223rd Ave	0	1	0	0
R-X-212-00-SR14	SR-14	33	0	0	0
R-X-214-00-WashougalRiver_Evergreen	Washougal River Rd / Evergreen Way	1	0	0	0
R-X-215-00-Albina_Mississippi	N Albina Ave / Mississippi Ave	0	0	2	0
R-X-216-01-MillPlain	Mill Plain (Vancouver)	11	0	0	0
R-X-216-02-MillPlain	W Mill Plain Blvd	9	0	0	0
R-X-218-00-FourthPlain	Fourth Plain Blvd	4	0	0	0
R-X-221-00-42nd	NE 42nd Ave	1	1	0	1
R-X-222-00-SR500	SR-500	28	0	0	0
R-X-224-00-SR502	SR-502	4	0	0	0
R-X-225-00-Portland	N Portland Rd	2	1	2	2
R-X-226-00-78th_Padden	NE 78th St / Padden Pkwy	9	0	0	0
R-X-227-00-DeltaPark	Delta Park	0	2	0	0
R-X-228-00-ScapooseVernonia	Scappoose Vernonia Rd.	4	0	3	6
R-X-229-00-Vancouver	Vancouver Ave	0	3	0	1
R-X-230-00-Haynes_CedarCreek	NE / Nw Hayes Rd / NE Cedar Creek Rd	4	0	0	0
R-X-231-00-33rd	NE 33rd Dr	3	0	3	1
R-X-235-00-FruitValley_FourthPlain	Fruit Valley / Fourth Plain Blvd	2	0	0	0
R-X-237-00-FruitValley_39th_78th	Lakeshore / Fruit Valley / 39th / 78th	3	0	0	0
R-X-239-00-Andresen	Andresen Rd	1	0	0	0
R-X-243-00-162nd_164th	162nd / 164th Ave	1	0	0	0
R-X-245-00-192nd	192nd Ave	1	0	0	0
R-X-247-00-SR503	SR-503	8	0	0	0
R-X-253-00-Sandy122Ramp	Sandy-122nd Ramp	1	0	1	0
R-X-255-00-40th	SW 40th Ave	0	0	0	1
R-X-257-00-CentralPoint	S Central Point Rd	1	0	0	0
R-X-259-00-26th	SW 26th Ave	0	0	0	1
R-X-261-00-181st	NE 181st Ave	0	1	0	0
R-X-265-00-LewisClarkBridge	Lewis & Clark Brg	0	0	0	1
R-X-267-00-Gideon	SE Gideon	0	1	0	1
S-X-101-08-I5	I-5 (Wa)	58	0	0	0
S-X-113-23-I205	I-205 (Wa)	50	0	0	0

ETR_ID_2020	ROUTENAME	Not Evaluated	Not Vulnerable	Potentially Vulnerable	Vulnerable
S-0-108-02-I84	I-84	0	2	0	0
S-0-113-01-I205	I-205	2	3	0	0
S-0-113-02-I205	I-205	0	1	3	0
S-0-113-03-I205	I-205	0	1	2	0
S-0-113-04-I205	I-205	2	1	1	0
S-0-113-05-I205	I-205	1	1	0	0
S-0-113-06-I205	I-205	0	0	1	0
S-0-113-07-I205	I-205	2	2	0	0
S-1-101-01-I5	I-5	0	1	2	0
S-1-102-00-US30	US-30	0	0	0	2
S-1-103-02-I405	I-405	0	0	1	0
S-1-103-03-I405	I-405	0	1	2	1
S-2-101-02-I5	I-5	0	0	2	3
S-2-101-03-I5	I-5	1	1	1	4
S-2-101-04-I5	I-5	1	2	2	4
S-2-101-05-I5	I-5	0	0	1	0
S-2-104-01-US26	US-26	2	0	0	1
S-2-104-02-US26	US-26	0	3	0	0
S-2-104-03-US26	US-26	1	0	0	0
S-2-107-01-OR99E	OR-99E	1	0	0	0
S-2-108-01-I84	I-84	1	2	0	4
S-3-104-05-US26	US-26	1	1	1	0
S-3-104-06-US26	US-26	1	0	0	0
S-3-105-02-OR217	OR-217	1	1	3	0
S-3-111-00-OR43	OR-43	3	3	1	1

Table 6.5 RETRs with Significant Landslide Risk

ETR_ID_2020	ROUTE_FROM	ROUTE_TO	LAND_SUSC				PERCENT_HAZARD
			Very High	High	Moderate		
R-X-100-00-MonteCristo	HWY 213	Meridian Rd			43	Moderate	43
R-X-101-01-Timber_GalesCreek	HWY 26	HWY 47		53	23	Moderate	23
R-X-101-02-Timber_GalesCreek	HWY 26 (Sunset HWY)	HWY 8 (Tualatin Valley HWY)		46	24	Moderate	24
R-X-102-00-Highway211	Marion Co Line	HWY 26		11	27	High	11
R-X-103-00-Greenville_KansasCity_Kemper	HWY 47	HWY 47			10	Moderate	10
R-X-104-00-Barnards	HWY 213	Marion Co Line			12	Moderate	12
R-X-105-00-Highway47	Yamhill Co Line	HWY 30	5	64	12	VERY HIGH	5
R-X-106-00-Macksburg	HWY 211	HWY 170 (Marquam Canby HWY)			15	Moderate	15
R-X-107-00-FernHill_SpringHill_Gaston	HWY 47	HWY 47		16	35	High	16
R-X-108-00-LoneElder	S Meridian Rd	HWY 170			11	Moderate	11
R-X-109-00-Apirary	HWY 30	HWY 47		36	36	High	36
R-X-110-00-Carus_Mulino	HWY 99E	Beavercreek Rd			25	Moderate	25
R-X-111-00-Highway219	HWY 8	HWY 210		5	22	High	5
R-X-112-00-Wilsonville	I-5	Clackamas Co Line		19	26	High	19
R-X-113-00-River	Scholls Ferry Rd	HWY 8 (Tualatin Valley HWY)			27	Moderate	27
R-X-114-00-Unger	Beavercreek Rd	HWY 211			30	Moderate	30
R-X-115-01-Brookwood	HWY 26	Shute Rd			20	Moderate	20
R-X-115-02-Brookwood	Cornell Rd	Shute Rd			24	Moderate	24
R-X-116-00-UpperHighland	HWY 211	Beavercreek Rd			32	Moderate	32
R-X-117-01-CorneliusPass	HWY 8	Multnomah Co Line			31	Moderate	31
R-X-117-02-CorneliusPass	Multnomah Co Line	HWY 30	9	44	39	High	44
R-X-118-00-NewEra_Penman	HWY 99E	S Carus Rd / Mulino Rd		11	34	High	11
R-X-119-00-185th	HWY 26	HWY 8 (Tualatin Valley HWY)			32	Moderate	32
R-X-120-01-SchollsFerry	Multnomah Co Line	HWY 26		16	51	High	16
R-X-120-02-SchollsFerry	River Rd	Multnomah Co Line			30	Moderate	30
R-X-121-00-RoyRogers_TualatinSherwood	Scholls Ferry Rd	I-5 (Or)		5	29	High	5
R-X-122-00-Redland	Springwater Rd	HWY 213	6	8	32	VERY HIGH	6
R-X-123-00-Murray	Scholls Ferry Rd	HWY 26			43	Moderate	43
R-X-124-00-Holcomb_Bradley	HWY 213	Redland Rd		6	43	High	6
R-X-125-00-CedarHills	HWY 26	HWY 8 (Tualatin Valley HWY)		5	23	High	5
R-X-126-00-BoonesFerry_CountryClub_Kruse	I-5 (Or)	Or-43			29	Moderate	29
R-X-127-00-Stafford	I-5 (Or)	I-205 (Or)		6	39	High	6
R-X-127-00-Stafford_McVey	HWY 43	I-205 (Or)		7	54	High	7
R-X-128-00-WildcatMountain	HWY 211	SE Firwood Rd	9	7	39	High	7
R-X-129-00-Arndt_Airport_Barlow	99E	I-5			24	Moderate	24
R-X-129-00-Barlow	HWY 99E	S Monte Cristo Rd			11	Moderate	11
R-X-130-00-Springwater	HWY 211	HWY 224		9	14	High	9
R-X-131-00-Meridian	S Monte Cristo Rd	99E			14	Moderate	14
R-X-132-01-Sunnyside	I-205	HWY 212			24	Moderate	24
R-X-132-02-Sunnyside	SE 82nd Ave	I-205			26	Moderate	26
R-X-133-01-Highway170	HWY 211	99E			12	Moderate	12
R-X-133-02-Kropf	HWY 213	HWY 211			19	Moderate	19
R-X-134-00-Kelso	Amisigger Rd / Kelso Rd / Richey Rd	HWY 26			5	Moderate	5
R-X-135-00-Highway213	Marion Co Line	I-205	5	8	30	VERY HIGH	5
R-X-137-00-Molalla	HWY 213	7th Ave			6	Moderate	6
R-X-138-00-Allen_GardenHome_Multnomah	Murray Blvd	I-5 (Or)		6	24	High	6
R-X-139-00-7th	Washington St	Molalla Ave			54	Moderate	54
R-X-140-00-TaylorsFerry	I-5 (Or)	HWY 43		14	55	High	14

ETR_ID_2020	ROUTE_FROM	ROUTE_TO	LAND_SUSC				PERCENT_HAZARD
			Very High	High	Moderate		
R-X-141-00-Washington	7th St	HWY 213		8	25	High	8
R-X-142-00-Dolph	SW Allen Rd/Garden Home Rd/Multnomah Blvd	SW 26th Ave			71	Moderate	71
R-X-142-00-Sellwood_Tacoma	HWY 43	HWY 99E		8	20	High	8
R-X-143-01-Highway99E	HWY 99E	Multnomah Co Line		6	21	High	6
R-X-143-02-Highway99E	NE Lombard St (HWY 30)	I-5		18	33	High	18
R-X-143-03-Highway99E	Multnomah Co Line	SE Division St Structure			12	Moderate	12
R-X-143-04-Highway99E	SE Division St Structure	NE Lombard St			6	Moderate	6
R-X-143-05-Highway99E	W Mill Plain Blvd	I-205				OTHER	100
R-X-144-00-JohnsonCreek	SE 39th Ave	HWY 99E		11	29	High	11
R-X-145-00-Highway99W	SW 60th Ave	SW Naito Pkwy		12	23	High	12
R-X-146-00-Highway224	SE 82nd Ave	HWY 212			10	Moderate	10
R-X-146-01-Highway224	HWY 212	HWY 211 (Eagle Creek - Sandy HWY)	15	25	11	Moderate	11
R-X-146-02-Highway224	HWY 99E	I-205			22	Moderate	22
R-X-146-03-Highway224	Estacada	Ripplebrook	16	20	61	VERY HIGH	16
R-X-147-00-Terwilliger	SW Taylors Ferry Rd	I-5 (Or)		11	49	High	11
R-X-148-00-Farmington	Cedar Hills Blvd	HWY 219			19	Moderate	19
R-X-149-00-Beavercreek	HWY 213	HWY 211		8	25	High	8
R-X-150-00-Highway8	HWY 47	HWY 26			7	Moderate	7
R-X-151-00-Fellows	Redland Rd	Upper Highland Rd		31	14	Moderate	14
R-X-152-01Cornell	Main St	HWY 26			7	Moderate	7
R-X-152-02-Cornell_Barnes	HWY 26 (Sunset HWY)	HWY 217			25	Moderate	25
R-X-153-00-Hattan	Springwater Rd	Redland Rd		14	37	High	14
R-X-154-00-Barnes	HWY 217	W Burnside Rd		7	49	High	7
R-X-154-01-Burnside	Brg	Brg		5	15	High	5
R-X-154-02-Burnside	Burnside Bridge	160th Ave E 330ft			13	Moderate	13
R-X-154-03-Burnside	Burnside Bridge	SW Barnes Rd		16	45	High	16
R-X-155-00-LowerHighland_Ridge	Beavercreek Rd	Springwater Rd		24	18	Moderate	18
R-X-156-01-Highway10	SW 65th Ave	SW Barbur Blvd (99W)		10	31	High	10
R-X-156-02-Highway10	SW 65th Ave	Cedar Hills Rd			9	Moderate	9
R-X-157-00-232nd	HWY 224	HWY 212	15	11	28	High	11
R-X-159-00-Amisigger_Kelso_Richey	HWY 224	HWY 212	13	9	12	High	9
R-X-160-01-Foster	SE Jenne Rd	Multnomah Co Line			35	Moderate	35
R-X-160-02-Foster	SE Powell Blvd	SE Jenne Rd			14	Moderate	14
R-X-161-00-Firwood	SE Wildcat Mountain Dr	HWY 26			36	Moderate	36
R-X-162-00-AerialTram	Brg	Brg		25	55	Moderate	55
R-X-163-00-CapitolHighway	HWY 10	I-5 (Or)			34	Moderate	34
R-X-164-02-Powell	SE 174th Ave	SE Burnside Rd			10	Moderate	10
R-X-164-03-Powell	HWY 99E	SE Powell Blvd			6	Moderate	6
R-X-165-00-45th_Vermont	SW Allen Rd/Garden Home Rd/Multnomah Blvd	SW Capitol HWY		7	34	High	7
R-X-167-00-Moody	SW Naito Pkwy	SW Lowell St		16	5	Moderate	5
R-X-168-00-Hawthorne	HWY 99E	SE 39th Ave			5	Moderate	5
R-X-169-01-Naito	W Burnside Rd	NW 15th Ave			14	Moderate	14
R-X-169-02-Naito	SW Barbur Blvd	685ft N Of 1-405		16	31	High	16
R-X-169-03-Naito	685 Ft N Of I-405	W Burnside Rd			19	Moderate	19
R-X-171-00-Broadway_Terwilliger	SW Market And SW Clay	Ohsu		45	30	High	45
R-X-172-00-Tilikum	Brg	Brg			10	Moderate	10
R-X-176-02-Highway26	Multnomah Co Line	HWY 212			11	Moderate	11
R-X-178-01-Sandy	E Burnside Rd	NE Columbia Blvd			8	Moderate	8
R-X-178-02-Sandy	NE Columbia Blvd	NE 181st Ave			8	Moderate	8
R-X-178-02-Stark	242nd Ave / Hogan Rd / 238th Dr	Stark St Brg		24	25	High	24

ETR_ID_2020	ROUTE_FROM	ROUTE_TO	LAND_SUSC				PERCENT_HAZARD
			Very High	High	Moderate		
R-X-178-03-Sandy	NE 181st Ave	I-84			30	Moderate	30
R-X-180-00-Glisan	NE Cesar E Chavez Blvd	NE 53rd Ave			14	Moderate	14
R-X-183-00-23rd_Vaughn	NW Nicolai St	W Burnside St		6	13	High	6
R-X-184-00-Nicolai	NW Front Ave	NW St Helens Rd @ Kittridge			18	Moderate	18
R-X-185-00-Murray	W Burnside St	SW Canyon Rd	92			VERY HIGH	92
R-X-188-00-RockyButte	NE 82nd Ave	Joseph Wood Hill Park		27	34	High	27
R-X-189-00-32nd_Harrison	Johnson Creek Blvd	HWY 224			28	Moderate	28
R-X-190-00-SwanIsland	I-5 (Or)	I-5 (Or)			12	Moderate	12
R-X-191-01-CesarChavez	E Burnside Rd	I-84			40	Moderate	40
R-X-191-02-CesarChavez	SE Crystal Springs Blvd	E Burnside Rd			43	Moderate	43
R-X-192-00-Killingsworth	I-5 (Or)	N Lombard St			8	Moderate	8
R-X-193-01-82nd	SE Clatsop St	NE Holman St			19	Moderate	19
R-X-193-03-82nd	NE Holman St	NE Alderwood Rd			38	Moderate	38
R-X-193-04-82nd	I-205	SE Clatsop St			17	Moderate	17
R-X-194-00-StJohnsBridge	Brg	Brg			21	Moderate	21
R-X-195-01-172nd	Sunnyside Rd	HWY 212			45	Moderate	45
R-X-195-02-172nd	SE Foster Rd	Sunnyside Rd			16	Moderate	16
R-X-196-00-Highway20Bypass	HWY 30 (Nw St Helens Rd)	N Lombard Blvd			51	Moderate	51
R-X-197-00-Foster	Multnomah Co Line	HWY 212			58	Moderate	58
R-X-198-00-Dekum	HWY 99E	NE Columbia Blvd			34	Moderate	34
R-X-200-00-Lombard	N Kelley Point Park Rd	N Columbia Blvd			11	Moderate	11
R-X-201-00-242nd_Hogan_238th	HWY 212	I-84			26	Moderate	26
R-X-202-00-Columbia	N Lombard St	NE Sandy Blvd			14	Moderate	14
R-X-203-01-122nd	E Burnside Rd	NE Marine Dr		5	17	High	5
R-X-204-00-ColumbiaRamp	NE Columbia Blvd	N Portland Rd			13	Moderate	13
R-X-205-00-Highland-190th-Tillstrom	SE Powell Blvd	SE Foster Rd			45	Moderate	45
R-X-206-01-Alderwood	NE 82nd Ave	Airport Way			12	Moderate	12
R-X-206-02-Alderwood	NE Columbia Bllvd	NE 82nd Ave			14	Moderate	14
R-X-207-00-112th-CherryBlossom	SE Stark St	SE Powell Blvd			10	Moderate	10
R-X-208-01-Marine	N Portland Rd	I-5			10	Moderate	10
R-X-208-02-Marine	N Kelley Point Park Rd	N Portland Rd			11	Moderate	11
R-X-208-03-Marine	NE 185th Dr	I-84			45	Moderate	45
R-X-208-04-Marine	I-5	NE 185th Ave		35	45	Moderate	45
R-X-209-00-182nd	SE Powell Blvd	E Burnside Rd			7	Moderate	7
R-X-210-01-Airport	I-205	NE 181st Ave			10	Moderate	10
R-X-211-00-Fairview_Glisan_223	NE Sandy Blvd	SE Powell Blvd		6	29	High	6
R-X-213-00-257th_Kane	I-84	HWY 26			25	Moderate	25
R-X-215-00-Albina_Mississippi	N Lombard St	Kerby Ave			24	Moderate	24
R-X-217-00-15th	NE Dekum St	NE Broadway / NE Weidler St			27	Moderate	27
R-X-221-00-42nd	NE Columbia Blvd	NE Broadway / Weidler St			30	Moderate	30
R-X-223-00-Cully	NE Sandy Blvd	NE Columbia Blvd			10	Moderate	10
R-X-224-00-SR502	I-5	SR-503				OTHER	100
R-X-225-00-Portland	N Columbia Blvd	N Marine Dr		5	13	High	5
R-X-227-00-DeltaPark	I-5 (Or)	HWY 99E			16	Moderate	16
R-X-228-00-ScapooseVernonia	HWY 30	HWY 47		76	10	Moderate	10
R-X-229-00-Vancouver	HWY 99E	NE Columbia Blvd		6	6	Moderate	6
R-X-231-00-33rd	NE Columbia Blvd	NE Marine Dr		6	37	High	6
R-X-233-00-47th_Cornfoot_Airtrans	NE Columbia Blvd	Airtrans Way			21	Moderate	21
R-X-249-00-Chautauqua	NE Columbia Blvd	N Lombard St			10	Moderate	10
R-X-251-00-Dewitt	HWY 10	HWY 10			37	Moderate	37

ETR_ID_2020	ROUTE_FROM	ROUTE_TO	LAND_SUSC				PERCENT_HAZARD
			Very High	High	Moderate		
R-X-253-00-Sandy122Ramp	NE 122nd Ave	NE Sandy Blvd		5	54	High	5
R-X-255-00-40th	SW Allen Rd/Garden Home Rd/Multnomah Blvd	SW Capitol HWY			51	Moderate	51
R-X-257-00-CentralPoint	S New Era Rd / Penman Rd	Parrish Rd	34	14	32	High	14
R-X-259-00-26th	SW Taylors Ferry Rd	HWY 99W		5	49	High	5
R-X-261-00-181st	E Burnside Rd	NE Sandy Blvd			18	Moderate	18
R-X-263-00-MarketClay	I-405 / HWY 26	SW Naito Parkway			24	Moderate	24
R-X-265-00-LewisClarkBridge	Brg	Brg			32	Moderate	32

Table 6.6 RETRs with Flood Risk

ETR_ID_2020	ROUTENAME	ROUTE_TO	ROUTE_FROM	Percent Hazard			At Risk (if > 25%)
				100 year	500 year	Total	
R-X-154-01-Burnside	Burnside Brg	Brg	Brg	81	19	100	High Risk
R-X-169-01-Naito	NW Naito Parkway	NW 15th Ave	W Burnside Rd		100	100	High Risk
R-X-193-02-82nd	82nd Ave	NE Airport Way	NE Alderwood		100	100	High Risk
R-X-193-03-82nd	NE 82nd Ave	NE Alderwood Rd	NE Holman St		100	100	High Risk
R-X-206-01-Alderwood	NE Alderwood Rd	Airport Way	NE 82nd Ave		100	100	High Risk
R-X-210-02-Airport	NE Airport Way	I-205	Pdx		100	100	High Risk
R-X-227-00-DeltaPark	Delta Park	HWY 99E	I-5 (Or)		99	99	High Risk
R-X-208-04-Marine	NE Marine Dr	NE 185th Ave	I-5	67	30	97	High Risk
R-X-233-00-47th_Cornfoot_Airtrans	47th / Cornfoot Rd / Airtrans Way	Airtrans Way	NE Columbia Blvd	9	86	95	High Risk
R-X-210-01-Airport	Airport Way	NE 181st Ave	I-205		93	93	High Risk
R-X-231-00-33rd	NE 33rd Dr	NE Marine Dr	NE Columbia Blvd	15	77	92	High Risk
R-X-208-01-Marine	N Marine Dr	I-5	N Portland Rd	28	62	90	High Risk
R-X-167-00-Moody	SW Moody Ave	SW Lowell St	SW Naito Pkwy	24	62	86	High Risk
R-X-194-00-StJohnsBridge	St Johns Brg	Brg	Brg		86	86	High Risk
R-X-208-02-Marine	N Marine Dr	N Portland Rd	N Kelley Point Park Rd	5	80	85	High Risk
R-X-206-02-Alderwood	NE Alderwood Rd	NE 82nd Ave	NE Columbia Bllvd		83	83	High Risk
R-X-125-00-CedarHills	SW Cedar Hills Blvd	HWY 8 (Tualatin Valley HWY)	HWY 26	77		77	High Risk
R-X-141-00-Washington	Washington St	HWY 213	7th St	71		71	High Risk
R-X-103-00-Greenville_KansasCity_Kemper	Greenville / Kansas City / Kemper Rd	HWY 47	HWY 47	58		58	High Risk
R-X-225-00-Portland	N Portland Rd	N Marine Dr	N Columbia Blvd	27	29	56	High Risk
R-X-265-00-LewisClarkBridge	Lewis & Clark Brg	Brg	Brg	52		52	High Risk
R-X-169-03-Naito	SW Naito Pkwy	W Burnside Rd	685 Ft N Of I-405		48	48	High Risk
R-X-229-00-Vancouver	Vancouver Ave	NE Columbia Blvd	HWY 99E	13	35	48	High Risk
R-X-172-00-Tilikum	Tilikum Crossing	Brg	Brg	44		44	High Risk
R-X-186-00-Front	NW Front Ave	NW 61st Ave	NW Naito Parkway		37	37	High Risk
R-X-208-03-Marine	NE Marine Dr	I-84	NE 185th Dr	31	5	36	High Risk
R-X-129-00-Arndt_Airport_Barlow	Arndt Rd / Airport Rd / Barlow Rd	I-5	99E	20	14	34	High Risk
R-X-107-00-FernHill_SpringHill_Gaston	Fern Hill / Spring Hill Rd / Gaston Rd	HWY 47	HWY 47	25		25	
R-X-143-01-Highway99E	HWY 99E	Multnomah Co Line	HWY 99E		23	23	
R-X-203-01-122nd	NE 122nd Ave	NE Marine Dr	E Burnside Rd		23	23	
R-X-146-00-Flavel	SE Flavel St	SE 92nd Ave	82nd Ave	22		22	
R-X-228-00-ScapooseVernonia	Scappoose Vernonia Rd.	HWY 47	HWY 30	20		20	
R-X-190-00-SwanIsland	Swan Island	I-5 (Or)	I-5 (Or)		17	17	
R-X-110-00-Carus_Mulino	S Carus Rd / Mulino Rd	Beavercreek Rd	HWY 99E	8	8	16	
R-X-109-00-Apirary	Apiary Rd	HWY 47	HWY 30	15		15	
R-X-230-00-Haynes_CedarCreek	NE / Nw Hayes Rd / NE Cedar Creek Rd	SR-503	I-5	14		14	
R-X-101-01-Timber_GalesCreek	Timber / Vernonia Rd	HWY 47	HWY 26	13		13	
R-X-142-00-Sellwood_Tacoma	Sellwood Brg / Tacoma St	HWY 99E	HWY 43	13		13	
R-X-144-00-JohnsonCreek	SE Johnson Creek Blvd	HWY 99E	SE 39th Ave	13		13	
R-X-200-00-Lombard	N Lombard St	N Columbia Blvd	N Kelley Point Park Rd		12	12	
R-X-111-00-Highway219	HWY 219 (Hillsboro HWY)	HWY 210	HWY 8	11		11	
R-X-154-03-Burnside	W Burnside St	SW Barnes Rd	Burnside Bridge		11	11	
R-X-105-00-Highway47	HWY 47	HWY 30	Yamhill Co Line	10		10	
R-X-203-02-122nd	SE 122nd Ave	E Burnside Rd	SE Foster Rd	5	5	10	
R-X-160-02-Foster	SE Foster Rd	SE Jenne Rd	SE Powell Blvd	9		9	
R-X-216-02-MillPlain	W Mill Plain Blvd	Port Of Vancouver	I-5		9	9	
R-X-106-00-Macksburg	Macksburg Rd	HWY 170 (Marquam Canby HWY)	HWY 211		8	8	

ETR_ID_2020	ROUTENAME	ROUTE_TO	ROUTE_FROM	Percent Hazard			At Risk (if > 25%)
				100 year	500 year	Total	
R-X-122-00-Redland	Redland Rd	HWY 213	Springwater Rd	8		8	
R-X-211-00-Fairview_Glisan_223	NE Fairview Pkwy / Glisan St / 223rd Ave	SE Powell Blvd	NE Sandy Blvd	8		8	
R-X-162-00-AerialTram	Aerial Tram	Brg	Brg		7	7	
R-X-194-00-StJohnsBridge	St Johns Brg	Brg	Brg		7	7	
R-X-241-00-136th_137th	136th / 137th	Mill Plain (Vancouver)	NE 78th / Padden Pkwy		7	7	
R-X-135-00-Highway213	HWY 213	I-205	Marion Co Line	6		6	
R-X-156-02-Highway10	HWY 10 (Beaverton Hillsdale HWY)	Cedar Hills Rd	SW 65th Ave	6		6	
R-X-224-00-SR502	SR-502	SR-503	I-5	6		6	
R-X-113-00-River	River Rd	HWY 8 (Tualatin Valley HWY)	Scholls Ferry Rd	5		5	
R-X-127-00-Stafford_McVey	Mcvey Ave / SW Stafford Rd	I-205 (Or)	HWY 43		5	5	
R-X-133-01-Highway170	HWY 170	99E	HWY 211	5		5	
R-X-160-01-Foster	SE Foster Rd	Multnomah Co Line	SE Jenne Rd	5		5	
R-X-178-03-Sandy	NE Sandy Blvd	I-84	NE 181st Ave		5	5	
R-X-193-01-82nd	82nd Ave	NE Holman St	SE Clatsop St		5	5	

APPENDIX A
Regional Emergency Transportation Routes Work Group (EWRG) Members

APPENDIX A

Regional Emergency Transportation Routes Work Group (EWRG) Members

Regional Emergency Transportation Routes Work Group

We wish to thank the following agencies and individuals have participated in the Regional ETR Work Group from 2018 to present.

	Agency	Participants
1	Regional Disaster Preparedness Organization (RDPO)	Laura Hanson, Chair
2	Metro	Kim Ellis, Co-chair Matthew Hampton Zac Christensen Molly Vogt Daniel Nibouar
3	Tri-County Metropolitan Transportation District of Oregon (TriMet)	Alex Ubiadas Justin Dillon
4	C-TRAN	Bob Medcraft
5	Oregon Department of Transportation (ODOT)	Albert Nako Talia Jacobson Bruce Johnson (retired) Tom Braibish Geoff Bowyer Michael Zimmerman Glen Bolen
6	Washington Department of Transportation (WSDOT)	Monique Rabideau John Himmel
7	Oregon Department of Geology and Mineral Industries (DOGAMI)	John Bauer (retired)
8	Oregon Counties Association	Brian Worley
9	Portland State University (PSU) Transportation Research and Education Center (TREC)	John MacArthur
10	Port of Portland	Art Spillman Alex Howard Greg Theisen
11	Clackamas County Disaster Management	Nancy Bush
12	Washington County Emergency Management	Ken Schlegel John Wheeler
13	Washington County Operations and Maintenance	Todd Watkins

	Agency	Participants
14	Multnomah County Emergency Management	Lisa Corbly David Lentzner
15	Multnomah County Transportation Division	Megan Neill Allison Boyd Tina LeFebvre
16	Portland Bureau of Emergency Management (PBEM)	Jonna Papaefthimiou
17	Portland Bureau of Transportation (PBOT)	Mauricio Leclerc Emily Tritsch Michael Serritella
18	Clark Regional Emergency Services Agency	Anthony Vendetti Cindy Stanley
19	Columbia County Emergency Management	Shaun Brown Steve Pegram
20	Columbia County Public Works	Mike Russell Lonny Welter (retired)
21	Gresham Transportation Manager	Chris Strong
22	City of Wilsonville Public Works	Martin Montalvo

APPENDIX B
Stakeholder Engagement Process

APPENDIX B

Regional Emergency Transportation Routes Update

Stakeholder Engagement

Summary of Engagement Activities

February 4, 2021

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SUMMARY OF ENGAGEMENT ACTIVITIES | 2019 TO 2021

A detailed project engagement schedule is provided in **Attachment 1**.

2019 Engagement Activities

In 2019, Metro and RDPO worked closely together with a work group comprised of local, regional, and state partners in transportation planning and emergency management as well as engaged the Portland State University Transportation Research and Education Center (TREC) and a team of local consultants to provide the following for the ETR project work group.

- Conduct a policy review and research on best practices for establishing emergency transportation routes
- Assemble readily available datasets to support the evaluation process
- Develop and refine the draft RETR evaluation framework.

Four meetings of the ETR work group were held.

In August 2019, Metro hosted a community leaders' technical briefing and discussion, bringing together community leaders focused on social equity, environmental justice, labor fairness and community engagement. More than 100 community leaders were invited, and approximately 20 leaders participated. A summary of the discussion is provided in **Attachment 2**.

2020 Engagement Activities

From January to February 2020, the project team requested feedback on the draft evaluation framework from regional technical committees and work groups as well as regional policymakers.

In March 2020, mid-way through the project, the COVID-19 emergency declaration and response prompted Emergency Operations Centers (EOCs) to activate region-wide and forced cancellation of in-person meetings throughout Oregon and Washington for the remainder of the project.

In April 2020, the project team made adjustments to the work plan and engagement schedule to advance the project:

- The draft methodology and criteria were made available online for groups or individual stakeholders who wanted to review and provide comments through the end of May. No additional comments were received.
- The project team applied the draft methodology and evaluation factors to the routes and datasets collected for preliminary review and refinement by the ETR work group in July.

The team felt confident making these adjustments to the work plan given the substantive feedback previously provided by the ETR Work Group and positive feedback received from other stakeholders prior to the emergency declaration.

In July 2020, the preliminary routes with maps were presented to the ETR work group by the consulting team, enabling the work group to review draft outputs of the methodology and provide substantive feedback on the evaluation factors, methodology, and data used before preparing the draft report and maps for review (and subsequent refinement) by project stakeholders.

In September 2020, catastrophic wildfires in the region and other parts of Oregon further delayed completion of project deliverables and engagement activities. The continued delays required requesting a project extension from the Urban Areas Security Initiative (UASI) to June 2021.

From August to October 2020, staff convened a series of on-line jurisdictional meetings to request feedback on the preliminary maps and recommendations for future work. The meetings were held with each of the five counties (and their respective cities) as well as the Port of Portland, Port of Vancouver, City of Portland, TriMet, and the South Metro Area Regional Transit (SMART). The project team prepared an on-line viewer to support the jurisdictional review. The review identified data limitations and gaps, and new potential ETRs to be included in the analysis.

From November to December 2020, the project team incorporated the missing data (when readily available) and the additional potential ETRs, updated the ETR analysis and prepared a draft report with updated maps and recommendations for future work. The ETR work group reviewed and provided feedback on the draft report in advance of broader engagement planned for 2021.

2021 Engagement Activities (Planned)

From January to April 2021, updated maps, draft findings, and recommendations for future work were brought forward for review and consideration by regional technical committees and work groups, county coordinating committees as well as regional policymakers, including the RDPO Steering Committee, the RDPO Policy Committee, the Metro Council, the Joint Policy Advisory Committee on Transportation (JPACT), the Metro Policy Advisory Committee (MPAC) and the Southwest Washington Regional Transportation Council (SW RTC).

A regional dissemination webinar is anticipated in May 2021 to more broadly share the updated maps, data findings, and recommendations for future planning work.

Attachment 1

REGIONAL EMERGENCY TRANSPORTATION ROUTES UPDATE

ENGAGEMENT SCHEDULE | 2020 - 2021

2020

Month	When	Who	What
January	1/23	ETR Working Group	• Project update • Seek feedback on draft criteria and methodology • Seek feedback on recommendations for future work
February	2/19	TPAC/MTAC workshop; ETR Working Group members invited	
	Via RDPO email	RDPO work groups (e.g., public works, law enforcement, healthcare)	
March			
	3/2	East Multnomah County Transportation Committee TAC	
	3/6	REMTEC	
	3/10	Metro Council	
April	4/13	East Multnomah County Transportation Committee	
	4/30	Washington County Coordinating Committee TAC	
May	5/18	Washington County Coordinating Committee	
	5/20	Clackamas County C-4 Metro Subcommittee	
July	7/9	REMTEC	
	7/17	Regional Transportation Advisory Committee	
	7/21	ETR Working Group	Seek feedback on preliminary maps
August	8/3	RDPO Steering Committee	Project update
	8/4	SW Regional Transportation Council (RTC)	Project update
	8/12	Clark County, Vancouver, WSDOT staff	Jurisdiction specific review of preliminary maps
	8/19	City of Portland staff	
	8/20	Multnomah County staff	
September	9/2	East Multnomah County Transportation Committee TAC	
	9/8	Clackamas County, Cities of Happy Valley, Gladstone, Lake Oswego, Milwaukie, Oregon City, West Linn and Wilsonville staff	
	9/10	Washington County, Cities of Beaverton, Cornelius, Forest Grove, Hillsboro, Sherwood, Tigard and Tualatin staff	
	9/14	Columbia County staff	
	9/23	RDPO Public Works WG Meeting	Project update
October	10/1	REMTEC	
	10/5	Ports of Portland and Vancouver staff	Jurisdiction specific

Month	When	Who	What
	10/9	TriMet, C-TRAN and SMART staff	review of preliminary maps
	10/26	ETR Working Group	Seek feedback on draft maps and report recommendations
	Via email	RDPO Public Works WG	Send out links to the maps and technical documents to review
December	Via email	ETR Working Group Reviews DRAFT Report	Email/online no meeting
	12/7	RDPO Steering Committee	Project update

2021

Final Review Process (planned)

Who	Anticipated Date
ETR Work Group Review	Jan. 20
REMTEC	Feb. 5
RDPO Steering Committee	Feb. 8
Transportation Policy Alternatives Committee (TPAC)/ Metro Technical Advisory Committee (MTAC) workshop	Feb. 17
Joint Policy Advisory Committee on Transportation	Feb. 18
Regional Technical Advisory Committee	Feb. 19
RDPO Policy Committee	Feb. 19
Metro Council	Feb. 23
Metro Policy Advisory Committee	Feb. 24
Southwest Washington Regional Transportation Council	March 5

Who	Anticipated Date
Clackamas County TAC	Feb. 24
East Multnomah County Transportation Committee TAC	March 3
Washington County Coordinating Committee TAC	March 4
Washington County Coordinating Committee (policy)	March 15
East Multnomah County Transportation Committee (policy)	March 15
C-4 subcommittee (policy)	March 18

Acceptance Process (planned)

Who	Anticipated Date
RTAC – seek recommendation to the SW RTC	March 19 or April 16
TPAC – seek recommendation to JPACT	April 2 or May 7
SW RTC – seek acceptance of updated map, report findings and recommendations for future work	April 6 or May 4
JPACT – seek recommendation to the Metro Council	April 15 or May 20
Metro Council – seek acceptance of updated map, report findings and recommendations for future work	April or May *pending JPACT action*
RDPO Policy Committee – seek acceptance of updated map, report findings and recommendations for future work	May or June *pending Metro Council and SW RTC action*

COMMUNITY LEADERS' TECHNICAL BRIEFING AND DISCUSSION
Friday, August 2, 2019
Meeting Summary of Regional Emergency Transportation Routes Discussion

On Aug. 2, 2019, Metro hosted a community leaders' technical briefing and discussion, bringing together community leaders focused on social equity, environmental justice, labor fairness and community engagement. Invitees included community representatives on the Metro Policy Advisory Committee (MPAC), Metro's Committee on Racial Equity (CORE), Metro's Public Engagement Review Committee (PERC), Metro Technical Advisory Committee (MTAC) and Metro's Transportation Policy Alternatives Committee (TPAC), as well as previous participants in 2018 Regional Transportation Plan (RTP) regional leadership forums and those involved in discussions about an affordable housing measure. More than 100 community leaders were invited, and about 20 leaders participated.

Attendees

Community Leaders: Bev Drottar, TPAC community member; Anjala Ehelebe, Woodlawn Neighborhood Association; Hannah Holloway, Urban League; DJ Hefferman, Sullivan's Gulch Neighborhood; Allie Yee, APANO; Coi Vu, IRCO Asian Family Center; Ali Mohamad Yusuf, IRCO; Sydney McCotter Bicknell, PAALF; Andrew Basin, Willamette Falls Trust; Diane Linn, Proud Ground; Richi Poudyal, The Street Trust; Nicole Johnson, 1000 Friends of Oregon; Chris Rall, Transportation for America; Vivian Satterfield, Verde; Mercedes Elizalde, Central City Concern; Arlene Kimura, East Portland Action Plan; Carol Chesarek, MTAC community member; Kari Schlosshauer, Safe Routes to School Partnership

Metro staff: Clifford Higgins (facilitator), Lake McTighe, Caleb Winter, Eryn Kehe, Matt Bihn

Cliff Higgins kicked off the meeting with introductions and an agenda overview.

Discussion 2: Emergency Transportation Routes
Presentation and large group discussion

- Cliff Higgins presented about the Emergency Transportation Routes Study to the group. He discussed some background on the region's existing Emergency Transportation Routes and the need to update the regional routes to reflect changing population centers, demographics, technology and new information about hazard risks. The study will both identify priority routes and also make recommendations on planning and investments to make those routes more resilient in preparation for major disasters.
- There were questions about how this project will go beyond just route prioritization and identification to also consider the connections between routes and ways community members can access the routes during an emergency.

Small group discussions:
Below are the major themes and takeaways from each of the small group discussions on this topic. The participants in these small groups were responding to the following prompts:

1) Based on how we've described it, is this project on the right track?
2) Does the problem to be solved make sense?
3) What else should we consider as this project moves forward?
4) How can we best pursue equity on this topic?

- Participants generally agreed that this project was on the right track,but wanted to make sure it is relevant to individual community disaster preparedness and that there are clear lines of communication about how emergency routes play into overall disaster planning regionally.
- Though most participants understood the need for the project, many emphasized that there are infrastructure improvement needs in communities now that need addressing, and this project must balance the local needs of these emergency routes with helping local communities to prepare for disasters. There were some suggestions of phasing improvements on certain routes to better serve community's immediate needs.
- As the project moves forward, there was an interest in how we can learn from best practices in other communities who have experienced significant natural disasters.
- Individuals brought up specific examples of necessary coordination with other utilities in this planning effort, including: water and sewer lines under Burnside, Powell and Division, the Linnton fuel tanks (fire risk) and major institutions housing vulnerable or dependent populations such as jails, nursing homes or hospitals.
- The overarching concern brought up by each of the groups was to adequately evaluate who would be served by these prioritized emergency transportation routes, and ensuring that the planning prioritizes serving those with fewer access to resources in a disaster.
- Pursuing equity on this topic means clear communication with communities about how to prepare for a disaster, where emergency transportation routes are how improving emergency transportation routes would impact their neighborhood. This also includes communication in different languages and longer planning timeframes to incorporate voices less familiar with these planning processes.

APPENDIX C
TREC at PSU Metropolitan Regional ETR Report

Background and Considerations for Updating the Regional Emergency Transportation Routes in the Portland-Vancouver Metropolitan Region

Baxter Shandobil
John MacArthur

Transportation Research and Education Center
Portland State University

August 2019

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Section I: Project Background

Natural disasters can happen any time and the Pacific Northwest is in a highly seismically active region. In addition to the risk posed by the three shallow, crustal fault lines that intersect Portland, geologists believe that there is a 24 percent chance of a magnitude 8.0 or greater earthquake occurring in the Cascadia Subduction Zone within the next 50 years.[1, 2] Landslides, wildfires, flooding, volcanic activity, and extreme snow and ice events pose additional threats, and when they strike, the transportation system must be resilient in order to facilitate emergency response and recovery activities.

In 1996, the Portland Metro region first designated Emergency Transportation Routes (ETRs), to be used after a major regional disaster to move emergency resources such as personnel, supplies and equipment to designated staging areas and subsequent deployment to heavily damaged areas. The 1996 report of the Metro Regional Emergency Transportation Routes Task Force identified several factors that influence the designation of routes as emergency transportation corridors, including:

- The response phase lasts a relatively short time, so the focus of the task force was on primary ETRs for use during the first 72 hours following an event.

- In past earthquakes, injured people generally found ways to access medical care and were not transported by ambulance to a hospital. The task force identified distributing patients from overloaded or out-of-action medical centers to underutilized ones, perhaps outside of the major impact area, as a primary concern.

- Utilities tend to congregate on major arterials. Downed wires or collapsed water or sewer mains may render these roads impassable. Freeways are less likely to be impacted by damaged utility facilities.

- Airport facilities and air traffic control systems could be damaged by the event. Alternatives for access to airlift locations should be conisdered for ETR selection.

[1] Monahan, R. (2019). “When the Big One Hits, Hundreds of Portland’s Buildings Could Crumble. Is it Fair to Make Property Owners Prepare?” *Willamette Week.* Retrieved from https://www.wweek.com/news/city/2019/03/06/when-the-big-one-hits-hundreds-of-portlands-buildings-could-crumble-is-it-fair-to-make-property-owners-prepare/ on 3/14/19/

[2] Read, R (2015). “Oregon State earthquake, tsunami expert Chris Goldfinger: ‘It’s not hopeless.’” *The Oregonian*. Retrieved from https://www.oregonlive.com/pacific-northwest-news/2015/07/tsunami_earthquake_cascadia_ch.html on 3/14/19.

The task force used four criteria for selecting specific routes:

1. State routes serving the metropolitan area were considered primary because of their high capacity and ability to handle oversized vehicles. Additionally, local emergency corridors are often only accessible via a state route.

2. Relatively flat routes with few major gradients or potential slide areas.

3. Routes should serve major population centers.

4. At-grade level alternative routing at overpasses and underpasses.

While the criteria established in the 1996 Report of the Metro Regional Emergency Transportation Routes Task Force are important, there are other additional criteria that are worth considering (see Sections V through VII).

In 2006, the current regional ETRs were established in a Memorandum of Understanding between Oregon Department of Transportation (ODOT), Washington State Department of Transportation (WSDOT), Metro and local jurisdictions in the Portland-Vancouver metropolitan region.

The MOU describes after-event procedures such as the chain of reporting and jurisdictional responsibility for each road and bridge segment of the ETR network. It also specifies basic assessment procedures, establishes standards on the reporting of route status, and designates the Richter scale magnitude earthquakes for which different response levels are activated. However, the MOU offers minimal guidance on how routes are established and updated.

Since 2006, the ETRs have not been updated thru the MOU and the current designations are not being maintained at a regional level. Recently, some local jurisdictions have identified changes to the local ETRs but these changes have not been shared or updated regionally.

ODOT is currently evaluating the seismic resilience of the state-designated Lifeline Routes in the Portland-Vancouver region portion of Oregon. Overall, ODOT is working with each county in Oregon to further assess the state designated lifeline routes and locally designated ETRs to anticipate seismic impacts to bridge and overpass infrastructure on the state's designated lifeline arterial streets and throughways. The ODOT analysis includes an evaluation of the cost-benefit to seismically update bridge and overpass facilities along state-owned routes compared to the cost-benefit to seismically update adjacent county routes. In addition, each county in Oregon is recommending changes to the ETRs within their respective jurisdiction based on this analysis and local information, when available.

In 2018, Clackamas County updated their routes while evaluating bridge and overpass facilities on the Statewide Lifeline Routes for ODOT. In 2019, Washington County, Columbia County and

Multnomah County will complete a similar analysis of their ETRs in partnership with ODOT. Clark County, in Washington State, will complete a similar analysis of their ETRs using DOGAMI data and analysis. Independent of ODOT's work with the counties, the City of Portland conducted an update of their ETRs in 2018, which will be brought into this planning effort.

Given the above work, the designation of current ETRs need to be re-evaluated to reflect updates recommended by the City of Portland and each of the five counties.

The Regional Disaster Preparedness Organization (RDPO) and Metro are coordinating efforts with transportation, emergency management and public works departments of each county and the City of Portland, ODOT and Washington Department of Transportation (WSDOT), as well as the Metro Council, the Joint Policy Advisory Committee on Transportation (JPACT), Southwest Regional Transportation Council (RTC), TriMet, SMART, C-TRAN and DOGAMI.

The Regional Emergency Transportation Routes (ETRs) update project will update the existing regional ETRs for the 5-county Portland-Vancouver metropolitan region by updating the regional ETR map. The project will also make recommendations on elements to be included in an updated memorandum of understanding (MOU), mutual aid or other written agreements needed to implement ETRs, and provide information to support future planning work related to regional transportation recovery, resiliency and emergency management.

The regional project will update existing designated regional routes using the latest DOGAMI seismic data, ODOT Lifeline analysis and subsequent county-level bridges and ETR analysis. This will also ensure the updated ETRs are responsive to local and state knowledge and priorities in our rapidly growing and changing region. Planning and updates to infrastructure within the region since 2006 will also inform the ETR update; particularly the now seismically-resilient Sellwood and Tilikum Crossing bridges owned by Multnomah County and TriMet, and recommendations identified in the 2018 Earthquake Ready Burnside Project Feasibility Report.

Given the limited time and funding available, this report is not intended to be an exhaustive literature review, nor make authoritative recommendations. Rather, it will serve as a resource document for the contracted consultants leading a longer regional ETR refinement process by providing a general knowledge base, cataloging relevant documents, and describing considerations and lessons learned from other regions that have been reviewed

Between March and June of 2019, Metro and RDPO partnered with a Portland State University's (PSU) Transportation Research and Education Center (TREC) to perform desk research to evaluate the policy framework in which ETRs currently operate in the Portland-Vancouver metropolitan region, as well as best practices from other regions with similar vulnerabilities.

Section II: Report Organization

Throughout the research process, we reviewed dozens of planning, policy, emergency management, and technical documents, and solicited feedback from representatives at Portland Bureau of Transportation (PBOT) and ODOT, as well as Multnomah, Washington, Clackamas, Columbia and Clark counties. Additionally, we had a phone conversation with Mike Andrews from North Shore Emergency Management in British Columbia about their current emergency transportation management policies and future plans in a region with similar vulnerabilities. **Appendix B** contains a table of all parties consulted during this process.

One of the initial key findings was a lack of consistency in how ETRs are both named and defined between jurisdictions. In **Section III**, seen below, we identify the four types of emergency transportation routes discussed in local, regional, and statewide planning, engineering, and emergency management documents. Additionally the degree to which ETRs are identified in planning documents between local and regional governments varies widely. ETRs are discussed in multiple sections of Metro's 2018 Regional Transportation Plan (RTP), while the Transportation System Plans (TSP) of the cities and counties in the Portland-Vancouver region hardly mention them at all. The table in **Appendix A**, identifies all local, regional, and statewide documents reviewed during the research process, their publication date and agency, how ETRs are defined within the document, relevant content on emergency transportation.

In addition to local, regional, and state emergency management memos, documents from other regions that have similar vulnerabilities as Oregon, or that have other natural disasters that would warrant established emergency transportation routes as an important disaster planning measure were reviewed. Given the limited time and budget of this project, only selected documents were reviewed. Among those documents, the majority identified transportation as crucial to recovery after a disaster. Some point out that routes may be impassable following an event, and others discuss the use of evacuation routes in the event of an emergency, however none established criteria or a process for identifying emergency transportation routes. While not particularly helpful for establishing best practices, they are included in the table in **Appendix D** so that the contractors hired to lead the larger regional ETR update project can focus their energy elsewhere and be advised on which documents are *not* pertinent.

Several of the emergency management documents from other regions that were reviewed *did* have pertinent discussion of emergency transportation routes, and other considerations that may be useful when updating the Portland-Vancouver region's existing ETRs (**Appendix C**). Sections **V, VI, and VII** synthesize the insights gained from this best practices research (**Section IV**) along with local, regional and statewide planning, technical, and emergency management documents, conversations with planners and disaster management experts into considerations for the regional ETR update.

Section III: ETR Types

We have identified four distinct types of emergency transportation routes within Oregon and in particular the Portland-–Vancouver region, all of which serve different purposes/have different functions. The four types of emergency transportation routes are:

1. **Local Emergency Response Streets (Routes)** are intended to provide a network of streets to facilitate prompt response to routine fire, police, and medical emergencies within a single jurisdiction. These streets, which are often identified by first responders and local and regional emergency managers with some input from transportation planners and policymakers, may receive specific design treatments such as wide streets and lanes, large curb radii, parking restrictions, and a lack of center medians, pedestrian islands, traffic circles, or speed bumps in order to ensure freedom of movement for emergency response vehicles. (This term originated from the City of Portland, and the authors believe is an applicable to term to include in this update project.)

2. During a large-scale event, seismic or otherwise, **Local Emergency Transportation Routes (ETRs)** are used both during the initial response phase and early recovery phase to both transport first responders and supplies such as fuel, food, and medical equipment that aid with recovery and therefore must connect with**,** staging areas, essential infrastructure (power generation, fuel, water mains, etc.) and intermodal transfer points either directly or via **Regional Emergency Transportation Routes** (defined below)**.** These routes are pre-designated by local jurisdictions with input from neighboring jurisdictions, Metro, and the Regional Disaster Preparedness Organization (RDPO), as they must connect with the Regional ETR network. Locally designated ETRs may also cross into a neighboring jurisdiction. In such instances, it is prudent to coordinate with the neighboring jurisdiction to ensure the road's designation as an ETR is consistent across jurisdictional boundaries.

   Prioritization of local ETRs in terms of retrofitting prior to an event, or inspection and debris clearance after an event is at the discretion of the local government but should be coordinated with local, regional and state partner governments. Given limited resources, prioritization of routes could be used to inform funding priorities for seismic retrofitting and hardening of assets (for example ODOT and Metro could use for future funding criteria).

   Locally designated ETRs also serve as detours for segments of **Statewide Lifeline Routes** that have been identified as Tier 2 or Tier 3 (defined below and in Appendix E).

   Often, ETRs are focused on the movement of emergency vehicles, cars, trucks, and buses. However, after an emergency in many metropolitan/urban, many people may not have access to public or private transportation. Alternative routes for pedestrians and bicycles should be considered in some areas to enhance mobility while also maintaining

the right of way for emergency responders on the primary ETRs. For example, some pedestrians and bikes may use unimproved, spontaneous pathways, but in some instances we may want to include bridges for bike/pedestrian use, and connections of pathways to the ETRs; during recovery it may become prudent to designate certain streets/routes for bike/pedestrian and others for cars.

As an example of how municipalities can expand their own ETRs for non-motorized use as a subset of the larger regional ETR network, the City of Portland is incorporating active transportation into the city's emergency response plans through a process called Bike ETRs (BETRs).

3. **Regional Emergency Transportation Routes** are pre-designated routes critical to the movement of emergency responders and supplies between *regional* nodes in Multnomah County, Washington County, Clackamas County, Columbia County in Oregon, and Clark County in the state of Washington. Because the regional ETRs connect across jurisdictions and connect with local ETRs and Statewide Lifeline Routes, the authors suggest that Metro and RDPO to facilitate the process for updating designated Regional ETRs, with input from and in coordination with local jurisdictions, ODOT and WSDOT. These routes may overlap with local ETRs, however their primary function is to form a backbone of roads connecting population centers as well as critical infrastructure and services of regional importance. Routes within the regional system may be tiered, so that the most critical links receive prioritization for retrofitting, maintenance, inspection or debris clearance and management.

   As an example, an East-West regional ETR may connect a fuel supply depot in Portland to a staging area in Beaverton. Local ETRs in Beaverton and Washington County distribute supplies to local distribution areas and population centers.

   Regional routes may overlap with locally designated ETRs in some instances. For example, at present, segments of SE Foster Road are identified as both local Multnomah County ETRs and as regional ETRs.

   In accordance with the 2006 Memorandum of Understanding, cities, counties, and state transportation departments prioritize the damage assessment and debris clearance of ETRs over other local streets.

4. **Statewide Lifeline Routes** are state-owned roadways considered critical to emergency response and recovery activity at the statewide level in Oregon and Washington. Defined in Policy 1E of the Oregon Highway Plan, the Lifeline Routes are intended to facilitate immediate emergency services and disaster response as well as support rapid statewide economic recovery. While local and regional ETRs support the movement of emergency responders within a region, Lifeline Routes allow for the movement of both emergency responders and freight to transport goods needed for recovery between regions within Oregon. The OHP states that in planning for lifeline routes, focus on

susceptibility of the route and improvements on it (bridges and other structures) to disasters such as earthquakes, landslides, and flooding and to consider the presence of designated lifeline routes in system investment and management decisions and in coordination efforts with local land use and transportation planning activities.

For example, the Redmond Municipal Airport in Deschutes County is thought to be more seismically resilient than Portland International Airport and is designated as the main airport for airlifting emergency response and recovery supplies. Lifeline Routes connect Redmond Municipal Airport with population centers across the state of Oregon.

The term **Lifeline Corridors** is used to denote the combination of Lifeline Route highways, and Local ETRs identified as Lifeline detours as not to imply that Lifeline Routes are to be used at the exclusion of other parallel roads if necessary.

While the focus of this report is Regional ETRs, there is more substantial documentation on the process of designating statewide Lifeline Routes and prioritizing them for seismic retrofitting. Although Lifeline Routes are functionally different than regional ETRs, many of the designation criteria are the same, and, as a result, the methodology used by ODOT can help inform the Regional ETR update process. Therefore, Lifeline Routes are discussed in greater detail in this section and in Appendix E.

Lifeline Routes have three main goals which capture needs during three distinct periods following a seismic event: short, medium, and long-term response and recovery. Within each goal is a series of specific actionable objectives to achieve each goal, and a series of criteria to evaluate how well each Lifeline segment can achieve the related objectives and goals. A cost-benefit analysis based on these criteria is used to categorize Lifeline Routes into a 3-tiered system for prioritizing seismic retrofits. Critical linkages necessary to serve the greatest number of residents at the lowest investment of time and money are given top priority. The specific goals, objectives, criteria and tiers used to designate Lifeline Routes are detailed in Appendix E.

It is useful to think of Lifelines, regional ETRs, and local ETRs as a street hierarchy (Figure 1). Lifelines connect regions of statewide importance and are limited to a few key north-south and east-west routes. Regional ETRs connect nodes of population and critical infrastructure within a region (i.e. Burnside connects Portland Metro east to west), and local ETRs connect regional nodes to destinations of local importance (populated areas, distribution centers, medical facilities, fire stations, etc.) As an example, Figure 2, seen below, depicts selected Lifelines, Regional ETRs and Local ETRs.

Figure 1. Emergency Transportation Route Hierarchy

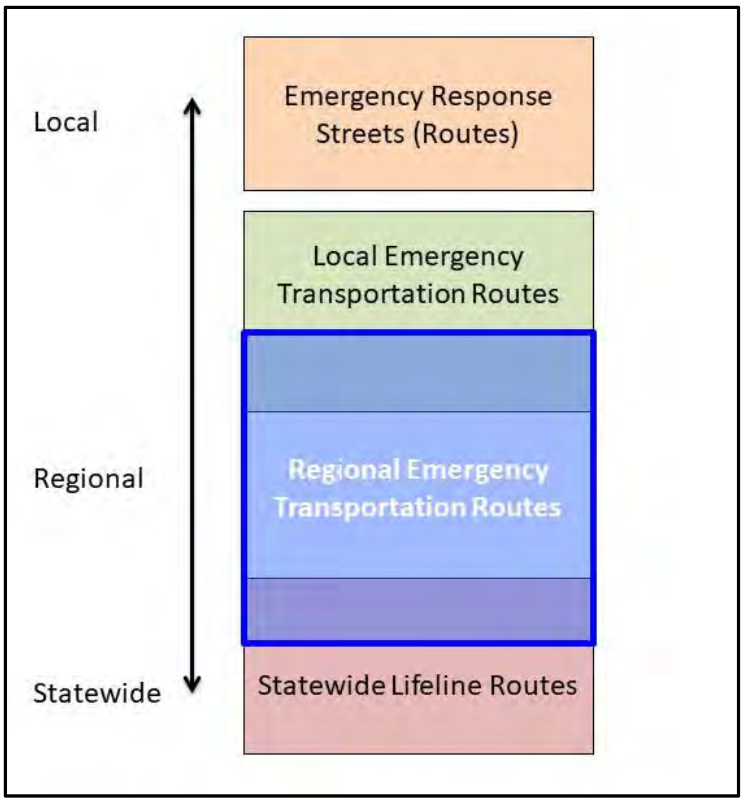


Figure 2. Selected Lifelines, Regional ETRs, and Local ETRs*

*Not all routes and key destinations are depicted. Rather, the map serves as an example of the hierarchy of emergency transportation routes.

Section IV - Literature Review

Our literature review of planning and emergency management documents from regions outside of Oregon proved largely unfruitful chiefly because most MPOs do not have established ETRs in the same way that Metro does. Pre-established evacuation routes in areas prone to hurricanes and flooding are common, however, these are functionally different than ETRs as they are designed to quickly move people out of an area, rather than bring emergency responders and supplies to an area.

West Coast Cities

Several emergency management documents from regions with similar hazards as Oregon were reviewed, including the State of California Emergency Plan, the Bay Area Earthquake Plan, the City and County of San Francisco Emergency Response Plan, and the City of Seattle Comprehensive Emergency Management Plan (See appendices C and D for a full list). While they all acknowledge the importance of a resilient transportation network, there is no discussion of a predetermined emergency transportation network, let alone a methodology for creating one.

Seattle prioritizes snow and ice routes to be plowed first during extreme winter weather events. These routes tend to be on major arterials and transit routes, but the Seattle Comprehensive Emergency Management Plan offers little detail on other criteria used.

British Columbia

Of all documents reviewed from regions outside of Oregon, the British Columbia Disaster Response Primer, and the British Columbia Disaster Response Transportation Planning Guide for Road Transportation were most relevant to the regional ETR update. Similar to ETRs, British Columbia establishes a network of regional and provincial routes "vital to the functioning of the transportation network in the impact area and movement of emergency resources cross-jurisdictionally." While these so called "Critical Routes" are pre-designated with the latest information regarding resiliency, BC disaster management experts recognize that these routes may fail given the unpredictable nature of disasters. In the event that a Critical Route is impassable, or does not provide sufficient access to the affected area, a separate system of Disaster Response Routes (DRRs) are activated post-event. DRRs are for the exclusive use of emergency response vehicles, or critical personnel with valid identification (exclusively for their use, as a separate system). The report further differentiates between short, medium, and long-term DRRs, which utilize different levels of traffic control and access restrictions.

Sections V through VII describe some considerations for updating Metro's regional ETRs organized by access considerations, roadway considerations, and policy and jurisdictional considerations.

Section V: Access Considerations

There are a wide range of locations that need to be accessible following a major earthquake. Table 1, seen below, contains a list of critical assets organized by regional importance (local, regional, statewide). This list is neither comprehensive nor prescriptive, rather it summarizes key destinations identified during the literature review for this project. Assuredly, there are additional locations of importance not identified here.

Table 1. Critical Assets by Regional Importance

Locations	Regional Importance		
	Local	Regional	Statewide
Major Hospitals	X	X	X
Urgent Care, Clinics, Medical Centers	X		
Fire, Police, and Ambulance	X	X	
National Guard			X
Airports		X	X
Marine Ports		X	X
Rail Yard		X	X
Fuel Depots		X	X
Fueling Stations	X		
Utilities: Electricity, Natural Gas	X	X	
Staging Areas	X	X	X
Community Points of Distribution	X		
Mass Shelter	X	X	
Transit Garages	X	X	
Drinking Water	X	X	
Food Sources	X	X	
Sewage Treatment Sites	X		
Disaster Debris Management Sites	X	X	
City Halls	X		
Emergency Operations Centers	X	X	
Community Centers	X		
Childcare Facilities	X		
Homeless Shelters	X		
Jails	X		
Residential Care Facilities	X		
Schools	X		

Additional Access Considerations:

- **Lifelines and critical infrastructure and services are interdependent:** Swift emergency response depends not only on the road itself, but the availability of other critical services such as radio, cellular, and broadband internet connections for communications, electricity or fuel for generators at hospitals, and water to suppress fires and support life-saving efforts. ETRs should connect with access points to other critical infrastructure so that services can be resumed as quickly as possible following an event. Due to security concerns, utility providers are often apprehensive about sharing the locations of critical assets and will only do so on a "need to know basis." However, there is a strong case that emergency preparedness planners need to know. One approach could be to share initial mapping and data with utility providers with a request to identify issues or network gaps.

- **Emergency vehicle energy sources may change:** Today, the majority of emergency response vehicles and heavy trucks and machinery are propelled by internal combustion engines fueled by gasoline, diesel, biodiesel, or compressed natural gas. Thus, connecting to fuel depots is crucial to keep vehicles in service. However, as electric vehicles continue to mainstream and models for light-duty use, such as pickups and vans, fueling needs may change such that charging stations, and power generation and transmission sites become more relevant.

- **Public access to ETRs:** The primary function of ETRs is to facilitate the movement of emergency responders, supplies, and other personnel that aid with immediate response and life-saving activities and the initial transition to recovery. Consideration should be given as to whether regional ETRs will be accessible to the general public (and in what timeframe, and in light of access needs including access to shelters, points-of-distribution, hospitals, etc).

  The most likely disaster scenario (major earthquakes) generally do not trigger large-scale evacuations. Unlike a hurricane, where people generally have advanced warning, and vacate the area prior to the event, earthquakes are usually "shelter-in-place" events. However, depending on when the earthquake occurs, there may be a significant number of people that need to travel home or an agreed upon meeting place to reconnect with family. According to the Transportation Technical Memorandum in the City of Portland's Evacuation Plan, a full-scale evacuation would cause congestion greater than a typical peak travel period. While a full-scale evacuation is unlikely, general traffic, perhaps worsened by panic, could impede emergency response. Mass relocation out of the region may occur during the recovery period, and likely warrants more consideration as part of transportation recovery planning.

Emergency management documents from British Columbia explicitly state that first responders will either receive police escort on their "Disaster Response Routes," or routes will be closed to the public entirely.

- **Public outreach about ETRs:** If ETRs are for the exclusive use of emergency responders, it still may be valuable for the public to be educated about their location through public outreach plan, so that they know where they should avoid in order to relieve congestion for re-supply operations, but give information on Commodity/Community Points of Distribution (C-POD) sites where they can expect to find help. However, during the literature review no instances of public engagement in the ETR planning process were identified; typically, outreach includes first responder agencies. ETRs generally do not extend into local neighborhood streets, and people may have to travel to receive medical care, so an understanding of where responders will be able to access may be beneficial. One of the public comments from the Portland Mitigation Action Plan that all jurisdictions can benefit from called for "Culture and language-appropriate webpage for new Portlanders [ergo all citizens] to access emergency information, videos, and events in their preferred language" - it is important that however public messaging about ETRs occurs it adheres to best practices about universally accessible formats, particularly in light of the fact that telecommunications may be down for a period of time following a seismic event.

- **Getting emergency responders and support staff to staging areas or rallying points:** While it is impossible to account for all of the dispersed residential locations of essential employees (i.e., employees needed to operate the sites and services listed in Table 1) when establishing ETRs, it is important to consider that they will need safe passage to their designated rallying point in order to perform their duties.

- **Consider the locations of isolated, marginalized or underserved communities:** Considerations need to be made for isolated, marginalized and underserved community areas. Often these communities lack access to public or private transportation and include higher proportions of people with low-incomes, people of color, older adults, people living with disabilities, houseless individuals and families, and be immigrant communities where English is not the primary language.

- **Alternate modes of transportation (i.e., helipads and makeshift aircraft landing zones, rail or marine terminals):** Despite the best efforts of emergency planners, key surface transportation links may fail in a large earthquake. Alternate transportation landing zones on both sides of the Columbia and Willamette rivers would provide first responders access to areas that cannot be reached otherwise.

- **Consider the movement of bicycles and pedestrians:** Following a disaster or major emergency, travel by foot or by bicycle (and scooters) may be the best option for a many people to move around the region. However, there are many people with mobility challenges or who need accommodation (i.e., wheelchairs or strollers) that should be

considered. Many roads may be impassable, and ETRs may be reserved for the movement of disaster responders. Fuel may also be reserved for the exclusive use of vehicles leading the response and recovery effort and not provided to the general public for an extended length of time. Moreover, walking or cycling may be the only option for residents without access to public or private transportation, which is a solution that does not work for many people due to mobility challenges. In order to keep ETRs clear for emergency response, planning processes to identify and manage alternative routes for other traffic at the time of need may need to be established.

- **Access to debris management areas:** There is a need to be prepared for a debris generating incident that overwhelms the existing solid waste infrastructure and to ensure the efficient, orderly and timely removal and disposal of debris. For example, Metro's Disaster Debris Management Plan provides guidance for Metro on how to manage and coordinate debris operations and system disruptions and identifies potential disaster debris management sites. Similarly, the Multnomah County Disaster Debris Management Plan outlines how debris will be cleared from roadways in two phases. During the immediate response, debris is pushed to the side so that traffic may pass, but no effort is made to remove the debris until short-term recovery. During short-term recovery, crews will need access to debris management sites in order to make roads fully operational again.

- **Critical Energy Infrastructure (CEI) Hub:** The CEI Hub is a six-mile stretch along the western bank of the Willamette in Portland's NW Industrial area that contains the majority of Oregon's energy infrastructure for petroleum, natural gas, liquefied natural gas, and electricity. DOGAMI data and analysis indicate that there is significant liquefaction and seismic risk within the CEI Hub. While it is critical the ETR network connects with the CEI hub so that damage can be assessed and operations restored after a non-seismic disaster, the CEI is in a liquefaction zone and will likely be destroyed or inaccessible. Additionally, ETRs in a liquefaction zone are at risk of significant damage themselves.

- **Connects to major population and economic centers as well as isolated, marginalized and underserved communities:** It is important to connect major population and economic centers both for emergency responses but also with the intention for recovery. These locations will be important for people to have access to services and jobs in post disaster recovery.

- **Intermodal transfer points:** Supplies needed to aid recovery could be sent to the region via rail, air, or marine vessel. ETRs must connect to resilient marine ports, marine terminals, airports, and rail yards.

- **Public transit:** In the event of an emergency, TriMet, C-Tran and other publicly-owned buses could be used to shuttle response and recovery personnel and supplies between areas of need. Buses can also be used to shuttle the public out of hazard areas and

to/from mass shelters and community points of distribution, for example. Access to bus garages and maintenance sites is necessary in order to make use of these vehicles.

Section VI: Roadway Considerations

- **Consider infrastructure constructed since the last ETR update:** Seismic upgrades to existing routes, as well as new bridges and roadways can improve the reach and survivability of emergency transportation routes. For example, since the last ETR update in 2006 two existing bridges have become more resilient and one new bridge has been constructed. The Sellwood Bridge and Sauvie Island Bridges have been replaced and are multimodal. In addition, the new Tilikum Crossing has opened for city buses, the Portland Streetcar, bicycles, pedestrians, and emergency vehicles. The Regional ETRs network may make use of these three resilient Willamette crossings. It is also worth noting development patterns in comprehensive plans to understand the projected transportation demands/flows.

- **Bicycle and pedestrian bridges:** If bollards are removable, and the path is wide enough, crossings typically reserved for bicycles and pedestrians could be used for emergency vehicles.

- **Debris management can impact movement for other modes.** During the first phase of debris clearance impedances are pushed to the side of the right of way before being removed later. This may allow for emergency vehicles to pass, while also creating an impediment for people using wheelchairs, strollers, others with mobility challenges, pedestrians, scooters and bicycles. If forced to use the vehicle lanes, may slow emergency responders.

- **Utilities may also share the right of way with ETRs:** Utilities may need to be accessed on these roads following an earthquake. Utility repair efforts could impede the path of first responders. Moreover, the utilities themselves pose a threat in the form of gas leaks, downed power lines, and broken water mains.

- **Consider the network as a whole, not just specific links:** The relative elevation of roads and bridges should be considered to ensure that connections can actually be made between existing routes. For example, on the current regional ETR map, Naito Parkway appears to intersect with the Burnside Bridge, when in fact, there is no road access between the two.

- **Flat routes, with few major gradients or potential slide areas.**

- **At-grade alternative routing at overpasses and underpasses.**

- **Intrinsic seismic resilience:** When Portland Metro's ETRs were first established in 1996, the Burnside Bridge was originally chosen as the key Willamette River crossing because bascule bridge types were considered less vulnerable and cheaper to seismically retrofit. Single span bridges are considered to be resilient during earthquakes and are more easily replaced if damaged.

- **Wide right of way:** Wide roads that can accommodate oversized support vehicles with wide turning radii are preferable.

- **Limited use of traffic calming devices:** design treatments like speed bumps and traffic calming circles can hinder the movement of emergency response vehicles.

- **ETRs may still be impassible after an event** While ETRs are chosen with the latest information on seismic and landslide risk, in an emergency, they may still fail or be impassable. Authorities must be prepared to designate alternate routes following an earthquake.

- **Automated vehicles:** While emergency response vehicles will likely still require a driver behind the wheel for the foreseeable future, automated emergency response vehicles and semi-trucks carrying recovery supplies are a real possibility in the coming decades. Debris in the right of way, or damaged roads may hamper their ability to operate as designed.

Section VII: Policy and Management Considerations

- **Defined roles and responsibilities prior to an event and for periodic updates to designated routes:** While the current MOU assigns responsibilities for the inspection and debris clearance of ETRs in the immediate aftermath of an event, there is little documentation on which entities should be involved is establishing, managing, and updating ETRs. As regional conveners, Metro is the logical choice to catalog existing Lifelines, local ETRs, and regional ETRs and RDPO and Metro together to facilitate regional ETR mapping updates with input from partner jurisdictions.

- **GIS Data Management and Mapping:** A single recognized dataset that contains all Lifeline Routes, Local ETRs, and Regional ETRs within the region would facilitate the coordination of local routes between jurisdictions, and with the larger system of regional routes, as well as serve as a resource for first responders, inspectors, debris managers and transportation planners. Metro is a logical candidate for managing the ETR dataset within the Regional Land Information System (RLIS) for all local Emergency Response

Streets (ERS), local and regional ETRs, and Statewide Lifeline Routes (defined in Section III). Metro's RLIS is a compilation of more than 100 GIS data layers that serve as the spatial data infrastructure for the Portland metropolitan area. Since the inception of RLIS in the late 1980s, Metro's Data Resource Center staff have worked with regional partners to collect and combine a wide array of data into a seamless dataset for use in region-wide decision-making.

- **Tiered regional ETRs:** While all roads within the regional ETR network are considered vital to disaster response and recovery, inevitably there will have to be a choice made about which segments should be prioritized for retrofitting (if needed) prior to an event, and which should be inspected, cleared, or repaired following an event. "Tier 1" regional ETRs could indicate the routes that absolutely must be passable in the event of a disaster, and should thus be placed at the top of the project list for seismic upgrades, and in disaster response plans. While Tiers 2 and 3 are still vital to recovery, they should be upgraded, repaired, or inspected only after Tier 1 routes are restored or deemed safe for emergency vehicles.

  During the literature review no examples were found to guide best practice on ETR tiering/prioritization. The only useful input is found in the criteria development of state lifeline routes. This region will therefore need to develop criteria for prioritization and/or tiering routes.

- **Set restoration targets and timelines:** Establishing restoration timelines helps set expectations for other agencies, and the users of the ETRs. Additionally, restoration timelines may dictate design or engineering considerations of the roadway itself.

- **Differentiation between response and recovery:** The immediate response to a crisis requires access to different destinations, requires different skills, and has different time horizons than the recovery phase.

  Documented criteria and methodology for selecting and prioritizing ETRs: Sections V and VI describe some considerations for the physical characteristics of roadways used as ETRs, as well as locations that may need to be accessible in the event of an emergency (ie. depending on time of day a school or community center may not need to be opened immediately). However, a system of prioritizing access to these locations is needed. Clearly defined and prioritized criteria will help identify the most important routes and interdependencies.

- **Regular Updates:** While the upcoming regional ETR update is the first since 2006, the current MOU outlines responsibility for the RDPO Emergency Management working group (REMTEC) to coordinate updates on a 5-year cycle. Updates aligned with the RTP update cycle (currently every five years) could help ritualize the process and prevent future lapses. An update cycle for regional ETRs deserves further discussion.

- **Integrate ETRs into Local and Regional Transportation Plans and Capital Improvement Plans:** If resiliency is part of the rubric for project funding, statewide Lifeline Routes, local and regional ETRs should be identified in city and county TSPs and the RTP so that facilities in need of retrofitting can be prioritized for seismic upgrades, and design treatments that adequately accommodate emergency response vehicles can be included. They can also be included in CIPs and in grant criteria.

- **Enhance communication and coordination between relevant stakeholders:** Effective communication and coordination helps build understanding of the importance of these routes and broad support for needed investments.

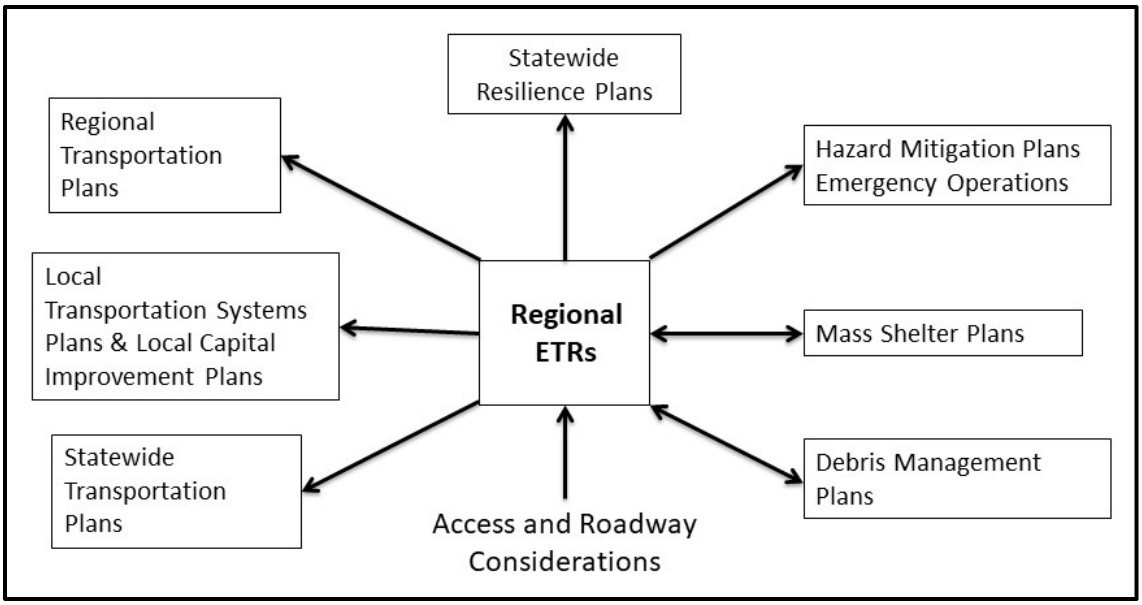
- **Consider all interdependent variables when designating and updating ETRs:** ETR designation is influenced by many factors including (but not limited to) existing infrastructure and its resiliency, the location of crucial assets and emergency services, and the latest science on seismic, landslide, and liquefaction risk. A change to any one of these variables has implications for all of the others.

  As a hypothetical example, new DOGAMI landslide risk data may show that a link previously thought to be resilient will likely be impassable after a large earthquake. In response, a parallel route is identified as a replacement. However, a close-by hospital is not accessible from the parallel route.

  Alternatively, a municipality constructs a new neighborhood fire station and alters their locally designated ETRs to ensure access for emergency responders, which in turn affects how Regional ETRs connect to local ETRs.

  Figure 3 below diagrams some (but certainly not all) of the interactions between the aforementioned variables.

Figure 3. Regional ETR relationship to local, regional and state plans


Statewide Resilience Plans
Regional Transportation Plans
Hazard Mitigation Plans Emergency Operations
Local Transportation Systems Plans & Local Capital Improvement Plans
Regional ETRs
Mass Shelter Plans
Statewide Transportation Plans
Debris Management Plans
Access and Roadway Considerations

Appendix A: Local, Regional and National Planning, Policy and Disaster Management Documents Reviewed

Document	Agency	Date	ETR as defined in Document	Contents pertaining to Emergency Transportation	Folder Location
Federal Documents					
Highway Evacuations in Selected Metropolitan Areas: Assessment of Impediments	U.S. Department of Transportation Federal Highway Administration	April 2010	No formal definition. This document is more focused on evacuating people out of a disaster zone than facilitating movement of emergency responders.	-Assess mass evacuation plans for the country's high-threat, high-density areas (including Portland) and identify and prioritize deficiencies on those routes that could impede evacuations. **-Portland no-notice event Vulnerabilities:** Earthquakes, wildland/urban interface fires, landslides, volcanoes. -None would trigger full scale evacuation, rather most residents would shelter in pace. Some **Top Highway Impediments** include**:** -Bridge Vulnerabilities (2 of 4 highway bridges have been retrofitted, and all sit in liquefiable soil). -157 city-owned overpasses and bridges could fall onto major thruways. **Capacity and Infrastructure Limitations:** Highways operate at capacity during peak periods. Chokepoints would cause problematic congestion during an evacuation.	Federal and National
Statewide Documents					
Seismic Lifelines Evaluation, Vulnerability Synthesis, and Identification CH2M Hill	ODOT / CH2M Hill	May 2012	No definition for ETRs. **3 main goals of Lifeline routes:** -Support survivability and Emergency response efforts immediately	Purpose: Facilitate implementation of Lifeline Routes. IDs specific highways/bridge retrofits key to Lifeline routes. Focused on routes of statewide importance, not local ETRs IDs Lifeline Corridors in Portland area (page 6-9) Establishes 3 tier system for prioritizing retrofits of lifeline segments. Most	Oregon

Document	Agency	Date	ETR as defined in Document	Contents pertaining to Emergency Transportation	Folder Location
prepared for ODOT			following event -Provide transportation to facilities that are critical to life support functions for interim period following event. -Support Statewide economic recovery (Document lists objectives and criteria to support each goal) **Lifeline Route vs Corridor:** Refers to lifeline corridors as such because it is not intended that lifeline routes are used at the exclusion of other alternatives in the same vicinity…."Future seismic vulnerability evaluation and remediation prioritization are likely to ID least cost alternatives for providing a seismically resilient route that include detours off of the ID'd roadway to bypass critical seismic vulnerabilities...Corridor is used to denote ID'd highway, along with easily accessed adjacent roadways as necessary."	critical linkages necessary to serve greatest number of residents at the lowest investment of time and money get top priority.	

Document	Agency	Date	ETR as defined in Document	Contents pertaining to Emergency Transportation	Folder Location
ODOT Seismic Plus	ODOT	October 2014	No Formal Definition of Lifeline route given. Discusess seismic vulnerabilities of highways in more general terms.	-Discusses phased seismic investment in Oregon state highways, in more general terms not just “Lifeline” routes. -Offers cost estimates for retrofitting infrastructure in each phase (Appendix A) -Appendix B discusses hazards at statewide-level and diagrams common vulnerabilities and hazard mitigation techniques (similar to Oregon Resilience Plan). -Refers back to CH2M Hill Seismic Lifelines Evaluation (End Appendix B) and identifies **stakeholders consulted during that process:** -Oregon Seismic Safety Policy Advisory Commission -DOGAMI During Resilient Oregon Plan development, Oregon Ports Association, Department of Aviation, Rail Advisory Committee, Oregon Freight Advisory Committee, Portland State University, and Oregon State University consulted. **-Appendix C: Lifeline Selection Summary Report** is a summary of the Lifeline route selection process found in Oregon Seismic Lifeline Report from CH2M Hill	Oregon
Oregon Resilience Plan Transportation Chapter (Page 105)	Oregon Seismic Safety Policy Advisory Commission	February 2013	No formal definition. Instead, states that resilience **Goal** for transportation network is to first facilitate immediate emergency response, including permitting personnel to access critical areas and allowing the delivery of supplies, and second to restore general mobility within specified time periods for various	-Describes and diagrams some **common vulnerabilities of highway bridges and common slope failure models.** Includes possible mitigation strategies for both. -Breaks down vulnerabilities (in general terms) by state zone): -Willamette -Central Oregon -Tsunami induction zone (per DOGAMI) -Coastal Zone (outside tsunami zone) ...and by Mode: Highway, rail, air, ports, transit	Oregon

Document	Agency	Date	ETR as defined in Document	Contents pertaining to Emergency Transportation	Folder Location
			areas of the state. **Priorities highways into 3 tiers:** **Tier 1:** Small backbone system that allows access to vulnerable regions, major population centers, and areas considered to vital to rescue operations **Tier 2:**. Larger network that provides access to most urban areas and restores major commercial operations. **Tier 3:** More complete transportation network. **Reliance targets established at 3 levels:** **Minimal:** A minimum level of service is restored, primarily for the use of emergency responders, repair crews, and vehicles transporting food and other critical supplies **Functional:** Although service is not yet restored to full capacity, it is sufficient to get the economy moving again--for example, ome truck/freight traffic can be accommodated.	-Chart describing current state of Oregon's transportation systems and the anticipated time to restore service after a CSZ event. Includes targets for relative time needed to restore service if the system were strengthened or retrofitted. **Page 141** -**Makes recommendations by mode (Page 146)**. Mostly calls for further study, but includes relevant points on highways, local roads, and transit: **Highways:** The longer investment in bridge and slope strengthening is delayed, the greater the cost and potential adverse effects of an earthquake will have on the state economy. **Public Transit:** -Plan, collaborate with local and regional emergency planners. -Inventory Assets (rolling stock and facilities) -Assess locations of vulnerable, transit-dependent populations -Assess routes, noting vulnerabilities of both current and alternate routes. -ID alternate routes ahead of event. -Potential tactical hardening or relocation of assets **Local Roads:** One observation made after the recent subduction zone earthquake in Chile: Local road/bridge system survived better than the state system because local roads tended to be straighter and wider, which resulted in larger roadway cuts and fills which make them more susceptible to damage. As a result, many local roads used as detours for damaged state highways/bridges. On the other hand, because many local roads and streets are narrow, with sharp curves, they cannot safely handle high volumes of traffic.	

Document	Agency	Date	ETR as defined in Document	Contents pertaining to Emergency Transportation	Folder Location
			Operational: Restoration is up to 90 % of capacity: A full level of service has been restored and is sufficient to allow people to commute to school and work.		
Washington State Comprehensive Emergency Management Plan	Washington Military Department Emergency Management Division	June 2016	No Definition for ETR/Lifeline Route	Little discussion of emergency routes. Under "Responsibilities" section, the Department of Transportation "Reconstructs, repairs, and maintains the state transportation system including designation of alternate routes in coordination with counties, cities, and ports."	Washington
Washington State Transportation System Plan	WSDOT	2007	No Definition for ETR/Lifeline Route	Under "Safety" subheading: Goal C: Encourage Inter-Agency Collaboration on Emergency Preparedness and Response Recommended Actions: -Accelerate efforts for interagency and cross-jurisdictional disaster responses, such as communications systems that work with each other and **agreed-to strategies and routes** for evacuation of injured persons, and provision of emergency shelter, food, and medical supplies. -Continue to develop plans to facilitate the movement of goods and supplies in the event of a disaster that affects transportation infrastructure. -Recognize and supports transit's role in emergency response efforts, such as evacuating large numbers of people or transporting those with special needs.	Washington
Washington State Highway Plan	WSDOT	2007	No Formal ETR/Lifeline Definition	Emergency Preparedness (P.36): "For immediate response purposes, the **designation of alternate routes and the development of evacuation plans** are important issues. For long-term planning, any **substandard structures on evacuation routes**	Washington

Document	Agency	Date	ETR as defined in Document	Contents pertaining to Emergency Transportation	Folder Location
				should be identified and targeted for improvements. Mitigation measures defined through the vulnerability assessment process should also be implemented to protect critical infrastructure across the highway system." Seismic Retrofits Needs (P. 19): The seismic program **priorizes bridge projects based on essential lifelines** that need to remain in service following a seismic event, and where the bridges are located in the seismic risk zones. All bridges within the highest risk zone and those on interstates in the moderate risk zone will have a higher priority and will be retrofitted first. Those bridges with single columns located in the low-moderate range will also be retrofitted after the higher risk areas have been completed."	
Regional Documents					
Memoranda of Understanding (MOU) Resolution 03-3352	-ODOT -WSDOT -PBOT -Metro DRC -REMTEC -Clark County -Tri-Met -Port of Portland -Clackamas County -Columbia County -Multnomah County -Washington County -State EOC/ECC	Adopted October 2003	"Road authorities and other local officials in the Portland metropolitan area have identified those **roadways in the region that they consider critical to the movement of response resources** and designated them as Emergency Transportation Routes (ETRs)"	The MOU describes after-event procedures such as the chain of reporting and jurisdictional responsibility for each road and bridge segment of the ETR network. It also specifies basic assessment procedures, establishes standards on the reporting of route status, and designates the Richter scale magnitude earthquakes for which different response levels are activated.	Metro and other Regional Partners -> Agreements
Metro Regional Transportation Plan 2018	Metro	December 2018	"priority routes targeted during an emergency for debris-clearance and transportation corridors to	**Ch 8:** **(8.2.3.10 - page 8.32 - 8.35)** Describes (this) process of updating the Emergency Transportation Routes.	Metro and other Regional Partners -> 2018 RTP - Relevant

Document	Agency	Date	ETR as defined in Document	Contents pertaining to Emergency Transportation	Folder Location
			facilitate life-saving and sustaining response activities." -Section 8.2.3.10	Includes a map of current ETRs as designated in 2006. **Expected Outcomes:** -ID Criteria by which to evaluate and refine existing ETRs and any alternates that are considered in this work. ODOT considered seismic resiliency in establishment of their **lifeline routes** to which the ETRs **must connect** -Recommendations for new MOU. Define reasonable time frame for periodic updates. -Recommendations on updated ETRs for consideration by JPACT and the MEtro Council in the next update to the next RTP and other relevant regional plans, policies and strategies. -Recommendations for future planning work related to regional transportation recovery, resiliency, and emergency mgmt. **Ch 2:** **Objective 5.3 - Preparedness and Resiliency:** Reduce the vulnerability of regional transportation infrastructure to natural disasters, climate change and hazardous incidents Falls under **Goal 5 - Safety and Security** **Ch 3: System Policies to achieve our vision:** **Sub-section 3.2.3 Climate Leadership Policies → Sub-heading 3.2.3.5 Transportation Preparedness and resilience:** Discuss need to respond to natural disasters quickly, collaboratively, and equitably, in order to be able to transport fuel, essential supplies, and medical transport. Discusses need for transportation system that is resilient in event of extreme weather events, flooding, and fires, not just earthquakes.	Chapters

Document	Agency	Date	ETR as defined in Document	Contents pertaining to Emergency Transportation	Folder Location
				Lists potential opportunities for future regional collaboration in support of transportation preparedness and resilience:	
Memo from Multnomah County Willamette River Bridges Capital Improvement Project	Multnomah County	March 2014	No Definition	Discusses how Burnside Street and Bridge were selected by ODOT as a **Lifeline** route. -Mentions that it was made part of the regional ETRs in March 1996. **Metro and ODOT team** selected Burnside bridge because of **Intrinsic seismic resiliency** (bascule bridge type considered less vulnerable / cheaper to seismically retrofit) **- Streets with least amount of seismic vulnerabilities. (**Less bridges, less failure points than adjacent routes) **Belief that only one route over Willamette required** because emergency services available on both sides of river.	Metro and other Regional Partners
Regional Emergency Transportation Routes: Report of the Metro Regional Emergency Routes Task Force	Metro Regional Emergency Transportation Routes Task Force	March 1996	"A Primary Emergency Transportation Route is a route use after a major regional disaster to move emergency resources such as personnel, supplies, and equipment to designated staging areas and subsequent deployment to heavily damaged areas."	-Includes a short "recommendations" section. **-Describes initial efforts and the conceptual framework for ETRs:** -Major arterials may be blocked because of downed wires or collapsed water/sewer mains. -Response phase lasts a short time. The task force focused on primary ETRs for use during the initial response period (first 72 hours after an event) -Most victims are not transported by ambulance to a hospital. Injured people will generally find medical care, and a primary medical concern is getting patients distributed from overloaded or out-of-action medical centers to underutilized ones. Includes need to move patients out of the impacted area to less affected areas. -Airport's facilities or traffic control systems may be damaged. Alternatives for airlift should be factored into emergency transportation corridor selection.. **-Includes Primary Route Selection Criteria:** 1. State routes servicing metro area considered primary because of high	Metro and Other Regional Partners

Document	Agency	Date	ETR as defined in Document	Contents pertaining to Emergency Transportation	Folder Location
				capacity and ability to handle oversized vehicles. Local emergency corridors often accessible via state route only. 2. Relatively flat with few gradients or potential slide areas. 3. Serve major population center 4. Routes should offer at-grade level alternative routing at overpasses and underpasses. -Includes map of ETRs as established in 1996. **-Describes Steps for Implementing ETRs:** 1. Regional emergency transportation plan in relation to ETR designation. 2. Method for testing plan through ETR exercise. 3. Plan describing operating procedures/responsibility assignment. 4. Establish MOU between participating jurisdictions 5. Standardized maps for response, recovery, mitigation activities. -Task force calls for permanent committee to develop standard operating procedures -Includes example MOU from Los Angeles County.	
RIPE Report (Report from multi-agency disaster preparedness exercise)	BES, BDS, BIBS, BPS, CBO, OMF, PBEM, PBOT, PF&R, PP&R, PWB -Bureau of Revenue and Financial Services,	June 2018	No Formal Definition	-Failure of other assets (natural gas, water mains, etc.) could compromise important roads and bridges -Many assets ID'd as critical by BES, Parks and Water likely inaccessible. -Transportation's top priority: Clean/repair **ETRs** to meet needs of emergency responders/hospitals. However, many of those **ETRs** are not near critical assets that other infrastructure bureaus will need immediate access to (drinking water/sewage). -Many **ETRs** intersect water, sewer, storm pipes, which, if broken, would result	Metro and Other Regional Partners

Document	Agency	Date	ETR as defined in Document	Contents pertaining to Emergency Transportation	Folder Location
	-Bureau of Technology Services, -Office of Mayor Ted Wheeler, -Multnomah County Bridges			in washed out ETRs and sinkholes.	
Local Documents					
Designing a Methodology for Portland's Emergency Transportation Routes	PBOT	August 2018	**Emergency Response Routes** are focused on the ***response*** phase of a disaster – the days and possibly weeks after an event. They include restrictions on the treatments that can applied to the street and are designated as routes for emergency responders such as fire, ambulance, and police services. -"comes from Portland's TSP. These are the roads utilized by emergency responders for access around the city." **Emergency Transportation Routes** are regionally-defined, updated on an ad hoc basis, and are used to prioritize major thoroughfare traffic after a	Report that proposes what redesigned ETRs could look like/makes suggestions for considerations/methodology for updating ETRs. -Suggested routes designed to augment, not replace, current ETRs -Sought input from various Portland agencies. -Concern about Kerby Facility given its vulnerability to nearby infrastructure collapse, liquefaction, and East Bank Fault. Suggested distributing resources to maintenance sites on both sides of Willamette. -Adding resilience as qualifying attribute for TSP projects, or a separate program specifically for addressing most pressing resilience needs in transportation infrastructure. -In several cases, ETRs overlap but are not actually connected: for example, West Burnside and Southwest Naito Parkway appear to connect, but are actually at separate elevations. In these cases, minor routes are proposed to eliminate the gaps and provide connectivity between two major routes. -Worth considering obligation to maintain each additional lane mile of ETR and repair after a seismic event.	Local -> Portland

Document	Agency	Date	ETR as defined in Document	Contents pertaining to Emergency Transportation	Folder Location
			disaster or significant disruption to transportation services. ETRs are focused on the ***recovery*** phase – the weeks and months after an event. -part of an intergovernmental agreement signed in 2006 by municipal governments within the Portland region. These routes provide prioritization for which roads are repaired first after a disaster.		
Multnomah County Multi-Jurisdictional Hazard Mitigation Plan	Multnomah County Emergency Management	July 2017	Seismic Lifeline: State highways identified as most able to serve response and rescue operations, reaching the most people and best supporting economic recovery. No ETR Definition	**-IDs and Maps critical facilities (2.7) in 3 categories** **Emergency:** Fire, Ambulance, Hospitals, Licensed Medical Facilities, Urgent Care, Law Enforcement **Administrative:** Airports, City Halls, Community Centers, County Assets, Libraries **Special Population:** Childcare Facilities, Homeless Shelters, Jails, Residential Care Facilities, Schools. -Table IDs key transportation system elements (Section 2.5.1) -References Bridge Capital Improvement Program (2.5.2) -References 2012 ODOT Seismic Lifeline Report and Oregon Resilience Plan. -Six-mile stretch along Willamette in Portland's NW Industrial area identified as	Local -> Multnomah County

Document	Agency	Date	ETR as defined in Document	Contents pertaining to Emergency Transportation	Folder Location
				"Critical Energy Infrastructure (CEI) Hub" contains the majority of Oregon's energy infrastructure for petroleum, natural gas, liquefied natural gas, and electricity. There is significant liquefaction and seismic risk within the CEI Hub. (Section 3.1).	
Gresham TSP	City of Gresham Transportation	?	No Definition	Little mention of emergency preparedness. The city's emergency preparedness page links to the Multnomah County Multi-Jurisdictional Hazard Mitigation Page.	Left out of folder (no discussion of ETRs)
Clackamas County TSP	Clackamas County Transportation	December 2013	No Definition	Essentially no discussion of the transportation system's role in emergency response. **Section 5.A. Compliance and Coordination Policies** "Work with the Oregon Office of Emergency MGMT to ensure that the TSP supports effective responses to natural and human-caused disasters and emergencies and other incidents, and access during these incidents."	Left out of folder (no discussion of ETRs)
Beaverton TSP	City of Beaverton	Septembe r 2010	No Definition	Only discussion of emergency response: "Ensure that adequate access for emergency services vehicles is provided throughout the city: Actions: -Work cooperatively with Tualatin Valley Fire and Rescue and other Washington County emergency service providers to designate and periodically update Primary and Secondary **Emergency Response Routes.** Continue to work with these agencies to establish acceptable traffic calming strategies for these routes. -Recognize the route designations and associated acceptable traffic calming strategies in the City's Traffic Calming Program.	Left out of folder (no discussion of ETRs)
Washington County TSP	Washington County	Nov. 2018	No Definition	Mentions of providing emergency access to responders.	Left out of folder (no discussion of ETRs)
Tualatin TSP	City of Tualatin	Updated February	No Definition	None	Left out of folder (no discussion of

Document	Agency	Date	ETR as defined in Document	Contents pertaining to Emergency Transportation	Folder Location
		2014			ETRs)
Portland TSP	PBOT	2018	**"Emergency Response *Streets*** are intended to provide a network of streets to facilitate prompt emergency response." (P 99 - street classification descriptions). Classifies emergency response streets into Major, Secondary, and Minor Response streets. Describes appropriate design treatments (in general terms) for each class of emergency response street (Balance of emergency vehicle mobility vs. traffic calming)	**Modal Policy:** **"Emergency Response:** Maintain a network of accessible **emergency response streets** to facilitate safe and expedient emergency response and evacuation. Ensure that police, fire, ambulance, and other emergency providers can reach their destinations in a timely fashion, without negatively impacting traffic calming and other measures intended to reduce crashes and improve safety." (P. 24)	
Post-Earthquake Bridge Inspection Response Plan	PBOT	2015	No Definition of Emergency Transportation Route or Lifeline Route. The prioritization tiers differentiate between Lifeline routes and Emergency Response Routes. However, it is unclear if ERRs and ETRs have been conflated with the term 'Emergency Response Streets" used in Portland's TSP. The introduction says "this plan is intended to be in compliance with the MOU	-Determines the inspection response by PBOT bridge personnel for a given earthquake magnitude, and prioritizes structures into 3 groups: **Priority 1 (High):** -Bridges based on Seismic Lifeline Route -Bridges on Emergency Response Routes (ERRs) classified as more vulnerable, vulnerable or less vulnerable. -Other bridges over I-84 not included above. **Priority 2 (Medium):** -Pedestrian bridges over ERRs or Seismic Lifeline Routes classified as more vulnerable and vulnerable.	Local -> Portland

Document	Agency	Date	ETR as defined in Document	Contents pertaining to Emergency Transportation	Folder Location
			Emergency Transportation Route, Post-Earthquake Damage Assessment and Coordination (No. 21,273) and with the City of Portland Ordinance No. 180656."	-Bridges on ERRs classified as less vulnerable and resilient. -Bridges on Freight Routes (all classifications) -Bridges on Transit Routes (all classifications) **Priority 3 (Lowest):** -All other bridges -Includes several maps with priority 1, 2, and 3 bridge locations, as well as routes inspectors should follow. -Include procedures and forms for the inspections.	
Basic Emergency Operations Plan 2016	Portland Bureau of Emergency Management	2016	No Definition	-Discuses ETRs only as they pertain to PBOT (damage assessment, debris clearance) under "Responsibilities" section. PPB/PF&R tasked with "coordinating with PBOT and ECC (if activated) to define immediate routes and destinations for evacuees," and to "direct and control traffic, secure and prevent unauthorized access to damaged or impassable roadways. -Discusses the vulnerabilities of transportation and other critical infrastructure in general terms. -Maps Critical Facilities by *Emergency Services:* (Emergency Coordination Centers, Medical Care Facilities, Police/Fire Stations). *High Potential Loss Facilities:* (Dams, Military, Nuclear Power Plants, Hazards Materials, Schools, *Other Assets:* [zoo, jaul, nursing/assisted living facilities])	Local -> Portland
Portland Mitigation Action Plan	Portland Bureau of Emergency Management	2016	No Definition	Minimal discussion of ETRs. Comments from Portlanders in the public engagement section(3.7): -Prioritize clearing bike paths so that non-automobile traffic can flow safely and develop plans to locate aid stations along these routes.	Local -> Portland

Document	Agency	Date	ETR as defined in Document	Contents pertaining to Emergency Transportation	Folder Location
				-Prioritize road access to grocery stores, medical offices, and hospitals. Consider isolated communities in establishing road-clearing priorities. -Pre-Established detour routes for access in and out of known landslide risk areas. -Culture and language-appropriate webpage for new Portlanders to access emergency information, videos, and events in their preferred language.	
Multnomah County Disaster Debris Management Plan	Multnomah County Department of Community Services & Emergency Management	September 2016	No Definition	Priority roads are divided into Emergency Transportation Routes and secondary Emergency Transportation Routes for east Multnomah County. A list of all priority roads for clearance can be found in in Attachment A: Emergency Transportation Routes.	Local->Multnomah County
Clackamas County Lifeline Seismic Bridge Priority Detour Recommendations	Clackamas County Disaster Management	November 2018	No Formal Definition	**Objective:** -'Re-evaluate county's **ETRs** by taking into consideration and establishing connections from critical facilities and the County's populated areas to the ODOT's **lifeline routes**. Prioritize the findings for seismic bridge retrofit or replacement, considering unstable slopes, landslides and other data available to inform decisions.' -'Review ODOT's lifeline routes and locations of vulnerable or potentially vulnerable bridges. Identify alternative routes on local roads that may be more cost effective to seismically retrofit or replace local bridges, considering unstable slopes and landslides as information is available' -ETR criteria expressed only in general terms -'Capitalize on current efforts and data to update and prioritize the County's ETRs.' -References Oregon Resilience plan's recommendations for retrofitting Lifeline routes. -Single-span bridges not considered because they are expected to perform well during an earthquake, and If damaged, they are more easily repaired. -Discusses outreach process.	Local -> Clackamas County

Document	Agency	Date	ETR as defined in Document	Contents pertaining to Emergency Transportation	Folder Location
				- Provides detour recommendations to ODOT Lifelines -Prioritizes and gives cost estimate to bridge retrofits on ETRs -Maps state and county bridge vulnerabilities as well as landslide risk around the routes	
Clackamas County Emergency Operations Plan - Transportation Annex	Clackamas County	2017	No Formals Definition	Discuss how transportation infrastructure may be damaged and that there are ETRs in place.	Local -> Clackamas County
ODOT/Multnomah County Triage Project Kick Off Meeting PowerPoint	Multnomah Department of Community Services - Transportation Division	2019	No Formal Definition	**Project Objectives:** *Review existing ETRs:* •Re-evaluate the county's Emergency Transportation Routes (ETR) by taking into consideration connections from critical facilities and populated areas to the ODOT's lifeline routes. •Prioritize the findings for seismic bridge retrofit or replacement, considering unstable slopes, landslides and other data available to inform decisions. *Identify Detour Routes:* •Review ODOT's lifeline routes and locations of vulnerable or potentially vulnerable bridges. •Identify alternative routes on local roads that may be more cost effective to seismically retrofit or replace local bridges, considering unstable slopes and landslides as information is available.	
City of Portland's Evacuation Plan: Attachment 1 - Transportation	Portland Office of Emergency Management (Prepared by CH2M Hill)	December 2008	**Emergency Transportation Routes** are intended for primary inspection and also used by emergency vehicles after an earthquake. They	-Modified travel demand model used to determine if evacuation routes could handle. -Divides city into 5 analysis zones. -During an evacuation all zones would experience congestion greater than typical PM peak. However, some arterials identified as evacuation routes may	Local - > Portland

Document	Agency	Date	ETR as defined in Document	Contents pertaining to Emergency Transportation	Folder Location
Technical Memorandum			generally share the same roadways as the evacuation routes. City has ID'd primary and secondary **Evacuation Routes.** Primary routes generally follow major roadways and would typically evacuated before secondary routes.	still have excess capacity. -Maps evacuations routes, which usually share roads with ETRs. -Maps projected congestion on evacuation routes during an evacuation event. -Maps proposed revisions to evacuation routes	

Appendix B: City, county, and state planners and emergency transportation personnel consulted

Name	Agency	Position	Contact
Jake Davis	Portland State University / PBOT	Master of Urban Planning Student / Intern	Jake.Davis@portlandoregon.gov
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Anthony Vendetti	Clark Regional Emergency Services Agency	Emergency Management Coordinator	anthony.vendetti@clark.wa.gov
Megan Neill	Multnomah County	Engineering Services Coordinator	megan.neill@multco.us
Mike Andrews	North Shore Emergency Management (British Columbia)	Deputy Director	mandrews@nsem.info

Appendix C: Pertinent Planning and Disaster Management Documents from Other Regions

Document	Agency	Date	ETR as defined in Document	Contents pertaining to Emergency Transportation	Folder Location
City of Seattle Comprehensive Emergency Management Plan Emergency Support Function #1 - Transportation CEMP - Annex IV Documentation	Office of Emergency Management	August 2018	The City's interdependent **lifeline** systems include transportation, power, water, sewer, natural gas, liquid fuel, telephone services, fiber-optic networks, cellular services, and cable services. This complex system of infrastructure is comprised of a mix of public and private sector assets and resources.	Identifies emergency support functions of Seattle Department of Transportation. Some include: -Update SDOT Snow and Ice Readiness Plan annually. -Designate snow and ice routes by service levels. -Coordinate with Metro transit to align snow and ice routes with us routes where possible. -Develop and maintain procedures to assign a liaison from Metro Transit and SPD to the Operations Center -Oversee damage assessments of city roadway and bridge structures. (Includes other post-event duties)	Other States and MPOs
CALTRANS Transit Emergency Planning Guidance	California Department of Transportation - Division of Mass Transportation	July 2007	None	"Plans should be established for alternative facilities, equipment, personnel, and other resources necessary to maintaining service during crisis, or resume service as quickly as possible following disaster. Typically, organizations will ID and pre-contract for alternate facilities in the event of catastrophic infrastructure loss. Facilities should meet accessibility standards to ensure an employee or contractor with a disability can effectively perform their duties."	Other States and MPOs
British Columbia Disaster Response Primer	Government of British Columbia	June 2018	**Critical Routes:** Regional and provincial routes vital to the functioning of the transportation network in the impact area and movement of emergency resources cross-jurisdictionally at the regional	-Establishes common understanding of disaster response transportation strategies and terminology. -"While critical routes are chosen with the latest intelligence regarding resiliency, the possibility still exists of actual routes post-disaster deviating from pre-designated critical routes dues to the unpredictable nature of disasters"	Other States and MPOs

			level. Also essential for movement of emergency resources at the local level. Critical Routes are to be established before an event. **Disaster Response Routes (DRRS)** are used to expedite movement for official purposes to achieve emergency response or recovery objectives. DRRs are not designated pre-event. They are determined at the time of the event based on the needs of response and recovery and available options. **DRRs may or may not coincide with Critical Routes.** DRRs are coordinated regionally and/or provincially. **Short term DRRs** consist of coordinated convoys for emergency personnel and resources. When short term DRRs are utilized, police officer escort will be used to move the convoy. **Medium term DRRs** are established during a local and/or provincial state of emergency when the power to control or prohibit travel to or from any area of BC is in effect. For road transportation, *the general public will be restricted from DRRs with the use of traffic*	**Transportation Node:** any designated location within a transportation route or network where resources, personnel or vehicles (and/or vessels, aircraft, etc) can enter or change route. Potential transportation nodes should be identified in the preparedness phase. **Transportation Node Types:** *Staging Areas:* Movement control points where resources are received, prioritized and organized prior to deployment (provincial, regional, local). *Community points of distribution:* Locations where emergency supplies are disseminated to the public following a disaster. *Transfer Points:* Locations or facilities where the transfer of resources and/or personnel can occur between one mode of transport to another. -Discusses strategies for recovery, steps for DRR activation, who gets transportation priority, and with what sort of identification.	

			control devices and mechanisms. DRRs may utilize both directions of travel, or specific lanes of travel. **Long term DRRs** may be required after the state of emergency has expired. Would require municipal/statewide resolution restricting use of roadway. The General public would be excluded.		
British Columbia Disaster Response Transportation Planning Guide for Road Transportation	Government of British Columbia	June 2018	See British Columbia Disaster Response Primer Above	-Provides guidance on selecting **Critical Routes, Disaster Response Routes, Staging Areas,** and **signage.** -Also includes guidance on changing pre-established critical routes.	Other States and MPOs
Lifelines: Lessons from Natural Hazards in Canterbury (New Zealand)	Centre for Advanced Engineering	December 2012	No Formal Definition	-Need for coordinated approach when reinstating utilities as roads often form the top layer. -Establish relationships with helicopter services. Useful for determining status of transportation links if cell/radio network lost. Useful for moving people and supplies until link is repaired. **3 Aspects of Infrastructure Resilience:** -Robust physical assets with key network routes and facilities having appropriate redundancy. -Effective coordination arrangements (pre and post-event). -Realistic end-user expectations and appropriate measures of back-up arrangements.	Other States and MPOs
Post Hurricane Sandy Transportation	Federal Highway Administration	October 2017	No Formal Definition	Some damage done from storm not detected for months after the storm.	Federal and National

Resilience Study in New York, New Jersey, and Connecticut				**Barriers to effective adaptation of transportation resiliency measures:** -Cross-agency coordination and jurisdictional issues can create delays and obstacles. -Legal and regulatory hurdles can hinder adaptation responses. (ROW acquisition, lawsuits from impacted landowners, environmental and community impact studies). -Limited sources of funding for transportation adaptation projects, and those that do exist are highly competitive, or can be only accessed after a disaster. Proactive adaptation needs to be folded into projects in the development pipeline, or there needs to be a strong case to implement standalone projects.	
Best Practices: Emergency Access in Healthy Streets	Ryan Snyder Associates and County of Los Angeles Public Health	March 2013	No Definition	Discusses street design considerations to accommodate emergency vehicles	Other States and MPOs

Appendix D: Non-pertinent planning and emergency documents from other jurisdictions that were reviewed

Document	Agency	Date Published
State of California Emergency Plan	State of California	October 2017
City and County of San Francisco Emergency Response Plan	San Francisco Department of Emergency Management	May 2017
MTC Regional Transportation Emergency Security Planning Report	San Francisco Bay Area Metropolitan Planning Organization	December 2008
Bay Area Earthquake Plan	California Governor's Office of Emergency Services / FEMA Region IX	July 2016
Move Seattle	Seattle Department of Transportation	Spring 2015
Vancouver Transportation 2040	City of Vancouver Streets and Transportation	
Catastrophic Hurricane Evacuation Plan Evaluation: A Report to Congress	U.S. Department of Transportation and U.S. Department of Homeland Security	2006
New Jersey Transportation System Plan	New Jersey Department of Transportation	2008
New Jersey Transit Corporation Comprehensive Emergency Management Plan	New Jersey Transit Corporation	2010
Plan 2045 Connecting North Jersey	North Jersey Transportation Planning Authority	2017

Appendix E: Details on Lifeline Goals, Objectives, Criteria, and Tiers

Section III describes how Statewide Lifeline Routes have three main goals, which capture needs during three distinct periods following a seismic event: short, medium, and long-term response and recovery. Within each goal is a series of specific actionable objectives to achieve each goal, and a series of criteria to evaluate how well each Lifeline segment can achieve the related objectives and goals. These goals, objectives and actions are as follows:

Goal 1 (Short-term): Support survivability and emergency response efforts immediately following the event.

Objective 1A: Retain routes necessary to bring emergency responders to the emergency location.

Criteria:

- Bridge and roadway seismic resilience
- Critical non-redundant access to a major area
- Access to fire stations and hospitals
- Access to ODOT maintenance facilities
- Ability to control access during response and recovery
- Dam safety
- Roadway width
- Access to ports and airports
- Access to population centers

Objective 1B: Retain routes necessary to transport injured people from the damaged area to hospitals and other care facilities.

Objective 1C: Retain routes necessary to transport emergency response personnel, equipment and materials to damaged area.

Criteria:

- Bridge and roadway seismic resilience
- Critical non-redundant access to a major area
- Access to emergency response staging areas
- Dam safety
- Roadway width
- Freight access
- Access to hospitals

Goal 2 (Medium-term): Provide transportation facilities that are critical to life support functions for an interim period following the event.

Objective 2A: Retain routes critical to bring life support resources (food, water, sanitation, communications, energy, and personnel) to the emergency location.

Criteria:

- Bridge seismic resilience *after* short-term repair
- Access to ODOT maintenance facilities
- Access to fire stations and hospitals
- Access to critical utility components (fuel depots and communication facilities)
- Dam safety
- Freight access
- Access to ports and airports
- Roadway seismic resilience

Objective 2B: Retain regional routes to hospitals.

Criteria:

- Access to hospitals

Objective 2C: Retain evacuation routes out of the affected region.

Criteria:

- Access to central Oregon.
- Importance of route to freight movement
- Access to ports and airports

Goal 3 (Long-term): Support statewide economic recovery.

Objective 3A: Retain designated critical freight corridors.

Criteria:

- Critical non-redundant access to major area
- Bridge and roadway seismic resilience *after* short-term repair
- Access to ports, airports, and railroads
- Freight access

Objective 3B: Support statewide mobility for connections outside of the affected region.

Criteria:

- Access to central Oregon.
- Access to ports, airports, and railroads

Objective 3C: Retain transportation facilities that allow travel between large metro areas.

Criteria:

- Critical non-redundant access to major area
- Connection to centers of commerce

Tiers:

A cost-benefit analysis based on these criteria is used to categorize Lifeline Routes into a 3-tiered system for prioritizing seismic retrofits. Critical linkages necessary to serve the greatest number of residents at the lowest investment of time and money are given top priority. The 3 tiers of Lifeline Routes are:

Tier 1: A small backbone system that allows access to vulnerable regions, major population centers, and areas are considered to be vital to rescue operations while minimizing retrofit costs. Other characteristics of a Tier 1 network include:

- A contiguous network (no isolated Tier 1 segments).
- Penetration to each geographic region.
- Redundant Willamette River crossings in Portland.
- Access to the eastern (less seismically vulnerable) part of the state.

Tier 2: A larger network that provides access to most urban areas and restores major commercial operations. Tier 2 routes add additional redundancy to allow for increased traffic volumes and alternate routes in high-population areas.

Tier 3: A more complete transportation network.

APPENDIX D
Chapter 6 - 2012 ODOT Seismic Lifeline Vulnerability Synthesis and Identification Report

6.0 Seismic Lifeline Routes

6.1 Overview and Definitions of the Tiers

Given the existing vulnerabilities of our built environment in Oregon, the many seismic hazards in the natural environment, and the geographic spread of the population, it is quite likely that nearly every roadway in the western half of the state would be needed to serve as a lifeline following a major CSZ event. As the years go by and the effects of age and use require the rehabilitation or replacement of our existing transportation infrastructure, the system will become more seismically resilient as those rehabilitations and replacements are accomplished according to design standards that take into account these recently identified seismic hazards. However, if a CSZ Mw 9.0 were to occur today, it is possible that nearly every state highway in Western Oregon would be impassible, possibly severely limiting ground transportation for many months. A program to immediately (within the next few years) retrofit all seismic lifeline routes in western Oregon to current design standards is likely beyond our means as a society to accomplish. Even if the State were to embark on a program of rapid seismic strengthening of the entire transportation system, it would be prudent to begin where the most benefit is accomplished in the least time for the least cost.

After a catastrophic earthquake, it is anticipated that ground transportation will be supplemented by air and water transport as necessary to address the most-critical needs. Air and water transportation services are much more limited in capacity and availability than ground transportation; consequently, the shorter the distance from a functioning ground transportation system to the area of need, and the fewer numbers of people in need, the more likely it is that the available air and water transportation vehicles and infrastructure will be able to meet all needs.

A prioritized seismic lifeline system should attempt to provide the following three functions:

1. First and foremost, it should provide access to and through the state, allowing access to the seismically vulnerable areas of the state (study area) for emergency responders and economic recovery.
2. Secondly, it should attempt to provide access into each region of the state.
3. Lastly, it should serve as a transportation network that provides redundant access throughout the state.

The PMT used the results of the evaluation framework and a review of system connectivity and key geographic features to identify a three-tiered seismic lifeline system—Tier 1 being the highest priority roadway segment, Tier 2 being the next highest, and Tier 3 being the third highest priority grouping. It is intended that seismically resilient infrastructure along each lifeline route tier would accomplish the three goals listed above and would consist of the following:

- Tier 1: A system that provides access to and through the study area from Central Oregon, Washington, and California, and provides access to each region within the study area
- Tier 2: Additional roadway segments that extend the reach of the Tier 1 system throughout seismically vulnerable areas of the state and that provide lifeline route redundancy in the Portland Metro Area and Willamette Valley
- Tier 3: Roadway segments that, together with Tier 1 and Tier 2, provide an interconnected network (with redundant paths) to serve all of the study area

The purpose of having three tiers of lifeline routes is to establish guidelines for prioritizing seismic retrofits of highways and bridges with the highest priority roadways being those that provide the most critical linkages necessary to serve the greatest number of residents in the study area, at the lowest investment of time and money. Ideally, as discussed previously, vulnerabilities along all three tiers of lifeline routes (as well as the remainder of public transportation facilities statewide) should be addressed. Recognizing potential cost restrictions, use of this tiered system is intended to provide the State of Oregon with guidance for identifying project priorities. It should be noted that this lifeline system is intended to serve statewide transportation needs, not to directly access all locations in the state. Planning for the needs of individuals and local communities is the responsibility of statewide, regional, and local agencies, whose core mission is emergency planning and response. As local response and recovery plans are developed, it is recommended that local earthquake preparation efforts include recognition of the state lifeline routes and could include evaluation of local roadways with a methodology similar to that used here.

The following sections define each tier and describe the recommended tier system within six geographic areas.

6.1.1 Tier 1

The routes identified as Tier 1 are considered the most significant and necessary to provide a functioning statewide transportation system. A functioning Tier 1 lifeline system will allow traffic to flow through the study area and to each region. Required characteristics of the Tier 1 system are as follows:

- Contiguous (all segments connected, with no isolated segments or groups of segments) connection to each geographic region of the study area with access to the most populous areas in those regions
- Access to the most-critical utilities required for statewide response and recovery (in particular fuel depots)
- Access from the east to the most-seismically vulnerable regions of the state
- Redundant crossings of the Willamette River in Portland
- Minimization of cost of retrofit and/or repair (fewest number of routes with least vulnerabilities that provide characteristics in the preceding bullets)

6.1.2 Tier 2

The Tier 2 lifeline routes provide additional connectivity and redundancy to the Tier 1 lifeline system. The Tier 2 system would allow for direct access to more locations, fewer miles to travel between some locations, increased traffic volume capacity, and alternate routes in high-population regions in the event of outages on the Tier 1 system. Requirements for this tier include the following:

- Contiguous (all segments connected, with no isolated segments or groups of segments)
- Redundant routes to provide circulation within the Portland Metro Geographic Zone and north-south movement within the Willamette Valley
- Minimization of cost of retrofit and/or repair (fewest number of routes with least vulnerabilities that provide characteristics in the preceding bullets)

6.1.3 Tier 3

The Tier 3 lifeline routes provide additional connectivity and redundancy to the lifeline systems provided by Tiers 1 and 2.

Together, the Tiers 1, 2, and 3 lifelines will comprise the Oregon Seismic Lifeline System and will accomplish the following:

- Include all of US 101 to provide access to all of the Oregon coast (the most-seismically vulnerable regions of the state)
- Include routes that have been identified as providing access to the most-critical utilities (the final seismic lifeline system includes all segments identified as providing access to critical utilities, except those providing access to power generation facilities on the Santiam and McKenzie rivers).
- Include all routes that have been identified as providing access to emergency response staging areas
- Include all routes that have been designated as strategic freight corridors or freight facilities
- Provide alternate routes between any two nodes that connect two or more segments (any node that is not a dead end)
- Minimize cost of retrofit and/or repair (fewest number of routes with least vulnerabilities that provide characteristics in the preceding bullets)

6.1.4 Study Routes Not Identified as Seismic Lifeline Routes

Several routes included in the study, as listed in Section 2.1, have not been identified as seismic lifeline routes on the statewide Seismic Lifeline Route System. Although these routes may be important for local circulation during a seismic event, they are not likely to function as key corridors on a statewide level. Several of these routes have more-significant and extensive vulnerabilities than do adjacent routes that can serve the same purpose in a statewide system. All of these routes are less favorable than routes included in the Seismic Lifeline Route System with respect to a variety of evaluation framework criteria.

6.2 Proposed Oregon Seismic Lifeline Routes

6.2.1 Seismic Lifeline Tier Designations

Figure 6-1 shows the proposed seismic lifeline routes with tier designations.

The proposed Tier 1 lifeline network shown provides roadway access to within about 50 air miles of all locations in western Oregon. Significant factors in the designation of each study route are discussed as follows by geographic zone. Total roadway miles for each tier are as follows:

- Tier 1: 1,146 miles
- Tier 2: 705 miles
- Tier 3: 422 miles

This provides a total of 2,273 miles of designated lifeline route. Study routes not identified as a seismic lifeline total 298 miles.

Figure 6-2 presents an overlay of the lifeline system on the peak ground acceleration coefficients used for the evaluation of bridge resilience in this study.

FIGURE 6-1
Oregon Seismic Lifeline Routes

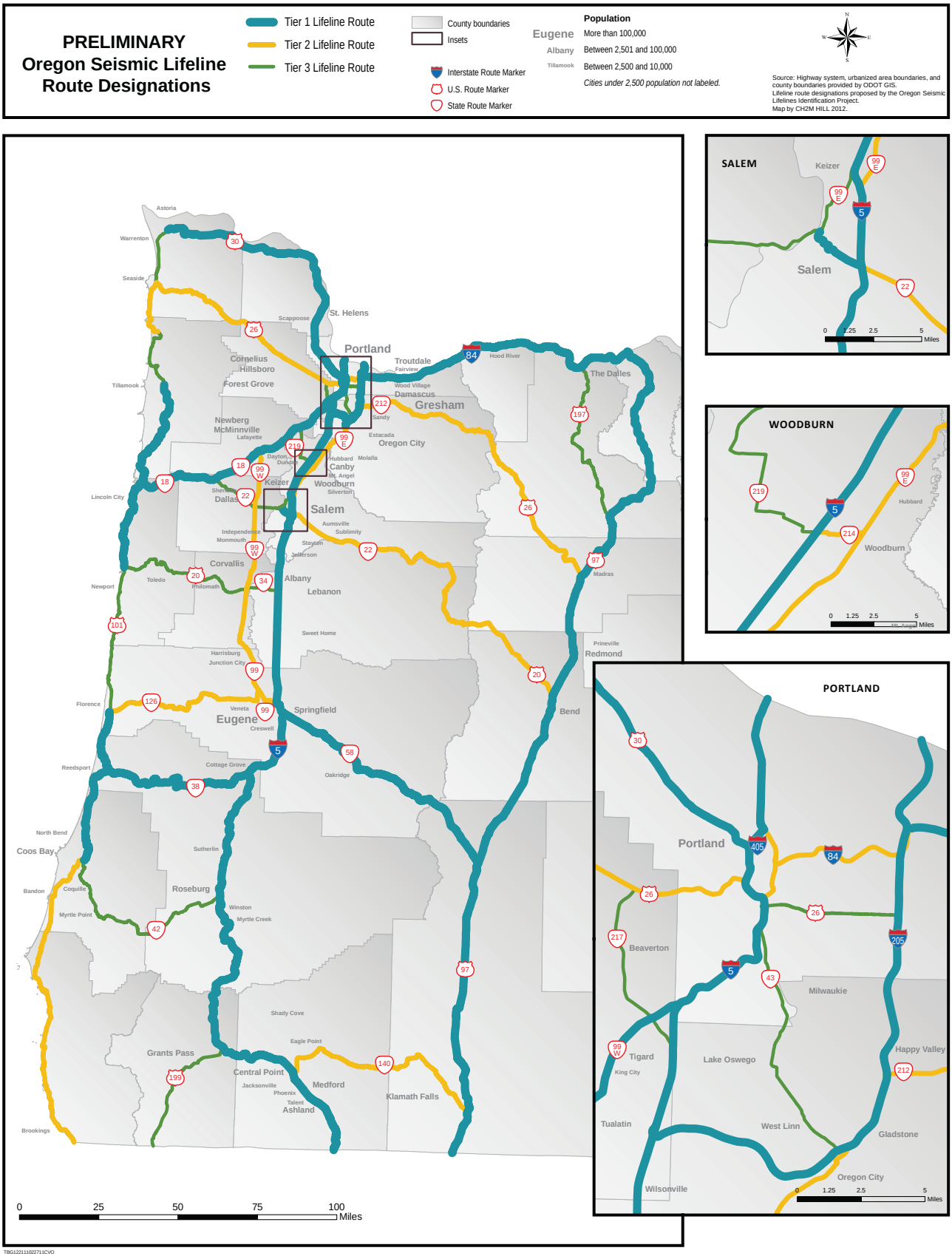

FIGURE 6-2
Lifeline Routes n Seismic Ris

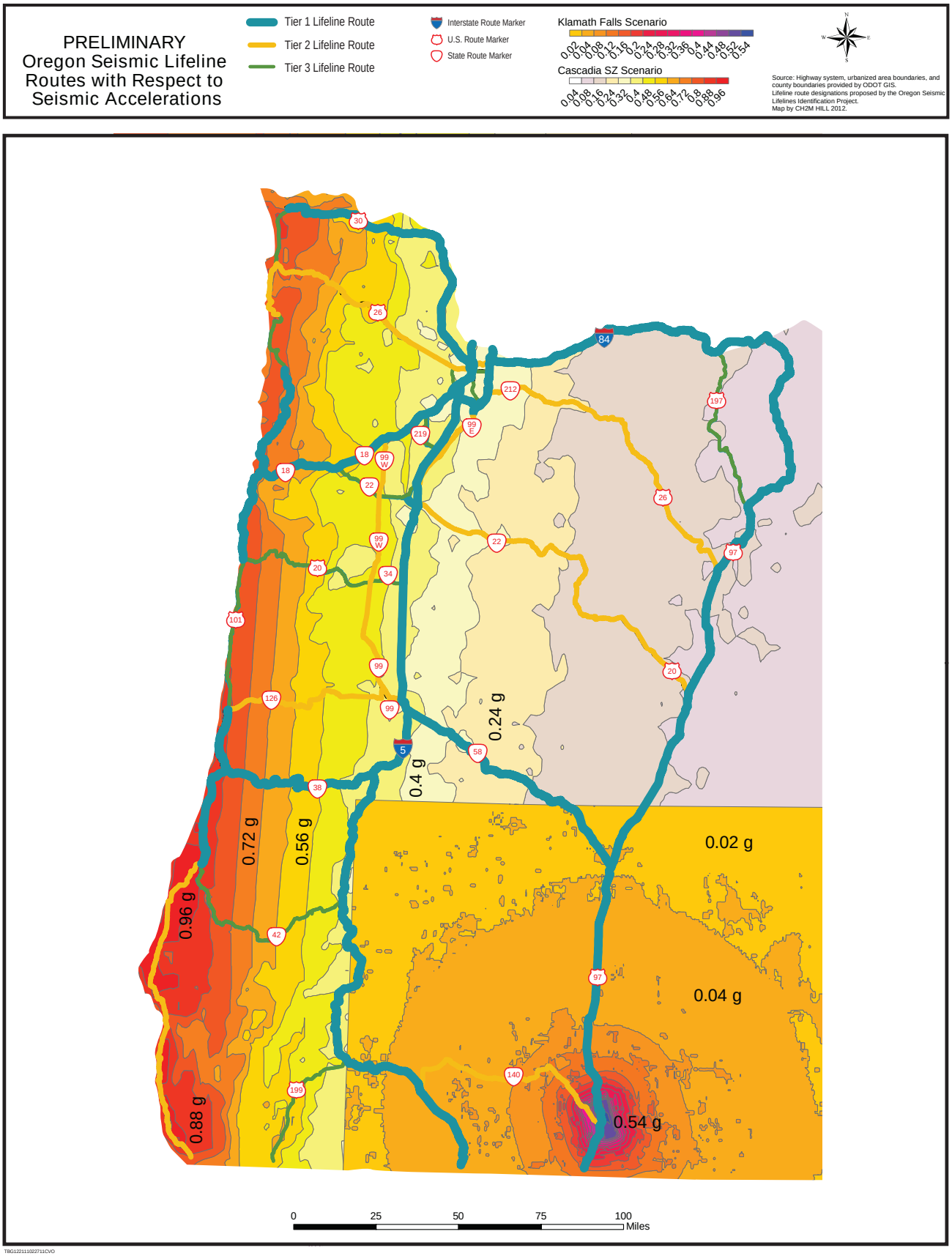

Table 6-1 contains a tabulation of lifeline roadway miles within three classifications of peak ground acceleration (PGA) coefficients, by tier for the CSZ seismic event. These CSZ PGA zones generally correlate to geographic areas with the high acceleration zone being the coast and Coast Range mountains, the moderate acceleration zone the inland valleys, and low acceleration zone the Cascades and central Oregon.

TABLE 6-1
Lifeline Roadway Length by CSZ Seismic Acceleration Zone and Tier (Miles)

CSZ PGA Zone	Approximate PGA (g)	Tier 1	Tier 2	Tier 3	Total
High	0.56 – 0.96	217	211	236	664
Moderate	0.24 – 0.48	540	313	127	979
Low	0.08 – 0.16	389	181	59	630
Total		1,146	705	422	2,273

6.2.2 Lifeline Corridor Definition

In the following discussion, the roadways selected to serve as lifeline routes are referred to as corridors since it is not intended that the identified state highways be used as seismic lifeline routes to the exclusion of other alternatives in the same vicinity. Future seismic vulnerability evaluation and remediation prioritization efforts are likely to identify least cost alternatives for providing a seismically resilient route that include detours off of the identified roadway to bypass critical seismic vulnerabilities. Therefore, the term “corridor” is used to denote that the identified highway, along with easily accessed adjacent roadways as necessary, are intended to serve as the seismic lifeline route.

Future efforts to identify possible detours around seismic vulnerabilities should take advantage of the information available in emergency closure response plans such as the “Pre-Identified Detour Routes for I-5” documents that are available in District Manager offices. Once this information has been reviewed and detailed seismic vulnerability assessments have been conducted, the exact route along specific roadways can be identified within the designated lifeline route corridors and the seismic retrofit needs can be prioritized. However, it is assumed that the final seismic lifeline routes will consist primarily of the roadways identified in this study.

6.2.3 Coast Geographic Zone

The Coast Geographic Zone is the most-seismically vulnerable geographic zone and is the most difficult to access because of geographic constraints. Although it could be argued that the critical post-earthquake needs of the region should dictate that all routes be Tier 1, this is not necessary to meet the statewide transportation goals (listed previously) that govern the identification of Tier 1 routes. Specifically, the conditions of US 101, the extent of the area being studied and limited resources make it infeasible to plan on being able to drive the full length of US 101 or being able to cross the Coast Range on all of the east-west study routes in this zone, nor is this necessary to accomplish the goals and provide the characteristics of the Tier 1 lifeline system. The reality is that the vulnerabilities are so extensive on these routes that the majority of the cost of making the entire lifeline system acceptably resilient is associated with this region. Because of the high vulnerability of the zone, it is paramount that emergency services and recovery resources can reach this zone from other zones. Consequently, the

consensus of the PMT and SC was that all needs are best served with a Tier 1 backbone system selected according to the criteria described in Section 6.1.

Tier 1

The Tier 1 system in the Coast Geographic Zone consists of the following three separate access corridors:

- OR 30 from Portland to Astoria
- OR 18 from the Valley to US 101 and north and south on US 101 from Tillamook to Newport
- OR 38 from I-5 to US 101 and north and south on US 101 from Florence to Coos Bay

Tier 2

The Tier 2 system in the Coast Geographic Zone consists of the following three access corridors:

- US 26 from Portland to US 101 and north and south on US 101 from Seaside to Nehalem
- OR 126 from the Valley to US 101 at Florence
- US 101 from Coos Bay to the California border

Tier 3

The Tier 3 system in the Coast Geographic Zone consists of the following corridors:

- US 101 from Astoria to Seaside
- US 101 from Nehalem to Tillamook
- OR 22 from its junction with OR 18 to the Valley
- OR 20 from Corvallis to Newport
- OR 42 from I-5 to US 101
- US 199 from I-5 to the California border

Segments Considered but Not Designated as Lifelines

The only state highways in the Coast Geographic Zone not designated a seismic lifeline are OR 103 and OR 202 from US 26 to Astoria. In spite of significant vulnerabilities on many of the routes, all other segments in the Coast Geographic Zone have been selected to be seismic lifelines because of their wide geographic distribution and the at-risk populations they serve.

Tier Designation Discussion

North Coast (Astoria to Tillamook). A special evaluation of the three possible routes from Portland to Astoria was performed by using the evaluation framework. In this evaluation, the parameters for each segment along each alternate route were summed, and then the evaluation framework methodology was applied to each alternate route composed of the combined segments. Because this analysis showed OR 30 was preferable by most measures, this highway was designated Tier 1.

US 101 from Astoria to Seaside has significant vulnerabilities in the areas of the bay crossing at Astoria and the low-lying area in downtown Seaside; therefore, it was designated Tier 3.

The system of US 26 to US 101 down to Nehalem was designated Tier 2. US 101 from Nehalem to Tillamook was designated Tier 3 because of extensive vulnerabilities in the low-lying areas of Nehalem and Tillamook Bays.

OR 102 and OR 202 were included in the study to evaluate alternate access to Astoria, but were found to not provide significant overall benefit compared to the other routes; therefore, these highways were not designated as lifelines.

Central Coast (Tillamook to Coos Bay). Five state highways were evaluated as east-west lifelines through this section of the Coast Geographic Zone. The project team preferred that the Tier 1 lifelines not be adjacent routes.

Of these five east-west highways, OR 42 was rated lower on most measures and significantly lower for bridge and roadway seismic resilience. This is a case where the segment rated marginally better on several criteria and therefore rated well on the PMT Weighted Evaluation Framework, but rated much worse on resilience criteria. This means that significantly more investment would be required to provide adequate seismic resilience on this route than on other alternatives, with little added benefit. Therefore, this highway was identified as a Tier 3 lifeline.

Of the four routes remaining as candidates to serve as Tier 1 lifelines, two serve the northern portion and two serve the southern portion of this central coast area. Of the two northern routes, OR 18 and OR 20, OR 18 has much better resilience ratings. The southern two routes, OR 126 and OR 38, are comparable on most measures. The best-rated sections of US 101 are between Florence and Coos Bay. OR 126 provides access to the north end and OR 38 provides access to the middle of this section of US 101. It is preferable to access the midpoint of a transportation corridor because this location is most beneficial for emergency response and recovery. A midpoint corridor location allows road and bridge repair crews to start in the middle of this section of US 101 and work both ways away from the center, rather than starting at one end and working the length toward the other end. Selection of OR 38 as a Tier 1 lifeline also provides access to the center of this higher-population area (from Florence to Coos Bay), whereas selection of OR 126 would provide access at the northern end of this area, much farther from Coos Bay. Therefore, OR 38 and US 101 north to Florence and south to Coos Bay were designated Tier 1.

Similarly, because of their central position with respect to more resilient portions of US 101, central location between population centers, and higher resilience ratings, OR 18 and the segments of US 101 north to Tillamook and south to Newport were identified as Tier 1 lifelines. OR 18 did not rate well with the PMT Weight Evaluation Framework; however, this is primarily due to the fact that the segment joins US 101 slightly north of Lincoln City and therefore does not rate well on a number of connections criteria, which are not pertinent to its selection as a Tier 1 route given the function it serves and the close proximity of the connection criteria parameters. OR 18 rates better with respect to the criteria rating and the alternative resilience emphasis rating.

Of the remaining two east-west lifelines, OR 26 has the superior seismic resilience; therefore, this highway was designated Tier 2. OR 20 was then designated Tier 3. US 101 between Newport and Florence also was designated Tier 3.

Southern Coast (Coos Bay to California). The only segments in this area are US 101 from Coos Bay to the Oregon/California border and US 199 from I-5 to the California border. The Tier 1 lifeline network extends to the north end of the southern US 101 segment, which rates in the middle range of the coastal segments, and the roadway serves a highly vulnerable and isolated region; therefore, it was identified as a Tier 2 lifeline. US 199 provides a third connection to the California border and has been designated Tier 3 since the I-5 connection is Tier 1 and US 101 is Tier 2.

6.2.4 Portland Metro Geographic Zone

In addition to encompassing the largest population concentration in the state, the Portland Metro Geographic Zone contains many facilities (such as transportation, communication, and fuel depots) that are critical to statewide earthquake response and long-term economic recovery. For these reasons, this

zone has a higher concentration of lifeline routes than do the other geographic zones and has redundant Tier 1 crossings of the Willamette River.

Tier 1

The Tier 1 system in the Portland Metro Geographic Zone consists of the following corridors:

- I-5, excluding the section between the northern and southern I-405 interchangesI-405
- I-205
- OR 99W from I-5 to OR 217

Tier 2

The Tier 2 system in the Portland Metro Geographic Zone consists of the following three access corridors:

- I-84
- I-5 between the northern and southern I-405 interchanges

US 26 from OR 217 to I-405Tier 3

The Tier 3 system in the Portland Metro Geographic Zone consists of the following corridors:

- OR 217
- US 26 from I-5 to I-205
- OR 43

Segments Considered but Not Designated as Lifelines

The following segments were considered but were not designated as lifelines:

- OR 224
- OR 99E from US 26 to Oregon City

Tier Designation Discussion

The single-most significant criteria for lifeline tier designations in the Portland Metro Geographic Zone were the known seismic vulnerabilities of the Willamette River crossings and key interchange structures. For these structures, more-comprehensive seismic vulnerability assessments have been performed than those performed within the REDARS2 evaluation. Since these structures are very large, they represent a significant percentage of the lifeline system bridge deck area and, therefore, potential seismic retrofit cost.

The Willamette River crossings evaluated for this study are the I-405 Fremont Bridge, the I-5 Marquam Bridge, the US 26 Ross Island Bridge, and the I-205 Abernathy Bridge. The US 26 route is not a prime candidate for a variety of reasons other than seismic resilience issues, so this leaves the other three routes as potential candidates for the desired two Tier 1 Willamette River Crossings. Of these three, the Marquam Bridge is the most-seismically vulnerable. In addition, the segment of I-5 north of the Marquam Bridge along with the I-5/I-84 interchange includes several structures that have been determined to have severe seismic vulnerabilities. Therefore, the Tier 1 Willamette River crossings are I-405 and I-205. This also provides one crossing in the downtown area and one on the outer edge of the geographic zone.

I-5, with the exception of the segment between the end points of I-405, is designated Tier 1 because it is arguably the most-important transportation corridor in the state and does not have significantly more identified vulnerabilities than any alternate routes.

I-205 is also Tier 1 for its Willamette River crossing discussed previously and since it serves a significant role—providing access to the Portland International Airport, connecting I-5, to the I-84 and OR 212/ US 26 corridors to the east, and connecting to the Washington state border.

I-405 serves the important function of connecting I-5 to OR 30 and the important fuel and communications facilities in that area, as well as containing the Willamette River crossing discussed previously. Therefore, I-405 has been designated Tier 1.

The final Tier 1 segment in the Portland Metro Geographic Zone is a short piece of OR 99W that provides connection from I-5 to the Tier 1 OR 99W segment in the Valley Geographic Zone.

In spite of the critical seismic vulnerabilities, I-5 between I-405 intersections, and I-84 between I-5 and I-205 have been designated Tier 2 due to the critical function they serve in the statewide transportation network.

US 26 in the Coast Geographic Zone was designated Tier 2 and must be connected to the Portland Metro Geographic Zone by a Tier 1 or 2 segment. The two alternatives for this connection are US 26 to I-405 and OR 217 to OR 99W. US 26 rates better on almost every measure and provides a more direct connection to the Tier 1 lifelines and supporting facilities. Therefore, US 26 was designated Tier 1. OR 217 was designated Tier 3 because it provides significant extra capacity through and around the Portland Metro area.

The remaining routes (US 26 from I-5 to I-205, OR 99E, OR 224, and OR 43) pass through the south and east portions of the city. Of these routes, US 26 from I-5 to I-205 and OR 43 rate the best. Because US 26 provides access to some critical facilities, serves as an alternate route to I-84, and provides a fourth Willamette River crossing, it was designated Tier 3. OR 43 provides an alternative to I-5 south on the west side of the Willamette River and was designated Tier 3, with the exception of the short segment of OR 43 from I-205 to OR 99E.

The short segment of OR 43 from I-205 to OR 99E has not been designated a seismic lifeline route because it would be the fifth Willamette River crossing in the Portland Metro Geographic Zone and is adjacent to the I-205 Tier 2 crossing of the Willamette. OR 224 and OR 99E from US 26 to I-205 would not serve significant functions in the statewide transportation network beyond those already provided by other seismic lifelines in the area and therefore have not been designated as seismic lifeline routes.

The short segment of OR 99E from I-205 to OR 43 was designated Tier 2 to connect with the Tier 2 segment of OR 99E in the Valley Geographic Zone.

6.2.5 Valley Geographic Zone

The Valley Geographic Zone generally consists of two or three north-south routes through the Willamette Valley and a variety of east-west connectors between those routes, intended to provide for redundant routes for north-south movement.

Tier 1

The Tier 1 system in the Valley Geographic Zone consists of the following corridors:

- I-5
- OR 99W from I-5 to OR 18 near Dayton
- OR 18 from OR 99W near Dayton to McMinnville
- OR 22 from I-5 to OR 99E in Salem

Tier 2

The Tier 2 system in the Valley Geographic Zone consists of the following corridors:

- US 26 from OR 47 to OR 217
- OR 99W from McMinnville to Junction City
- OR 99 from Junction City to I-5 in Eugene
- OR 99E from Oregon City to I-5 in Salem
- OR 214 in Woodburn from I-5 to OR 99E

Tier 3

The Tier 3 system in the Valley Geographic Zone consists of the following corridors:

- OR 219 from Newberg to Woodburn
- OR 99E in Salem from I-5 to OR 22
- OR 22 from OR 99W to Salem
- OR 34 from Corvallis to I-5

Segments Considered but Not Designated as Lifelines

The following segments were considered but were not designated as lifelines:

- OR 47
- OR 99W from north of Dayton to the south side of McMinnville
- OR 99E from Albany to Junction City
- OR 569 in Eugene

Tier Designation Discussion

Most segments of I-5 in the Valley Geographic Zone rate as well or better than the alternatives. These ratings, as well as the capacity and importance of I-5, justifies a Tier 1 designation for all of I-5 through this zone.

In the McMinnville area, OR 99W and OR 18 were included as alternate routes. The evaluation framework rating was slightly better for OR 18; therefore, OR 18 through McMinnville and OR 99W from near Dayton to I-5 in Tigard were designated Tier 1 to join to the Tier 1-designated OR 18 in the Coast Geographic Zone. With OR 18 through McMinnville designated Tier 1, the adjacent segments of OR 99W do not serve a significant function; therefore, they are not designated as seismic lifeline routes.

The last route in this zone designated Tier 1 is a piece of OR 22 in Salem that connects the state government offices to I-5.

Routes available to serve as north-south travel alternatives to I-5 are OR 99E, OR 99W, and OR 47. OR 99E, from Oregon City to Woodburn, is very significant because it provides a route from the Portland Metro area to points south without a Willamette River crossing. Large river crossings have some level of

seismic vulnerability even when constructed to current code requirement. They also do not generally have many alternatives. Because inclusion of routes that do not require large river crossings is preferred in the seismic lifeline system, OR 99E from Oregon City to Salem was designated Tier 2.

On the other side of the valley, OR 99W provides a route from the Portland Metro area to the south valley without large river crossings. Therefore, it was designated Tier 2 from McMinnville to I-5 in Eugene. In the south Valley, OR 99E was included in the study between Albany and Junction City. However, this route has very low seismic resilience and does not serve a statewide transportation function already served by I-5 and OR 99W. Therefore, OR 99E from Albany to Junction City was not designated a seismic lifeline route.

OR 47 could provide additional north-south travel redundancy; however, it did not rate well with respect to many criteria and therefore was not designated as a seismic lifeline.

US 26 from OR 47 to OR 217 was designated Tier 2 to provide a connection to the Tier 2 segment of US 26 in the Coast Geographic Zone.

OR 214 in Woodburn from I-5 to OR 99E was designated Tier 2 because it provides valuable connectivity between those routes in a short distance.

The following routes, which were rated reasonably well and serve to provide additional connectivity between the north-south routes, were designated Tier 3: OR 219 from Newberg to Woodburn, OR 99E in Salem from I-5 to OR 22, OR 22 from OR 99W to Salem, and OR 34 from Corvallis to I-5.

OR 569 in Eugene has very low seismic resilience and was rated lower than the adjacent alternate segment of OR 99; therefore, OR 569 was not designated as a seismic lifeline route.

6.2.6 South I-5 Geographic Zone

The only roadway in this zone is I-5 from Eugene to the California border. All of I-5 in this zone was designated Tier 1 because of the regional importance of I-5, the connection to California, and the lack of alternate corridors.

6.2.7 Cascades Geographic Zone

The Cascades Geographic Zone lifeline routes consist of five crossings of the Cascade Mountains from western to central Oregon. These routes serve to connect the highly seismically affected western portion of the state to the central portion of the state, which is expected to be far less affected by a CSZ event. In addition, the southernmost route can serve as a connection from Medford to the Klamath Falls area in the event of a seismic event in the Klamath Falls area.

Tier 1

The Tier 1 system in the Cascades Geographic Zone consists of the following corridors:

- I-84OR 58

Tier 2

The Tier 2 system in the Cascades Geographic Zone consists of three corridors:

- OR 212 and US 26
- OR 22 from Salem to Santiam Junction and US 20 from Santiam Junction to Bend
- OR 140 and OR 62

Tier 3

No corridors are designated as Tier 3 in the Cascades Geographic Zone.

Segments Considered but Not Designated as Lifelines

The following segments were considered but were not designated as lifelines:

- OR 34 from I-5 to Lebanon and US 20 from Lebanon to Santiam Junction
- OR 126 from I-5 to Santiam Junction
- OR 126 from US 20 to US 97

Tier Designation Discussion

I-84 serves a critical transportation function for the state and rated well; therefore, it was designated Tier 1. The other route that rated well is the OR 212 to US 26 route from Portland to Madras; however, since it is adjacent to I-84 and less significant as a freight corridor and in providing access to critical utilities, it is also designated Tier 2.

The second Cascades Geographic Zone route designated Tier 1 is OR 58. This selection was intended to provide a Tier 1 route from the southern end of the Willamette Valley to central Oregon. OR 58 was preferred over other routes for the Tier 1 designation because of its importance as a freight route and its central location.

The southernmost Cascades route, OR 140 and OR 62, was designated Tier 2 for the access it provides between Medford and Klamath Falls.

The remaining three routes through the Cascades Geographic Zone begin in Salem, Corvallis, and Eugene and converge at Santiam Junction, then continue to Bend on US 20. Because of their relative ratings, in particular their importance to freight, OR 22 was designated Tier 2. OR 34/US 20 was not designated as a seismic lifeline primarily due to its limited capacity to carry freight traffic. OR 126 was not designated a lifeline because it did not provide significant statewide transportation function beyond that already provided by OR 22 and OR 58. US 20 from Santiam Junction to Bend was designated Tier 2 as a continuation of OR 22. Because OR 126 from Sisters to Redmond rated lower than US 20 and US 97, provided no additional function, and there are few seismic vulnerabilities in this area that would warrant alternate routes, it was not designated as a lifeline.

6.2.8 Central Geographic Zone

Tier 1

The Tier 1 system in the Central Geographic Zone consists of the following corridors:

- I-84 from The Dalles to Biggs Junction
- US 97

Tier 2

No Tier 2 corridors are located in the Central Geographic Zone

Tier 3

The one Tier 3 corridor in the Central Geographic Zone is US 197.

Segments Considered but Not Designated as Lifelines

All segments considered in this zone were designated as lifelines.

Tier Designation Discussion

Because the ground shaking levels in the Central Geographic Zone (east of the Cascades) from a CSZ seismic event are much lower than for the zones to the west, damage in the area is expected to be minimal. US 97 will serve as a critical transportation corridor for the response to and recovery from such an event. Consequently, it is important that all vulnerabilities that do exist are taken care of. Furthermore, US 97 will be an important lifeline in the event of a Klamath Falls area seismic event. For these reasons, US 97 was designated Tier 1.

Two alternate routes connect US 97 north of Madras to I-84 in The Dalles—US 197 and US 97 from US 197 to I-84 at Biggs Junction and then west on to I-84 to The Dalles. The US 97 and I-84 route rated better on most criteria and therefore was designated Tier 1. Because the US 197 route provides access to critical utilities, it was designated Tier 3 rather than being dropped from the system.

Table 6-2 lists each segment studied in the project, its tier designation (or lack thereof) and a brief description of the justification for inclusion or exclusion as a seismic lifeline routes.

TABLE 6-2
Tier Designation by Segment

Seg.	Highway	Geographic Zone	ODOT Hwy No.	Description (Point to Point)	Tier	Tier Designation Justification Notes
1	I-5	Portland Metro	1	Washington border to I-405	1	I-5
2	I-5	Portland Metro	1	I-405 to I-84	2	Significant known vulnerabilities on this segment at I-84 interchange
3	I-5	Portland Metro	1	I-84 to I-405/OR 43/ US 26	2	Significant known vulnerabilities on this segment at I-84 interchange and Marquam Bridge (I-5 over Willamette River), Fremont (I-405) and Abernathy (I-205) bridges selected as Tier 1
4	I-5	Portland Metro	1	I-405/OR 43/US 26 to OR 99W	1	I-5
5	I-5	Portland Metro	1	OR 99W to OR 217	1	I-5
6	I-5	Portland Metro	1	OR 217 to I-205	1	I-5
7	I-5	Valley	1	I-205 to OR 214	1	I-5
8	I-5	Valley	1	OR 214 to OR 99E Bus.	1	I-5

TABLE 6-2
Tier Designation by Segment

Seg.	Highway	Geographic Zone	ODOT Hwy No.	Description (Point to Point)	Tier	Tier Designation Justification Notes
9	I-5	Valley	1	OR 99E Bus. to OR 99E	1	I-5
10	I-5	Valley	1	OR 99E to OR 22	1	I-5
11	I-5	Valley	1	OR 22 to OR 99E	1	I-5
12	I-5	Valley	1	OR 99E to OR 34	1	I-5
13	I-5	Valley	1	OR 34 to OR 569	1	I-5
14	I-5	Valley	1	OR 569 to OR 126/OR 99	1	I-5
15	I-5	South I-5	1	OR 126 to OR 58	1	I-5
16	I-5	South I-5	1	OR 58 to OR 38	1	I-5
17	I-5	South I-5	1	OR 38 to OR 42	1	I-5
18	I-5	South I-5	1	OR 42 to OR 199	1	I-5
19	I-5	South I-5	1	OR 199 to OR 140	1	I-5
20	I-5	South I-5	1	OR 140 to California border	1	I-5
21	I-84	Portland Metro	2	I-5 to I-205	2	Provides connection to east from Tier 2 portion of I-5
22	I-84	Cascades	2	I-205 to US 197	1	Interstate connection to east
23	I-84	Central	2	US 197 to US 97	1	Interstate connection to east
24	I-205	Portland Metro	64	Washington border to I-84	1	Access to airport
25	I-205	Portland Metro	64	I-84 to US 26	1	Connection between other Tier 1 lifelines
26	I-205	Portland Metro	64	US 26 to OR 224	1	Connection between other Tier 1 lifelines
27	I-205	Portland Metro	64	OR 224 to OR 212	1	Connection between other Tier 1 lifelines
28	I-205	Portland Metro	64	OR 212 to OR 99E	1	Connection between other Tier 1 lifelines
29	I-205	Portland Metro	64	OR 99E to OR 43	1	One of two Tier 1 Willamette River crossing in Portland Metro Geographic Zone
30	I-205	Portland Metro	64	OR 43 to I-5	1	Connection between other Tier 1 lifelines

TABLE 6-2
Tier Designation by Segment

Seg.	Highway	Geographic Zone	ODOT Hwy No.	Description (Point to Point)	Tier	Tier Designation Justification Notes
31	I-405	Portland Metro	61	I-5 to US 30	1	Connection between other Tier 1 lifelines, access to fuel, and Portland circulation, one of two Tier 1Willamette River crossings
32	I-405	Portland Metro	61	US 30 to US 26	1	Connection between other Tier 1 lifelines, access to fuel, and Portland circulation
33	I-405	Portland Metro	61	US 26 to I-5/OR 43/US 26	1	Connection between other Tier 1 lifelines, access to fuel, and Portland circulation
34	OR 217	Portland Metro	144	US 26 to OR 99W	3	Low resilience
35	OR 217	Portland Metro	144	OR 99W to I-5	3	Low resilience
36	OR 99W	Portland Metro	91	I-5 to OR 217	1	Connection to Tier 1 route to coast
37	OR 99W	Valley	91	OR 217 to OR 219	1	Connection to Tier 1 route to coast
38	OR 99W	Valley	91	OR 219 to OR 18	1	Connection to Tier 1 route to coast
39	OR 99W	Valley	91	OR 18 to OR 47	0	Redundant to OR 18
40	OR 99W	Valley	91	OR 47 to OR 18	0	Redundant to OR 18
41	OR 99W	Valley	91	OR 18 to OR 22	2	Alternate to I-5
42	OR 99W	Valley	91	OR 22 to US 20	2	Alternate to I-5
43	OR 99W	Valley	91	US 20 to 99E/99W merge	2	Alternate to I-5
44	OR 99	Valley	91	99E/99W merge to OR 569/126	2	Alternate to I-5
45	OR 99	Valley	91	OR 569/126 to I-5	2	Alternate to I-5
46	OR 99E	Portland Metro	81	US 26 to OR 224	0	Redundant to OR 43 and US 26
47	OR 99E	Portland Metro	81	OR 224 to I-205	0	Redundant to OR 43 and US 26
48	OR 99E	Portland Metro	81	I-205 to OR 43	2	Alternate to I-5
49	OR 99E	Valley	81	OR 43 to OR 214	2	Alternate to I-5
50	OR 99E	Valley	81	OR 214 to I-5	2	Alternate to I-5
51	OR 99E	Valley	81	I-5 in Albany to OR 34	0	Redundant to I-5 and OR 99W

TABLE 6-2
Tier Designation by Segment

Seg.	Highway	Geographic Zone	ODOT Hwy No.	Description (Point to Point)	Tier	Tier Designation Justification Notes
52	OR 99E	Valley	81	OR 34 to 99E/99W merge	0	Redundant to I-5 and OR 99W
53	OR 47	Valley	29	OR 26 to OR 99W	0	Redundant to I-5 and OR 99W
54	OR 212	Cascades	174	I-205 to US 26	2	Redundant connection to Central Oregon, less critical to freight than I-84 route to east
55	OR 224	Portland Metro	171	OR 99E to I-205	0	Redundant to OR 43 and US 26
56	OR 18	Valley	39	OR 99W to OR 99W	1	Connection to Tier 1 route to coast
57	OR 18	Coast	39	OR 99W to OR 22	1	Central Tier 1 route to coast
58	OR 18	Coast	39	OR 22 to US 101	1	Central Tier 1 route to coast
59	OR 43	Portland Metro	3	US 26 to I-205	3	Additional capacity in Portland
60	OR 43	Portland Metro	3	I-205 to OR 99E	0	Redundant crossing of Willamette
61	US 30	Coast	92	US 101 to I-405	1	Northern Tier 1 route to coast
62	OR 202	Coast	102	US 101 to OR 103	0	Redundant route to Astoria
63	OR 103	Coast	103	OR 103 to US 26	0	Redundant route to Astoria
64	US 101	Coast	9	OR 202 to US 26	3	Low resilience
65	US 101	Coast	9	US 26 to OR 18	1, 2, 3	Tier 2 access to Nehalem, Tier 3 due to low resilience Nehalem to Tillamook, Tier 1 access from OR 18 to Tillamook
66	US 101	Coast	9	OR 18 to US 20	1	Tier 1 access from OR 18 to Newport
67	US 101	Coast	9	US 20 to OR 126	3	Low resilience
68	US 101	Coast	9	OR 126 to OR 38	1	Tier 1 access from OR 38 to Florence
69	US 101	Coast	9	OR 38 to OR 42	1	Tier 1 access from OR 38 to Coos Bay
70	US 101	Coast	9	OR 42 to California border	2	Access to south coast
71	US 197	Central	4	I-84 to US 97	3	Redundant to US 97 and I-84 but provides access to critical utilities
72	US 97	Central	42	I-84 to US 197	1	North-south lifeline outside of highly CSZ event affected zone
73	US 97	Central	4	US 197 to US 26	1	North-south lifeline outside of highly CSZ event affected zone

TABLE 6-2
Tier Designation by Segment

Seg.	Highway	Geographic Zone	ODOT Hwy No.	Description (Point to Point)	Tier	Tier Designation Justification Notes
74	US 97	Central	4	US 26 to OR 126	1	North-south lifeline outside of highly CSZ event affected zone
75	US 97	Central	4	OR 126 to US 20	1	North-south lifeline outside of highly CSZ event affected zone
76	US 97	Central	4	US 20 to OR 58	1	North-south lifeline outside of highly CSZ event affected zone
77	US 97	Central	4	OR 58 to OR 140	1	North-south lifeline outside of highly CSZ event affected zone and access to Klamath Falls
78	US 97	Central	4	OR 140 to California border	1	North-south lifeline outside of highly CSZ event affected zone and access to Klamath Falls
79	US 26	Coast	47	US 101 to OR 103	2	Intermediate route to coast
80	US 26	Coast	47	OR 103 to OR 47	2	Intermediate route to coast
81	US 26	Valley	47	OR 47 to OR 217	2	Intermediate route to coast
82	US 26	Portland Metro	47	OR 217 to I-405	2	Intermediate route to coast
83	US 26	Portland Metro	26	I-5/OR 43/US 26 to OR 99E	3	Fourth Willamette River crossing in Portland Metro Geographic Zone
84	US 26	Portland Metro	26	OR 99E to I-205	3	Alternate route through Portland, mostly at grade with many detours available
85	US 26	Cascades	53	OR 212 to US 97	2	Redundant connection to Central Oregon, less critical to freight than I-84 route to east
86	OR 22	Cascades	162	I-5 to Santiam Jct	2	Freight route
87	US 20	Coast	33	US 101 to OR 99W	3	Low resilience
88	OR 34	Valley	210	OR 99W to OR 99E	3	Connection from OR 99W to I-5
89	OR 34	Valley	210	OR 99E to I-5	3	Connection from OR 99W to I-5
90	OR 34	Cascades	210	I-5 to US 20	0	Redundant to OR 22
91	US 20	Cascades	16	OR 34 to OR 126	0	Redundant to OR 22
92	US 20	Cascades	16	OR 126 to OR 22	0	Redundant to OR 22
93	US 20	Cascades	16	OR 22 to OR 126	2	Continuation of OR 22 route to Bend
94	US 20	Cascades	16	OR 126 to US 97	2	Continuation of OR 22 route to Bend
95	OR 126	Coast	62	US 101 to OR 99/ OR 569	2	Alternate route to OR 38

TABLE 6-2
Tier Designation by Segment

Seg.	Highway	Geographic Zone	ODOT Hwy No.	Description (Point to Point)	Tier	Tier Designation Justification Notes
96	OR 569	Valley	69	OR 99/OR 126 to I-5	0	Redundant to OR 99
97	OR 126	Cascades	69	I-5 to US 20	0	Redundant to OR 58
98	OR 38	Coast	45	US 101 to I-5	1	Southern Tier 1 route to coast
99	OR 58	Cascades	18	I-5 to US 97	1	Tier 1 route to Central Oregon
100	OR 42	Coast	35	US 101 to I-5	3	Alternate to OR 38
101	OR 140	Cascades	270	I-5 to US 97	2	Medford – Klamath Falls connection
102	US 199	Coast	25	I-5 to California border	3	Access to southern Oregon and CA border
103	OR 22	Coast	30	OR 18 to OR 99W	3	Alternate connection of OR 18 to OR 99W
104	OR 22	Valley	30	OR 99W to OR 99E Bus.	3	east west connection OR 99W to I-5, alternate crossing of Willamette
105	OR 22	Valley	30	OR 99E Bus. To I-5	1	Connection of State Government to I-5
106	OR 219	Valley	140	OR 99W to I-5	3	Alternate crossing of Willamette
107	OR 214	Valley	140	I-5 to OR 99E	2	East west connection OR 99E to I-5
108	OR 126	Cascades	15	US 20 to US 97	0	Redundant to US 20
109	OR 99E Bus.	Valley	72	I-5 to OR 22	3	Alternate to I-5 and OR 22

APPENDIX E
GIS Methodology Report (FLO)

Appendix E: GIS Methodology

RDPO/Metro Regional Emergency Transportation Routes Update Project

Prepared by:
Cascade GIS & Consulting
and FLO Analytics
Date: February 2, 2021

Prepared for:
Thuy Tu Consulting &
Salus Resilience

TABLE OF CONTENTS

CHAPTER 1: GIS METHODOLOGY STATEMENT

1.1 INTRODUCTION

This GIS Methodology provides supplementary information to the Regional Emergency Transportation Routes (ETR) Update Project report. The Regional ETR report includes significant background and stakeholder information describing the scope of the current project and delineating an approach for future work. The GIS Methodology provides additional background and details of the technical approach to this update.

Primary methodology development, data compilation, and initial analysis were completed by Cascade GIS staff, including Principal Analyst Erica McCormick, and GIS Analysts Andy Wilson and Tyler Harris. The project transitioned to FLO Analytics in Fall 2020. Finalization of the data compilation and analysis were completed by Senior GIS Analyst Jed Roberts and GIS Technician Ethan Poole.

1.2 ORGANIZATION OF DOCUMENT

The Methodology is organized by technical approach as follows:

- **Chapter 1 – GIS Methodology Statement:** This chapter describes the purpose and organization of this document.
- **Chapter 2 – Regional Data Aggregation:** This chapter describes the methodology for compilation of regional data.
- **Chapter 3 – Regional ETR Update Modeling:** This chapter describes the GIS methodology used to develop the updated Regional ETRs.
- **Chapter 4 – List of Acronyms**

CHAPTER 2: REGIONAL DATA AGGREGATION

2.1 INTRODUCTION

The project required the creation of a GIS database of existing regional data. The approximately 4,400-square-mile study area in the Portland Metro Area consists of Clackamas, Columbia, Multnomah, and Washington counties in Oregon as well as Clark County in Washington. Some data extended beyond the study area.

A regional geospatial data inventory was needed to evaluate the Regional ETRs based on the final framework criteria and to perform analyses of connectivity, resilience, and community equity. The data inventoried fall under five broad categories:

- **Critical infrastructure:** Defined and prioritized in the framework criteria for the project, critical infrastructure has been sub-categorized as having a role in emergency response at the state/regional, city/county, or community/neighborhood level.
- **Essential facilities:** As with critical infrastructure, defined and prioritized in the framework criteria and sub-categorized by emergency response role.
- **Routes:** Regional ETRs developed in 1996 and revised in 2005 served as the foundation for updated routes. Updates to existing routes were coordinated through a stakeholder engagement process.
- **Analysis:** Regional ETRs were analyzed for resilience and social equity. Earthquake, landslide, and flood hazard data were used to analyze resilience. Socioeconomic data from the U.S. Census American Community Survey were used to analyze equity.
- **Reference:** Various datasets were used to inform and support the project team's decisions about adding, removing, or changing Regional ETRs.

GIS data were obtained in two ways: through direct coordination with stakeholders and from publicly available sources. All GIS data were reviewed, compiled, and aggregated in a comprehensive geospatial data inventory. Data were collected from

public repositories and from stakeholders over a period of eighteen months, from July 2019 through December 2020. Stakeholders were provided with a formal list of requested items in September 2019. Following the data request, and follow-up correspondence, a wide range of data formats were received including GIS data (shapefiles, geodatabases, and layer packages), spreadsheets, PDFs, and descriptions and addresses via email. To facilitate stakeholder review of Regional ETRs and analysis data, Metro staff posted working data on an online web map at points throughout the project.

2.2 METHODOLOGY

ArcGIS Advanced 10.8 software was used. The original and derivative data were reviewed and geoprocessed in ArcMap and ArcCatalog. FLO Analytics developed analysis workflows using Alteryx 2020.4.

2.2.1 DATA COLLECTION

All stakeholder data were organized in folders by agency and date received. No changes were made to these original data. A spreadsheet was maintained to track the progress of data collection, identify data gaps, and to follow-up with stakeholders as needed. The data compiled also included publicly available data from authoritative entities and sources, including Metro's Regional Land Information System (RLIS), Federal Emergency Management Agency (FEMA), the Oregon Department of Geology and Mineral Industries (DOGAMI), City of Portland's Portland Maps, Oregon Geospatial Enterprise Office (GEO), Oregon Department of Transportation (ODOT) and Washington Department of Transportation (WSDOT) GIS, Clark County GIS, and the Washington Geospatial Open Data Portal. Table 1 provides a summary of the data collected from stakeholders and public sources.

Table 1. Summary of GIS data compiled from stakeholders and public sources

Theme	Type / Use	Essential Facility / Critical Infrastructure Category	Data Provider	Date Acquired / Published	Format
911 dispatch centers	Essential facility	State/regional	Clark County	Nov-19	Email
			Washington County	Jan-20	Email
Airports	Essential facility	State/regional	Columbia County	Sep-19	Shapefile
			Metro RLIS	Aug-16	Shapefile
			Washington Department of Transportation	Unknown	Shapefile
Armories	Essential facility	City/county	Columbia County	Sep-19	Shapefile
			Washington County	Oct-19	Geodatabase
Average daily traffic	Reference	n/a	City of Gresham	Feb-20	Shapefile
			City of Portland	Apr-20	
			Clackamas County	Jan-20	Shapefile
			Clark County	Feb-20	Access, shapefile
			Columbia County	Jan-20	Shapefile
			Multnomah County	Sep-19	Shapefile
			Port of Portland	Oct-19	PDF
			Washington County	Oct-19	Geodatabase
Bike routes	Critical infrastructure	City/county	Metro	Oct-19	Geodatabase
			Metro RLIS	Oct-18	Shapefile
			Multnomah County	Sep-19	Shapefile
			Port of Portland	Oct-19	PDF
			Portland Bureau of Transportation	Oct-19	Geodatabase
Boat ramps	Critical infrastructure	City/county	Oregon Geospatial Enterprise Office	Unknown	Shapefile
Bridges	Reference	n/a	Clackamas County	Nov-19	Shapefile
			Clackamas County	Nov-19	Shapefile
			Clark County	Jan-20	Geodatabase
			Metro	Oct-19	Shapefile

Theme	Type / Use	Essential Facility / Critical Infrastructure Category	Data Provider	Date Acquired / Published	Format
			Oregon Department of Transportation	Oct-19	Shapefile
			Portland Bureau of Transportation	Oct-19	Geodatabase
			Washington County	Oct-19	Geodatabase
			Washington Department of Transportation	Unknown	Geodatabase
Bus routes	Critical infrastructure	City/county	Columbia County	Apr-20	Shapefile
			Trimet	Oct-19	Shapefile
			Washington County	Oct-19	Geodatabase
Churches	Essential facility	Community / neighborhood	Columbia County	Sep-19	Shapefile
			Washington County	Oct-19	Geodatabase
City limits	Reference	n/a	Metro RLIS	Apr-20	Shapefile
Community centers	Essential facility	Community / neighborhood	City of Gresham	Jan-19	Address
			Metro RLIS	Oct-18	Shapefile
			Portland Bureau of Transportation	Oct-19	Geodatabase
Debris tonnage (seismic induced)	Reference	n/a	Oregon Department of Geology and Mineral Industries	Oct-19	Geodatabase
Disaster debris management sites	Essential facility	State/regional	Metro	Jan-20	Shapefile, PDF
Emergency operations centers	Essential facility	City/county; state/regional	City of Gresham	Jan-20	Email
			City of Portland	Nov-19	Shapefile
			Clackamas County	Nov-19	Shapefile
			Clark County	Nov-19	Email
			Port of Portland	Oct-19	Email
			Trimet	Nov-19	Spreadsheet, shapefile
			Washington County	Jan-20	Email
			Washington Department of Transportation	Nov-20	Email

Theme	Type / Use	Essential Facility / Critical Infrastructure Category	Data Provider	Date Acquired / Published	Format
Fairgrounds	Essential facility	State/regional	Google maps	Oct-20	Address
Fire and rescue	Essential facility	City/county	Columbia County	Nov-19	Shapefile
			Washington County	Oct-19	Geodatabase
Flood hazards	Analysis	n/a	Federal Emergency Management Agency	Jul-19	Shapefile
Freight routes	Reference	n/a	Metro	Oct-19	PDF, shapefile
			Multnomah County	Sep-19	Shapefile
			Washington Department of Transportation	Aug-19	PDF
Fuel retail	Critical infrastructure	City/county	CNA	Dec-20	Geodatabase
Fuel storage	Critical infrastructure	State/regional	CNA	Dec-20	Geodatabase
Health care clinics	Essential facility	City/county	Columbia County	Sep-19	Shapefile
			Washington County	Oct-19	Geodatabase
Highways	Reference	n/a	Oregon Geospatial Enterprise Office	Oct-18	Geodatabase
Highways (STRAHNET)	Reference	n/a	Metro	Nov-19	Shapefile
Hospitals	Essential facility	State/regional	Metro RLIS	Nov-18	Shapefile
			Oregon Geospatial Enterprise Office	Jan-14	Geodatabase
			Washington Geospatial Data Open Portal	Oct-19	Shapefile
Landslide deposits	Analysis	n/a	Oregon Department of Geology and Mineral Industries	Dec-19	Geodatabase
			Washington Department of Natural Resources	Sep-19	Shapefile
Landslide scarps	Analysis	n/a	Oregon Department of Geology and Mineral Industries	Dec-19	Geodatabase

Theme	Type / Use	Essential Facility / Critical Infrastructure Category	Data Provider	Date Acquired / Published	Format
Landslide susceptibility	Analysis	n/a	Oregon Department of Geology and Mineral Industries	Jan-19	Geodatabase
			Washington Department of Natural Resources	Sep-19	Shapefile
Light rail	Critical infrastructure	City/county	Washington County	Oct-19	Geodatabase
Liquefaction susceptibility	Analysis	n/a	Oregon Department of Geology and Mineral Industries	Oct-19	Geodatabase
			Washington Department of Natural Resources	May-20	Map package
Marine facilities	Critical infrastructure	State/regional	Metro	May-19	Shapefile
Marine terminals	Critical infrastructure	State/regional	Columbia County	Oct-19	Shapefile
			Port of Vancouver	Nov-19	PDF
Natural areas	Essential facility	Community / neighborhood	Metro RLIS	Oct-19	Shapefile
Parks	Essential facility	Community / neighborhood	Clark County	Unknown	Shapefile
			Columbia County	Sep-19	Shapefile
			Portland Bureau of Transportation	Oct-19	Geodatabase
Police	Essential facility	City/county	City of Gresham	Jan-20	Email
			Port of Portland	Oct-19	Email
			Washington County Consolidated Communications Agency	Jan-20	Shapefile
Population	Analysis	n/a	Metro	May-20	Shapefile
Public land ownership	Reference	n/a	Bureau of Land Management	Oct-18	Geodatabase
Public works facilities	Essential facility	City/county; state/regional	City of Gresham	Jan-20	Email
			Clackamas County	Dec-19	Shapefile
			Clark County	Jan-20	Geodatabase
			Columbia County	Sep-19	Shapefile

Theme	Type / Use	Essential Facility / Critical Infrastructure Category	Data Provider	Date Acquired / Published	Format
			Port of Portland	Nov-19	Shapefile
			Port of Vancouver	Nov-19	PDF
			Portland Water Bureau	Dec-19	Spreadsheet
			Washington County	Oct-19	Geodatabase
Rail	Critical infrastructure	State/regional	Columbia County	Sep-19	Shapefile
			Metro RLIS	Jul-18	Geodatabase
			Washington County	Oct-19	Geodatabase
Railyards	Critical infrastructure	State/regional	Metro	Nov-19	Shapefile
Regional emergency transportation routes (1996)	Routes	n/a	Metro	Sep-19	Layer package, shapefile
Regional emergency transportation routes (2005)	Routes	n/a	Metro	Sep-19	Layer package, shapefile
Regional emergency transportation routes (2021)	Routes	n/a	Clackamas County	Jun-19	Geodatabase
			Clark County	Oct-19	Email
			Columbia County	Sep-19	Shapefile
			Multnomah County	Sep-19	Shapefile
			Portland Bureau of Transportation	Oct-19	Geodatabase
			Washington County	Oct-19	Email
			Washington County	Oct-19	Geodatabase
Sand piles	Essential facility	City/county	Portland Bureau of Transportation	Oct-19	Geodatabase
Schools	Essential facility	Community / neighborhood	Columbia County	Sep-19	Shapefile
			Portland Bureau of Transportation	Oct-19	Geodatabase
			Washington Geospatial Data Open Portal	Oct-19	Shapefile
Shelters	Essential facility	Community / neighborhood	Federal Emergency Management Agency	Oct-20	Google KMZ
Snow routes	Critical infrastructure	City/county	Clark County	Nov-19	Geodatabase, PDF

Theme	Type / Use	Essential Facility / Critical Infrastructure Category	Data Provider	Date Acquired / Published	Format
State seismic lifeline routes	Reference	n/a	Oregon Department of Transportation	Oct-19	Shapefile
Streets	Reference	n/a	Clark County	Nov-19	Shapefile
			Columbia County	Sep-19	Shapefile
			Metro RLIS	Oct-19	Shapefile
Trails	Critical infrastructure	Community / neighborhood	Clark County	Unknown	Shapefile
			Metro RLIS	Oct-19	Shapefile
Transit centers	Critical infrastructure	City/county	Trimet	Nov-19	Spreadsheet, shapefile
			Washington Department of Transportation	Nov-19	Shapefile
Transit facilities	Essential facility	State/regional	Trimet	Nov-19	Spreadsheet, shapefile
Unreinforced masonry buildings	Reference	n/a	City of Portland (Open Data Hub)	Feb-20	Shapefile
Urban growth boundaries	Reference	n/a	Metro RLIS	Oct-19	Shapefile
Vulnerable populations	Analysis	n/a	Metro	Oct-19	Geodatabase

Datasets included are DOGAMI's seismic impact study results, cadastral boundaries (states, counties, cities, urban growth boundaries), ownership (public lands), demographics (underserved and vulnerable populations), critical emergency or community facilities (police stations, fire stations, emergency operations centers [EOCs], parks, schools, hospitals, etc.), transportation features (state seismic lifeline routes, roads, bridges, bike routes, transit centers, bus stops, bus routes, trails, rail, freight routes, throughways, and pedestrian routes), transportation facilities, geology and soils, seismic hazards (shaking and landslides), flood hazard areas and floodplains, and emergency response layers (i.e., locations where emergency equipment are stored).

This project resulted in a large amount of aggregated data, both existing data as well as derived through subsequent analysis. All data were securely managed and curated with redundant back-ups.

2.2.2 DATA COMPILATION

The GIS data were then compiled thematically in a file geodatabase in ArcCatalog (Figure 1). Therefore, shapefiles were exported as feature classes into the appropriate thematic feature dataset. Some datasets with multiple types of features were split across thematic datasets. For example, police stations may have been extracted from a file of all government buildings. In some files, features were individually reviewed and attributed with facility type and category before being split and organized thematically. Some data files were post-processed to extract optimal values. For example, Clark County Average Daily Traffic (ADT) was received as a shapefile with numerous associated tables. The Count tables contained all past ADT records for the 625 intersections, yielding over 3,400 records. These were reduced in Excel using conditional statements before joining to the spatial data so that only the most recent data for any given intersection is shown. City of Portland data also included numerous features for any given intersection and were therefore processed in Excel, after selecting the desired traffic types.

All data were projected to a common coordinate system, specifically Oregon State Plane HARN NAD83, International Feet, the coordinate system used by the City of Portland and Metro. The vertical datum assigned was North American Vertical Datum (NAVD) 1988.

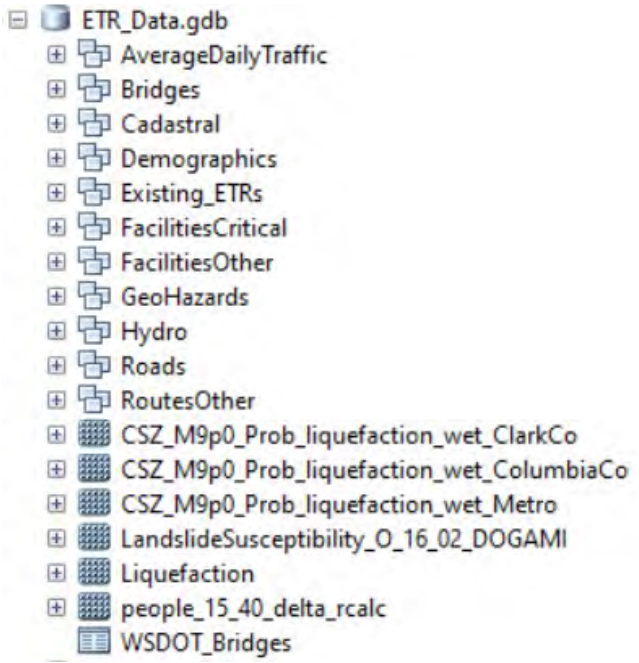

Figure 1. The source data organized thematically in an Esri file geodatabase.

2.2.3 DATA CONSOLIDATION

Related features were then consolidated into single, consistent master layers following the Regional ETR framework criteria. State/regional level critical infrastructure and essential facilities were combined into a single Category 1 EOC layer for each theme (e.g., emergency operation centers). The same was done for city/county level (Category 2) and community/neighborhood level (Category 3) themes.

A series of models were developed in ArcGIS ModelBuilder to facilitate the merging of these layers. In addition to *Merge*, other tools used within the models include *Select*, *Clip*, *Feature to Point*, *Mosaic to New Raster*, and *Dissolve*, predominantly from the Analysis and Data Management toolboxes. Limited field mapping was performed within the *Merge* tool parameters where appropriate. The extensive number of datasets (with thousands of attribute columns) precluded field mapping every attribute.

The ADT model used conditional if/else statements written in Python to populate a single ADT field (representing the most recent total ADT counts) drawing from

numerous input columns in the Clark County layer to limit null and zero values. Remaining null and zero values were removed. The City of Portland ADT weekend and weekday traffic types were used. Types such as *covid test* and *bike only* were not used.

Roads were merged into a complete coverage for the study area. Inputs included Metro's "Streets", Columbia County's "Streets" and Clark County's "Roads". The "LocalID" field was field mapped using the "LocalID" attributes in both of the Oregon layers and the "RoadsID" attribute from the Clark County layer.

Parks (from stakeholder data) and the parks and natural areas features from Metro's Outdoor Recreation and Conservation Areas layer were combined. A public lands layer was created using library data curated in-house to be included as part of the basemap as needed.

Geohazard data consisted of liquefaction susceptibility, landslide hazard, landslide inventories, loss estimates (debris tonnage), and unreinforced masonry buildings. Classified liquefaction susceptibility from two of DOGAMI's studies were used: OFR O-19-09[1] and OFR O-20-01[2]. The latter study is a risk assessment and did not result in a published liquefaction susceptibility product[3]. Liquefaction susceptibility in Clark County was an intermediate product however and though it remains unpublished it is a significant improvement on the latest published data for the county, a 2004 Washington Department of Natural Resources (WA DNR)[4] data layer. Our study

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[1] "Coseismic landslide susceptibility, liquefaction susceptibility, and soil amplification class maps, Clackamas, Columbia, Multnomah, and Washington Counties, Oregon: For use in Hazus: FEMA's methodology for estimating potential losses from disasters." By Christina A. Appleby, William J. Burns, Robert W. Hairston-Porter, and John M. Bauer. Oregon Department of Geology and Mineral Industries Open-File Report O-19-09. 2019.

[2] "Probability of Permanent Ground Deformation due to liquefaction, Cascadia Subduction Zone Magnitude 9.0 Earthquake, Wet Soil Conditions, for Clark County, Washington." By John M. Bauer, Recep Cakir, Corina Allen, Kate Mickelson, Trevor Contreras, Robert Hairston-Porter, and Yumei Wang. Oregon Department of Geology and Mineral Industries Open-File Report O-20-01. 2020.

[3] "Liquefaction_RC2." Shapefile. Intermediate data developed for DOGAMI's Open-File Report O-20-01. Incorporates WA DNR's 2004 liquefaction susceptibility, updated geologic mapping, and updated landslides. WA DNR. 2020.

[4] "Liquefaction Susceptibility and Site Class Maps of Washington State, By County" by Stephen P. Palmer, Sammantha L. Magsino, Eric L. Bilderback, James L. Poelstra, Derek S. Folger,and Rebecca A. Niggemann. WASHINGTON DIVISION OF GEOLOGY AND EARTH RESOURCES. Open File Report 2004-20. 2004.

therefore used the unpublished 2020 data. The DOGAMI data are classified using a scale from None to High. Washington's data were classified using a different scale from None to Very High and included categories for water and peat. These were merged into a single layer and the liquefaction categories field mapped to a new field. The 2004 layer was reviewed to determine a relative classification for peat. Landslide susceptibility was included from DOGAMI's OFR-O-16-02 study[5], using the raster classified from Low to Very High. Landslide inventory polygons were compiled from DOGAMI's SLIDO 4.0[6], DOGAMI's OFR-O-19-09[7] and WA DNR's unpublished 2017 data[8] for Clark County. Landslide point data also used SLIDO as well as local data provided by Clackamas County, Washington County, and ODOT. All scarps and scarp flanks are from SLIDO. Debris tonnage was referenced using the neighborhood unit loss estimates from DOGAMI's OFR 18-02[9,10] and OFR O-20-01[11,12] studies. The loss

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[5] "Landslide Susceptibility Overview Map of Oregon." By William J. Burns, Katherine A. Mickelson, and Ian P. Madin. In *Landslide susceptibility overview map of Oregon*. Oregon Department of Geology and Mineral Industries Open-File Report O-16-02. 2016.

[6] "Statewide Landslide Information Database for Oregon Release-4.0 (SLIDO R-4.0)." Geodatabase. By Jon J. Franczyk, William J. Burns, and Nancy C. Calhoun. Oregon Department of Geology and Mineral Industries. 2019.

[7] "Soil Amplification Classes and Landslides Geologic Group for Clackamas, Columbia, Multnomah, and Washington Counties, Oregon." By Christina A. Appleby, William J. Burns, Robert W. Hairston-Porter, and John M. Bauer. In *Coseismic landslide susceptibility, liquefaction susceptibility, and soil amplification class maps, Clackamas, Columbia, Multnomah, and Washington Counties, Oregon: For use in Hazus: FEMA's methodology for estimating potential losses from disasters.* Oregon Department of Geology and Mineral Industries Open-File Report O-19-09. 2019.

[8] "DRAFT_Clark_County_SLIP_Landslide" Shapefile. By Washington Geological Survey. 2017.

[9] "Neighborhood Units for Clackamas, Multnomah, and Washington Counties, Oregon." Feature class. By John M. Bauer, William J. Burns, and Ian P. Madin. In *Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon.* Oregon Department of Geology and Mineral Industries Open-File Report O-18-02. 2018.

[10] "Loss estimates per Neighborhood Unit, Cascadia Subduction Zone M 9.0 earthquake, wet (saturated) conditions scenario, Clackamas, Multnomah, and Washington Counties, Oregon" File geodatabase table. By John M. Bauer, William J. Burns, and Ian P. Madin. In *Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon*. Oregon Department of Geology and Mineral Industries Open-File Report O-18-02. 2018.

[11] "Neighborhood Units for Columbia County, Oregon, and Clark County, Washington." Feature class. By John M. Bauer, Recep Cakir, Corina Allen, Kate Mickelson, Trevor Contreras, Robert Hairston-Porter, and Yumei Wang In *Earthquake regional impact analysis for Columbia County, Oregon, and Clark County, Washington.* Oregon Department of Geology and Mineral Industries Open-File Report O-20-01. 2020.

[12] "Loss_Neighborhood_Unit_CSZ_M9p0_wet." File geodatabase table. By John M. Bauer, Recep Cakir, Corina Allen, Kate Mickelson, Trevor Contreras, Robert Hairston-Porter, and Yumei Wang In *Earthquake regional impact analysis for Columbia County, Oregon, and Clark County, Washington.* Oregon Department of Geology and Mineral Industries Open-File Report O-20-01. 2020.

estimate tables for a Cascadia Subduction Zone wet season scenario were joined to the feature classes and merged into a single layer. Unreinforced masonry was acquired from the City of Portland's open data hub[13].

Flood hazards were evaluated using FEMA's latest National Flood Hazard Layer[14].

Numerous ETRs were provided by stakeholders including Clackamas County, Columbia County, Multnomah County, Washington County, and the Portland Bureau of Transportation (PBOT). Those that were not also Regional ETRs or SSLRs were considered Local ETRs (LETR). The SSLRs consist of ODOT's Lifeline routes[15].

Bridges required additional processing. Nineteen inputs were received, which included point, line and polygon data. These had various levels of precision, accuracy, and attribution. In addition, there were numerous duplicates between inputs. The ODOT and WSDOT bridges were given precedence. A single layer of bridges without duplicates along the Regional ETRs was needed. Most duplicates were not spatially coincident and points were not well aligned with the road features. Manual editing and several GIS tools including *Near*, *Find Identical*, *Buffer*, and *Frequency* were used to remove bridges not located along the routes, remove duplicates, merge the bridges, and attribute with seismic vulnerability. The bridge data received from ODOT[16] contained seismic vulnerability classifications whereas the others did not. Bridges without seismic vulnerability were attributed as "Not Evaluated".

These consolidated data layers were organized in an Esri file geodatabase separate from the compiled source data geodatabase (Figure 2). No sensitive information protected under non-disclosure agreements was included in either file geodatabase.

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[13] "Unreinforced Masonry (URM) Buildings." City of Portland. 2020.

[14] "Flood Plains (FEMA)." The National Flood Hazard Layer (NFHL). By the Federal Emergency Management Agency (FEMA). 2019.

[15] "SeismicPlus_Routest (sic)". Shapefile of the ODOT Lifelines received October 10, 2019. ODOT.

[16] Local and State bridges for Clackamas, Columbia, Multnomah, and Washington Counties. Eight shapefiles. Received October 10, 2019. ODOT.

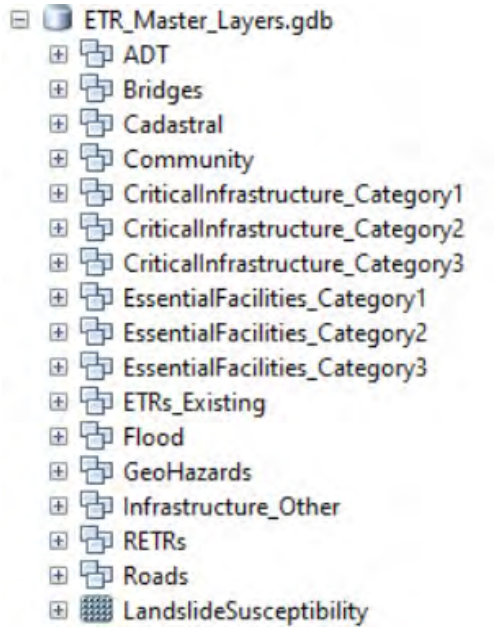

Figure 2. The consolidated GIS layers.

These master data layers can be used for several purposes:

1. As inputs for the analyses to evaluate the updated Regional ETRs,
2. For cartographic efficiency, and
3. To identify remaining data gaps.

2.3 FINAL DATA LAYERS

The resulting data layers were used as reference or in evaluating the Regional ETRs for the five-county study area: ADT, bridges, city limits, UGBs, vulnerable populations, population density, 911 dispatch centers, EOCs, public works, disaster debris management sites, hospitals, fire stations, police stations, sand piles, health clinics, armories, shelters, schools, churches, community centers, airports, fuel storage, marine terminals, marine facilities, railyards, rail, transit centers, boat ramps, light rail, bus routes, bike routes, trails, culverts, tunnels, flood hazard areas, landslide inventory, landslide susceptibility, liquefaction susceptibility, unreinforced masonry buildings, and debris tonnage.

CHAPTER 3: ETR MODELING

3.1 INTRODUCTION

A single base dataset of the most recent ETRs was needed to evaluate proximity to essential facilities, critical infrastructure, and exposure to hazards. The source data included ETRs designated by the Regional Emergency Management Group (REMG) and updated by Metro Data Resource Center (DRC) in GIS in 2005 "Metro_EmergencyTransportationRoutes" shapefile[1], representing the most recent version of ETRs in the region; 1996 ETRs designated by REMG and compiled in GIS by Metro DRC in "etr" shapefile[2]; Clark County's "Roads" shapefile[3]; and Columbia County's "Streets" shapefile[4].

Following an initial visual evaluation, additional recommended routes were added to the 1996 and 2005 ETRs dataset, which was used as the backbone to the final data Regional ETR deliverable and therefore needed to be as accurate as possible. The updated Regional ETR layer was then re-evaluated for proximity and hazards. The final Regional ETR layer can be used at a scale of 1:3,000 or smaller.

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[1] "Metro_EmergencyTransportationRoutes" Shapefile. Emergency Transportation Routes in Clackamas, Multnomah, & Washington Counties, for use in disaster response and recovery. From July 2005 *Memorandum of Understanding, Emergency Transportation Route Post-Earthquake Damage Assessment and Coordination. Portland, Oregon/ Vancouver, Washington Regional Area.* Misc. Contracts and Agreements ODOT No. 21,273. Metro Data Resource Center. 2005.

[2] "etr" Shapefile. From Metro Data Resource Center. *Regional Emergency Transportation Routes Report.* Metro Regional Emergency Transportation Routes Task Force. 1996.

[3] "Roads" Shapefile available on the Clark County Open Data Hub. Clark County GIS. 2019.

[4] "Streets" Shapefile. Columbia County GIS. 2019.

3.2 METHODOLOGY

3.2.1 EXISTING REGIONAL ETRS

The first Regional ETR layer was created using a combination of the routes designated by REMG and compiled in GIS in 1996 and 2005, giving precedence to the 2005 routes. In the tri-county Metro area, the 2005 data were used and updated. Because the 2005 routes did not extend into Columbia and Clark counties, they were joined with the relevant routes identified during the 1996 study. In addition, ETRs recently created by DOGAMI[5] based off the 2005 routes were reviewed and referred to for consistency.

Whereas the 2005 data layer was still mostly accurate, the 1996 polylines had four main issues precluding their use:

1. Roads were misaligned up to 250 feet (Figure 3),
2. Ground conditions in Clark County have changed significantly since 1996 (Figure 4),
3. Highway ramps were not consistently included (Figure 5), and
4. They lacked "LocalID" attribution.

[5] "Emergency_Transportation_Routes- Potential Impact of a Major Earthquake on Emergency Transportation Routes in Columbia County, Oregon, and Clark County, Washington" Feature class in RDPO_Earthquake_Impact_Analysis_Phase2.gdb. By John M. Bauer, Recep Cakir, Corina Allen, Kate Mickelson, Trevor Contreras, Robert Hairston-Porter, and Yumei Wang. 2020. Oregon Department of Geology and Mineral Industries Open-File Report O-20-01.

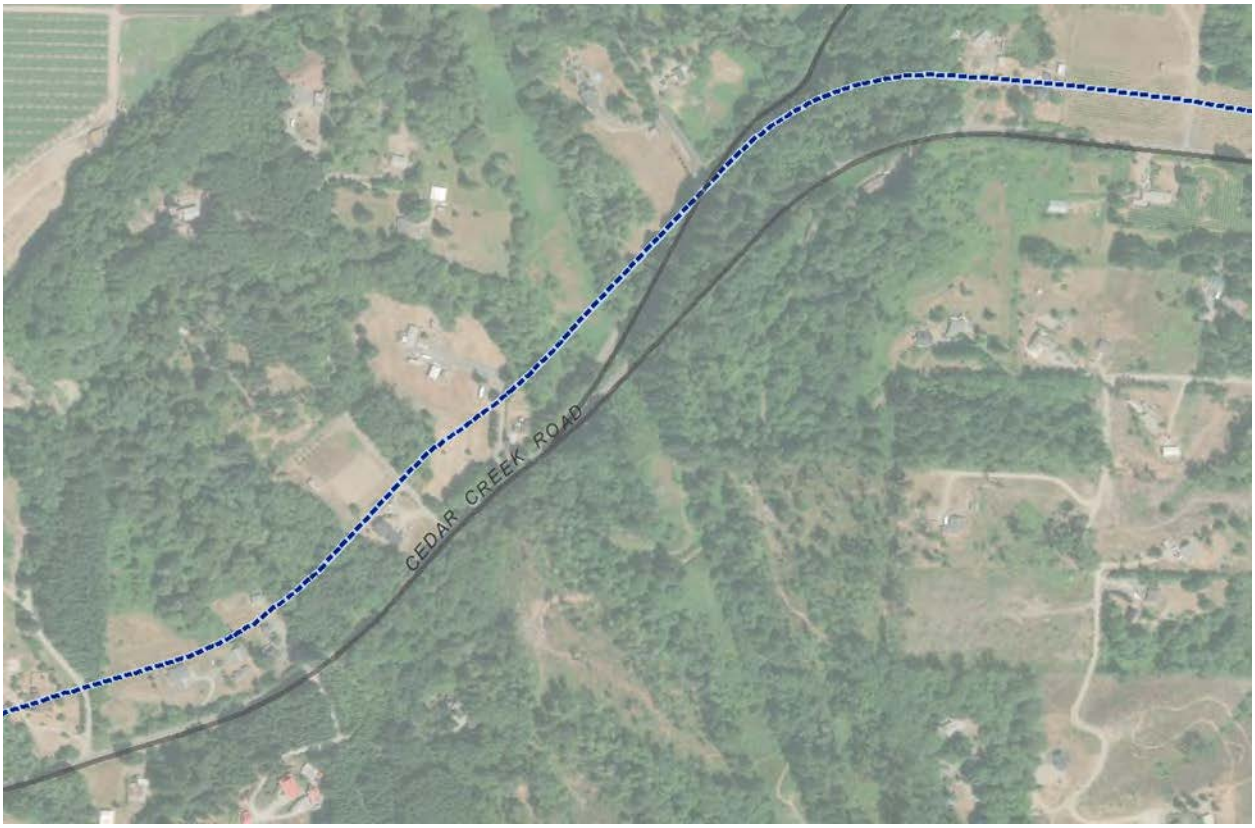

Figure 3. The Hayes Road/Cedar Creek Road 1996 ETR segment (in blue) was misaligned up to 250 feet.

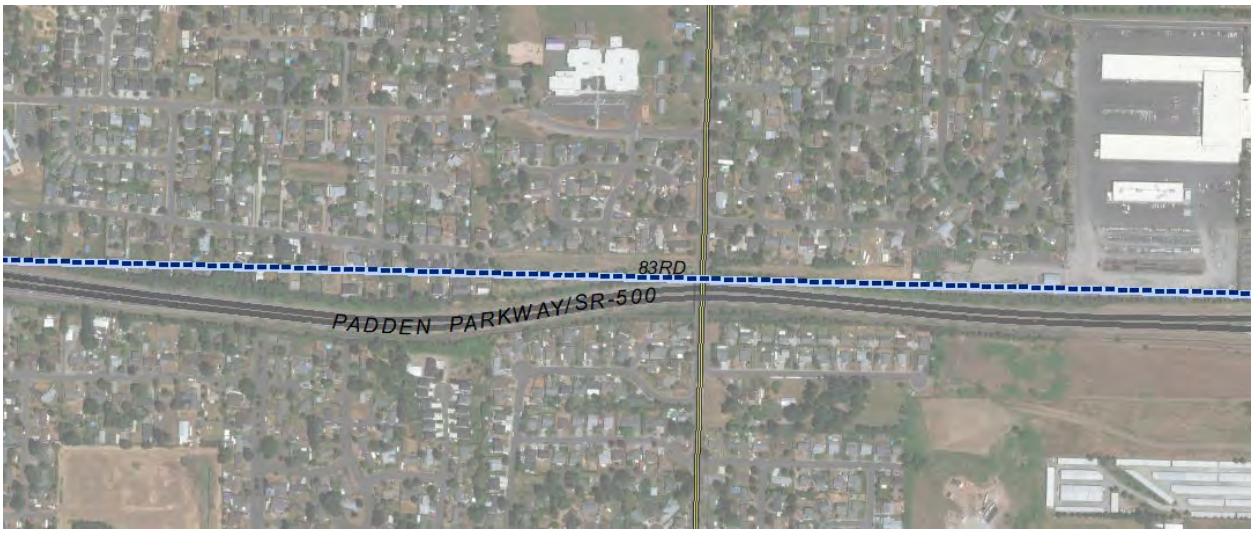

Figure 4. Some Clark County routes in the original 1996 ETRs (in blue) have been significantly realigned, such as Padden Parkway/SR-500.

Figure 5. Road improvements and approaches were incorporated. For example, 72nd Street no longer connects 78th Street and what was 83rd Street. 83rd Street has been replaced by Padden Parkway. In addition, the old ETRs (in blue) did not include highway ramps.

Development of a Baseline Regional ETR Layer

To stage the Regional ETR inputs a model was developed to prepare the roads, clip the 2005 routes, extract the 1996 routes in Clark and Columbia Counties from authoritative road layers, and assign the ETR segment IDs to the Clark and Columbia

routes. The 2005 layer was clipped to the study area extent, keeping river crossings intact, while removing extraneous segments beyond the study area. Road alignments in Clark County have changed significantly since 1996, precluding minor manual edits to the 1996 shapefile and necessitating a fresh start. Therefore, the roads identified in the 1996 ETRs were extracted from the County's 2019 "Roads" layer. These primarily included "Interstate", "Interstate Ramp", "State Route", and "SR Ramp" features as well as a few "Primary Arterials", using a SQL query. The 1996 ETRs were clipped to Clark and Columbia counties. These were then used to spatially join the ETR segment ID numbers to the routes outside of the tri-county Metro area. A copy was made for manual editing. Little has changed in Columbia County, however, roads were misaligned in several locations. Therefore, the Columbia County "Streets" layer was similarly used to extract that county's designated ETRs, using a SQL query to select the highways and other relevant roads and ramps as identified in the 1996 study. These were clipped to the study area, spatially joined with the ETR segment IDs, and a copy was made for manual editing.

Manual editing of each of the three ETR inputs (2005 ETR routes, Columbia County routes, and Clark County routes) consisted of the following:

1. For Clark County, excess segments that resulted from the SQL query were removed, where they extended beyond the designated ETRs.

2. Similarly, excess fragments were removed in Columbia County. For example, parts of Highway 47 that pass through Vernonia are classified as streets (Rose Street and Bridge Street). The portions of these streets pulled out during the SQL query that extended beyond the ETRs were removed.

3. The ETR IDs were edited in Clark and Columbia counties where needed, primarily at ramps since these had no previous counterpart.

4. The 2005 routes were manually edited where necessary to coincide with current road alignments. These changes mainly occurred at interchanges (Figure 6). Road segmentation was updated as well, for example where new intersections have been constructed resulting in new "LocalIDs".

5. The ETR IDs in Clackamas, Multnomah and Washington counties were edited for accuracy.

Figure 6. Highway ramps were updated, such as at this interchange between I-205 and 82nd Avenue. The 2005 ETRs (in red) are overlain on the RLIS Streets network (in blue). Inconsistencies were corrected.

Regional ETR Ownership

Following manual edits to the inputs, additional steps were modeled to assign ownership and to combine the layers into a single coverage. An "OWNER" field was added to the Columbia County layer to maintain consistency with the 2005 layer. Field Calculator was used to attribute the routes with ownership, using ODOT's most recent Oregon Transportation Network roads dataset[6] for verification. Because the polylines did not align sufficiently with the Columbia County Roads layer, an accurate

[6] Oregon Transportation Network - 2017" Geodatabase. By Geographic Information Services Unit, Oregon Department of Transportation (ODOT). 2018.

spatial join for ownership attribution was not feasible. The "ROADOWNER" attributes from the ODOT data were used and then formatted to be consistent with the 2005 layer. Python scripts were then written to convert the names to those matching the 2005 attributes. For example, "Oregon Department of Transportation" was replaced with "ODOT" and "Columbia County" was replaced with "COLUMBIA CO."

In Clark County, the Roads layer used to extract the routes also contained jurisdiction information. An OWNER field was added to reclass County information for consistency. After coordination with Clark County GIS staff, a combination of the "JURIS" and "RoadClass" fields was used. Where RoadClass referred to interstates, state routes, or their ramps, these were reclassed using python to "WSDOT". For all other classifications, the city or county jurisdictions in the JURIS field were used, populating the new "OWNER" field.

The process described above provided a baseline of ownership information that was known to be inaccurate for some Regional ETRs. In January 2021 a table of information was provided to stakeholders for their review and the ownership field was updated based on their feedback.

Regional ETR Road Classifications

The 2005 ETRs lacked road classifications. Therefore, the RLIS Streets were used to assign this information with the spatial join tool (using the SHARE_A_LINE_SEGMENT_WITH match option) and the *Transfer Attributes* tool. RLIS Streets uses a code in the Type field, rather than a text string. A "ROAD_CLASS" field was added to the ETR dataset. Field Calculator was used to populate it with the Type code and Python scripts were written to replace the Type number with the road classification text string, as detailed in the RLIS metadata. For example, value 1110 equates to "Freeway;" value 1120 equates to "Ramps for freeways, interchanges and feeders."

Regional ETR Route Connectivity

The *Snap* tool was then used to snap the routes together to ensure connectivity (Figure 7). These were then merged into a single dataset, using field mapping to

correlate fields across inputs[7]. Field Calculator and Python were again used to format fields for consistency, such as to convert text to upper case. A new field was added for "COUNTY". The counties were then spatially joined. "STATE" was populated as well. Extraneous fields were deleted with the *Delete Field* tool and a copy was created and stored in the project geodatabase.

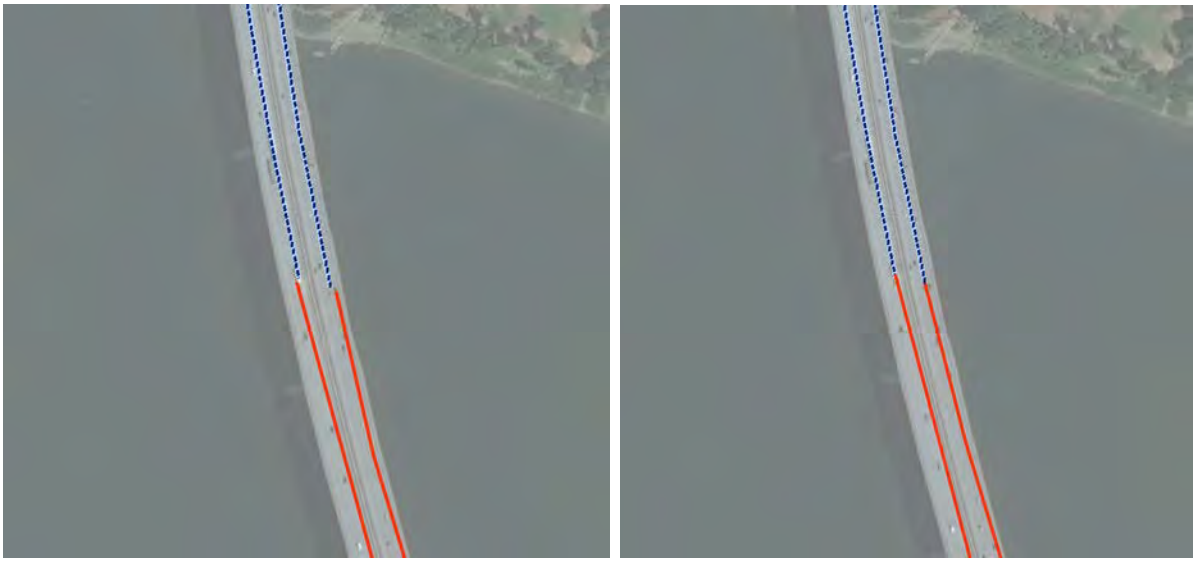

Figure 7. The 2005 routes (in red) were snapped to the Clark County routes (in blue) to ensure connectivity. Scale 1:2,000.

The attribute table was exported to Excel where the route names, from, and to fields were standardized for Clark and Columbia counties. This was then joined back to the spatial data. The refined Regional ETR layer was reviewed for QA/QC using visual and tabular checks including identifying duplicates (*Find Identical*) and mismatches (*Dissolve* and *Transfer Attributes*). The attributes are shown in Figure 8.

[7] The Columbia County roads data contained no road classifications.

ROUTENAME	ETR_ID_2005	ETR_ID_2020	ROUTE_FROM	ROUTE_TO	VERSION	ROUTE_TYPE	TOTAL_ROUTE_LENGTH
162nd / 164th Ave	60	R-X-243-00-162nd_164th	SR-14	Ward Rd	2005	Primary	35271.426863
SE 182nd Ave	55	R-X-209-00-182nd	SE Powell Blvd	E Burnside Rd	2005	Primary	11574.7655
232nd Ave	2	R-X-157-00-232nd	HWY 224	HWY 212	2005	Primary	10005.600279
242nd Ave / Hogan Rd / 238th Dr	3	R-X-201-00-242nd_Hogan_238th	HWY 212	I-84	2005	Primary	48836.718032
7th Ave	8	R-X-139-00-7th	Washington St	Molalla Ave	2005	Primary	2694.412237
82nd Ave	22	R-X-193-01-82nd	SE Clatsop St	NE Holman St	2005	Primary	48198.6343
82nd Ave	24	R-X-193-02-82nd	NE Alderwood	NE Airport Way	2005	Primary	3706.948812
Amisigger Rd / Kelso Rd / Richey Rd	100	R-X-159-00-Amisigger_Kelso_Richey	HWY 224	HWY 212	2005	Primary	18353.808888
Apiary Rd	83	R-X-109-00-Apirary	HWY 30	HWY 47	2005	Primary	109263.608288
Arndt Rd / Airport Rd / Barlow Rd	102	R-X-129-00-Arndt_Airport_Barlow	99E	I-5	2005	Primary	24362.296332
Beavercreek Rd	5	R-X-149-00-Beavercreek	HWY 213	HWY 211	2005	Primary	80084.841178
Brookwood Parkway	61	R-X-115-01-Brookwood	HWY 26	Shute Rd	2005	Primary	11446.491288
Brookwood Parkway	91	R-X-115-02-Brookwood	Cornell Rd	Shute Rd	2005	Primary	15058.436445
Burnside Brg	1	R-X-154-01-Burnside	Brg	Brg	2005	Primary	1415.628901

Figure 8. The attribute table of the Regional ETR layer.

Revisions to Baseline Regional ETRs

Additional routes beyond the 1996 and 2005 inputs then needed to be added to the Regional ETR layer before beginning the spatial analysis evaluation. After internal and stakeholder review, several routes were manually added. The Regional ETR layer was dissolved by "ETR ID", "ROUTE_FROM" and "ROUTE_TO" to create a layer of route segments. New routes were added to this dissolved route segment layer. These included ETR routes received from Clackamas County[8], Multnomah County[9,10], Washington County[11,12], and PBOT[13] during initial data gathering and additional routes identified during subsequent jurisdiction-specific meetings held in summer 2020.

Using the stakeholder-provided data to the extent possible, routes were added using a combination of edit and merge tools. Each input had different schema and levels of precision and accuracy. All routes were individually cross-checked and edited to align with the RLIS Streets layer to facilitate "LocalID" attribution and because the RLIS Streets layer has the most accurate road alignments. The From and To attributes were manually entered in addition to a "ROUTE_TYPE" attribute that identified whether

[8] "ClackamasETRs" Feature class received June 18, 2019. Clackamas County.

[9] "MultcoETRs" Shapefile received September 16, 2019. Multnomah County.

[10] "MultnomahCountyProposedSeismicETR" Shapefile received June 4, 2020. Multnomah County.

[11] "ETR" Feature class received October 25, 2019. Washington County.

[12] "SeismicResiliencyRoute_WashCo" Feature class received October 25, 2019. Washington County.

[13] "tsp_etr_coverage" Geodatabase of four feature classes received October 15, 2019.

routes were primary or alternate (i.e. detours around vulnerable bridges). The "Primary" and "Alternate" terms were already in use by Clackamas County and were therefore adopted for this study.

Establishing a Regional ETR Route Identification Naming Convention

During the first phase of evaluation, it was determined that a consistent naming convention should be developed to help with route evaluation, identification, and use. With direction from the work group, the team developed a naming convention that provides consistency, as well as the ability to add and update routes during future phases of work and update cycles. The route identification convention is **(S/R/L)-#-XXX-00-RouteName**, where:

- The **S/R/L** term designates whether it is a State, Regional, or Local route
- The **#** term will be the route tier as designated by ODOT or by the region and localities in future phases of work
- Each route has a three-digit number **XXX** assigned to it as an ID that reflects the location and direction of the route. Routes with an odd ID are north/south routes and those with even IDs run east/west. These numbers currently run between 100 and 267 for the updated route segments.
- The **00** term indicates if a route has segments. Route 101-01 and 101-02 connect to make route 101. Routes with "00" only have one segment.
- The **RouteName** reflects the road name(s) that make up the ETR.

Handling of Oregon State Seismic Lifeline Routes

The Oregon SSLRs were removed from the Regional ETR layer, to be consistent with the various ETR definitions (i.e. SSLRs vs RETRs vs LETRs). On-ramps and off-ramps were carefully evaluated. Connectivity of Regional ETRs to Oregon SSLRs was ensured.

Final Regional ETR Segments

The Regional ETRs originally had 122 segments. Following the removal of the Oregon SSLRs and several other existing routes (Table 2) and the addition of the new routes (Table 3), the Regional ETRs had 188 route segments for final evaluation.

Table 2. Summary of Regional ETRs removed from 1996/2005 baseline

Route Name and Segment	Jurisdiction(s)
Regional ETRs	
Wildcat Mountain Drive	Clackamas County
Eagle Fern Road	Clackamas County
NE 78th Street (re-aligned to Padden Parkway)	Clark County, City of Vancouver
NE 83rd Street (re-aligned to Padden Parkway)	City of Vancouver
State Route 502 or NE 10th Avenue (I-5 bypass between exits 9 and 11)	Clark County
I-5 Columbia River Bridge	Multnomah County, Clark County, Portland, Vancouver
I-205 Columbia River Bridge	Multnomah County, Clark County, Vancouver
Oregon SSLRs	
I-5	Clackamas County, Multnomah County, Washington County, Portland, Tigard, Tualatin, Wilsonville
I-205	Clackamas County, Multnomah County, Washington County, Gladstone, Maywood Park, Oregon City, Portland, Tualatin, West Linn
I-405	Multnomah County, Portland
I-84	Multnomah County, Fairview, Gresham, Portland, Troutdale, Wood Village
US Highway 26	Clackamas County, Columbia County, Multnomah County, Washington County, Beaverton, Hillsboro, Portland, Sandy
US Highway 30	Columbia County, Multnomah County, Clatskanie, Columbia City, Portland, Rainier, Scappoose, St. Helens
State Highway 212	Clackamas County, Happy Valley
State Highway 217	Washington County, Beaverton, Tigard
State Highway 43	Clackamas County, Multnomah County, Lake Oswego, Portland, West Linn
State Highway 99E	Clackamas County, Canby, Oregon City
State Highway 99W	Multnomah County, Washington County, Portland, Sherwood, Tigard, Tualatin

Table 3. Summary of Regional ETRs added to 1996/2005 baseline

Route Name and Segment	Jurisdiction(s)
SE Firwood Road	Clackamas County
SE Kelso Road	Clackamas County
S Fellows Road	Clackamas County
S Unger Road	Clackamas County
S Lower Highland Road / Ridge Road	Clackamas County
S Carus Road / Mulino Road	Clackamas County, Canby
S New Era Road / Penman Road	Clackamas County
S Central Point Road	Clackamas County, Oregon City
S Lone Elder Road	Clackamas County
S Barlow Road	Clackamas County
S Barnards Road	Clackamas County
Wilsonville Road	Clackamas County, Wilsonville
SW Stafford Road	Clackamas County, Wilsonville
SW Roy Rogers / Tualatin Sherwood Road	Clackamas County, Washington County, Wilsonville, Tualatin, Sherwood, Tigard
Kruse Way / Boones Ferry / Country Club	Clackamas County, Lake Oswego
S Holcomb Boulevard / Bradley Road	Clackamas County, Oregon City
S Hattan Road	Clackamas County
State Highway 224	Clackamas County, Happy Valley
SE 172nd Avenue	Clackamas County, Happy Valley
Sunnyside Road	Clackamas County
SW Highland / 190th Drive / Tillstrom Road	Clackamas County, Multnomah County, Happy Valley, Gresham
SE Stark Street	Multnomah County, Gresham, Troutdale
257th / Kane Drive	Multnomah County, Gresham, Troutdale
NE Fairview Parkway / Glisan Street / 223rd Avenue	Multnomah County, Gresham, Fairview
SE 112th Avenue / SE Cherry Blossom Drive	Multnomah County, Portland
SE Flavel Street	Multnomah County, Portland
Rocky Butte	Multnomah County, Portland
SE Woodstock Boulevard	Multnomah County, Portland
SE Gideon	Multnomah County, Portland
SE 17th Avenue / SE Holgate Blvd	Multnomah County, Portland
SE Hawthorne Boulevard	Multnomah County, Portland
Sellwood Bridge / Tacoma Street	Multnomah County, Portland
NE Glisan Street	Multnomah County, Portland

Route Name and Segment	Jurisdiction(s)
NE Broadway / NE Weidler Street	Multnomah County, Portland
NE Cully Boulevard	Multnomah County, Portland
NE 42nd Avenue	Multnomah County, Portland
NE 15th Avenue	Multnomah County, Portland
NE Killingsworth Street	Multnomah County, Portland
NE Dekum Street	Multnomah County, Portland
NE Lombard Street	Multnomah County, Portland
NE 47th / Cornfoot Road / Airtrans Way	Multnomah County, Portland
NE 33rd Drive	Multnomah County, Portland
Vancouver Avenue	Multnomah County, Portland
Delta Park	Multnomah County, Portland
Swan Island	Multnomah County, Portland
N Albina Avenue / N Mississippi Avenue	Multnomah County, Portland
N Chautauqua Boulevard	Multnomah County, Portland
NW Front Avenue	Multnomah County, Portland
Tilikum Crossing	Multnomah County, Portland
SW Moody Avenue	Multnomah County, Portland
Aerial Tram	Multnomah County, Portland
SW Broadway / Terwilliger Boulevard	Multnomah County, Portland
SW Murray Street	Multnomah County, Portland
NW Vaughn Street / NW 23rd Avenue	Multnomah County, Portland
SW Dewitt Street	Multnomah County, Portland
SW Capitol Highway	Multnomah County, Portland
SW Taylors Ferry Road	Multnomah County, Portland
SW Terwilliger Boulevard	Multnomah County, Portland
Dolph Court	Multnomah County, Portland
SW 45th Avenue / Vermont Street	Multnomah County, Portland
SW 26th Avenue	Multnomah County, Portland
SW 40th Avenue	Multnomah County, Portland
SW Allen Road / Garden Home Road / Multnomah Boulevard	Multnomah County, Washington County, Portland, Beaverton
NW Cornell / Barnes Road	Washington County, Beaverton
Fern Hill / Spring Hill Road / Gaston Road	Washington County, Gaston, Forest Grove
Timber / Gales Creek Road	Washington County, Forest Grove
Greenville / Kansas City / Kemper Road	Washington County
Washougal River Road / Evergreen Way	Clark County, Washougal
192nd Avenue	Clark County, Vancouver

Route Name and Segment	Jurisdiction(s)
NE 18th Street	Clark County, Vancouver
136th / 137th	Clark County, Vancouver
Andersen Road	Clark County, Vancouver
Fourth Plain Boulevard	Clark County, Vancouver
Fruit Valley / Fourth Plain Boulevard	Clark County, Vancouver
Lakeshore / Fruit Valley / 39th / 78th	Clark County, Vancouver
Main Street / Highway 99	Clark County, Vancouver

3.2.2 Spatial Analysis

The Regional ETR segment layer was used as the input for spatial analyses. The evaluation was broken into three parts, and therefore three modeling efforts. These include a proximity analysis, a resilience analysis, and a community and equity analysis. All results were exported to Excel spreadsheets and provided to the team for further analysis.

Critical Infrastructure/Essential Facilities Proximity Analysis

Model inputs included the consolidated facilities and infrastructure layers (see Table 1) plus a dissolved buffer of one quarter-mile on both sides of the Regional ETRs (Figure 9). The study area was first used to clip the boat ramps and trails to the five-county region. A batched spatial join was then utilized for each of the six categories (i.e., Categories 1-3 of both critical infrastructure and essential facilities). The spatial join, as opposed to a clip function, preserved all features in the output regardless of whether they were in or out of the buffer, attributing them with their relationship to the buffer, thereby facilitating the percentage calculation of those within the buffer. The study area feature class, which was attributed with county, was again used to attribute the Regional ETR segments with county. The Near tool was used to calculate the distance between the city limits to the nearest Regional ETR. Each of these calculations were then tabulated in a spreadsheet.

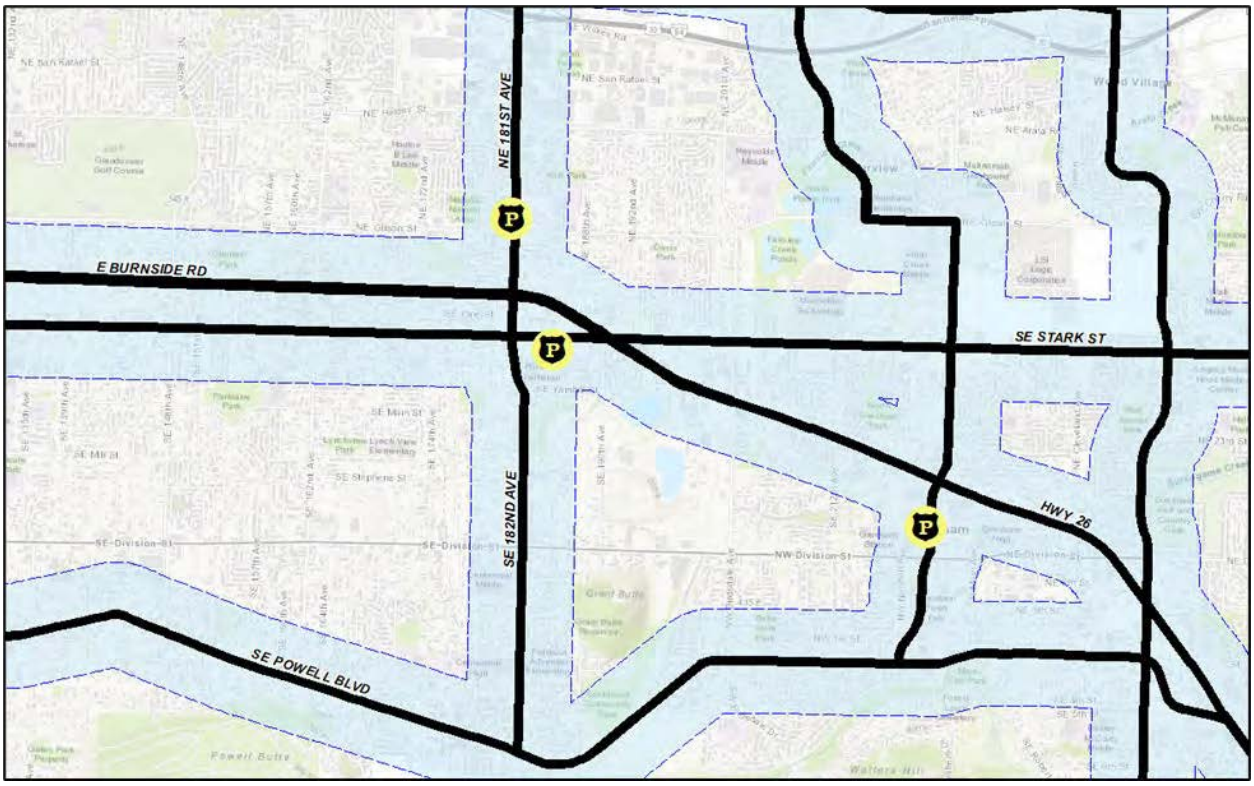

Figure 9. Police stations within the quarter-mile buffer.

Resilience Analysis

The hazards data (geohazards and flood) were used as inputs for the resilience analysis. Landslide susceptibility was converted from raster to polygons. Liquefaction susceptibility, landslide susceptibility, landslide inventory, and flood hazard areas were then joined with the Regional ETR segments using the *Identity* tool (Figure 10). Results were dissolved by classification. An Alteryx workflow was used to calculate the percentage of the classifications along each route. The tables were exported from Alteryx to spreadsheets.

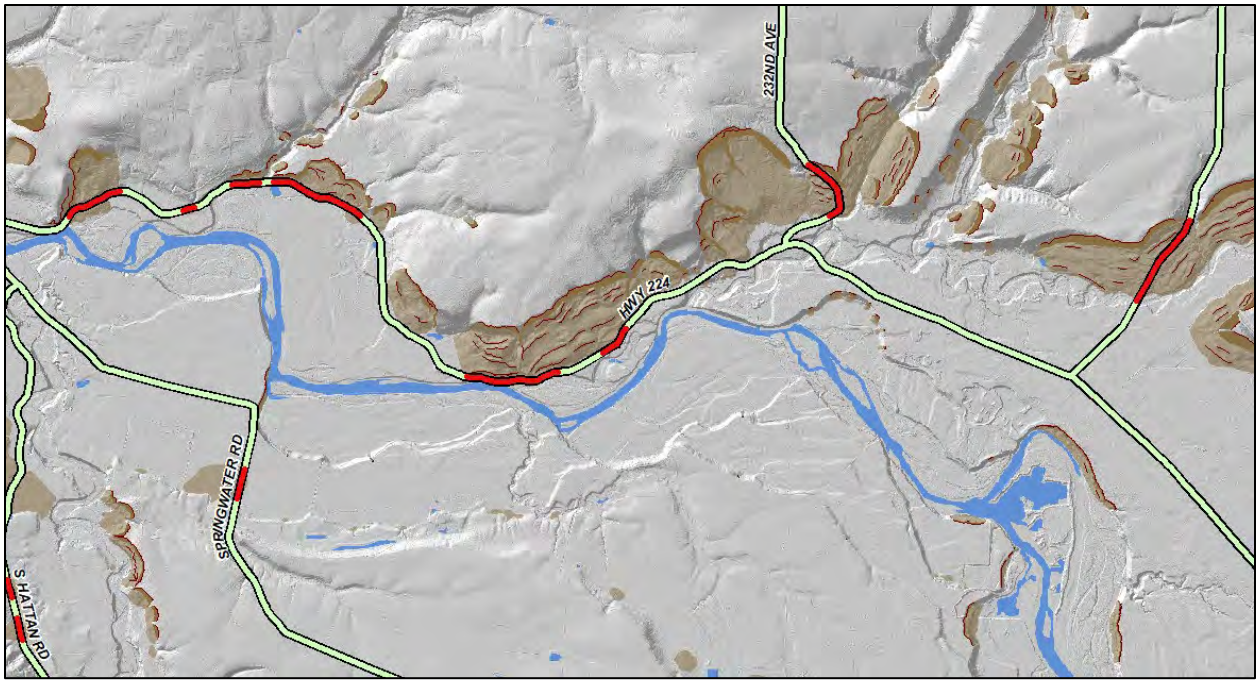

Figure 10. The percentage of hazards on each route segment was calculated using GIS tools. Landslide inventory is shown above. The red sections overlap with the hazard.

Community and Equity Analysis

To determine how well Regional ETRs provide emergency access to vulnerable populations, Metro developed "equity focus areas" (EFAs). EFAs were created from the U.S. Census Bureau's American Community Survey (ACS) 5-Year Estimates (2013-2017) and are geographically aggregated to Census tracts. Six population indicators were used to identify vulnerable populations and develop EFAs:

- People of color[14]
- Under the age of 18
- Over the age of 65
- Households with no vehicle

[14] People of color are identified as Black or African American, American Indian and Alaska Native, Asian, Native Hawaiian and Other Pacific Islander, some other race, two or more races, and any race combined with Hispanic or Latino ethnicity.

- Limited English proficiency
- Low income (less than 200% of the federal poverty level)

To determine which Census tracts were EFAs, first the average percent population for each indicator was calculated for the five-county study area. Then tracts were flagged where the percent population exceeded the study area average. Finally, population density at the block group level (subset of a tract) was calculated and compared to the study area's average population density to identify high-density Census tracts. Any tract that includes a high-density block group and is flagged for any of the six indicators is designated as an EFA.

A simple proximity analysis in ArcGIS was used to determine that there was connectivity of all EFAs to at least one Regional ETR.

3.3 LIMITATIONS AND DATA GAPS

This process revealed several gaps in data coverage, including:

- Disaster Debris Management Sites (outside of Metro jurisdictional boundary),
- Churches (outside Columbia and Washington Counties),
- Updated liquefaction susceptibility for Clark County (most recent published, data are from 2004; this study uses unpublished 2020 data),
- Landslide susceptibility for Clark County (only partial 2018 coverage exists),
- Road characteristics (number of lanes, road geometry, pavement width, turning radius, medians, signalized intersections, multiple driveways),
- Seismic vulnerability for local Oregon bridges (other than those evaluated by ODOT),
- Seismic vulnerability for state and local Washington bridges, and
- The equivalent of Oregon Statewide Seismic Lifeline Routes (SSLRs) for Washington.

Several data and analysis limitations should also be highlighted, including:

- Resilience analyses relies on the intersection of Regional ETRs with hazard layers. In the case of landslide deposits and scarps this does not account for future risk, such as an ETR that does not intersect a landslide deposit but is

downslope from it. For this reason, it is important to also consider landslide susceptibility along Regional ETRs.

- Community and equity analyses relies on U.S. Census American Community Survey estimates, which are known to be less accurate in rural Census tracts.
- Route ownership and road characteristics were not available consistently throughout the study area. Additional coordination with transportation agencies would be needed to provide or confirm these aspects of the Regional ETRs.
- Seismic induced debris tonnage was provided by DOGAMI in aggregate by neighborhood geographic unit. For larger neighborhoods especially, it does not provide insight into the proximity of debris sources (e.g., unreinforced masonry buildings) to Regional ETRs and the likelihood debris may either block the ETR or be difficult to access for removal via the ETR.

CHAPTER 4: LIST OF ACRONYMS

ADT: Average Daily Traffic

DOGAMI: Oregon Department of Geology and Mineral Industries

EFA: Equity Focus Area

EOC: Emergency Operations Center

ETR: Emergency Transportation Route

GIS: Geographic Information Systems

ODOT: Oregon Department of Transportation

RDPO: Regional Disaster Preparedness Organization

RLIS: Regional Land Information System (Metro)

SSLR: State Seismic Lifeline Route

WA DNR: Washington Department of Natural Resources

WSDOT: Washington Department of Transportation

APPENDIX F
Large Format Maps (not included in Draft)