State of Oregon
Oregon Department of Geology and Mineral Industries
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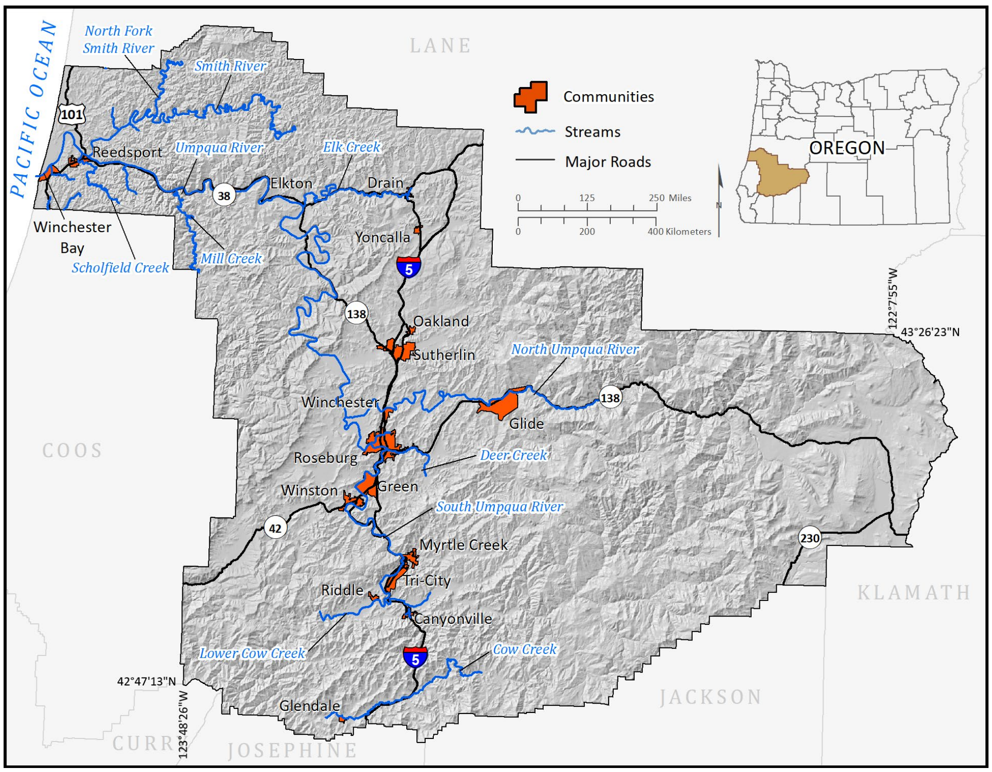
**OPEN-FILE REPORT O-24-06**

# MULTI-HAZARD RISK REPORT FOR DOUGLAS COUNTY, OREGON

**INCLUDING THE CITIES OF CANYONVILLE, DRAIN, ELKTON, GLENDALE, MYRTLE CREEK, OAKLAND, REEDSPORT, RIDDLE, ROSEBURG, SUTHERLIN, WINSTON, AND YONCALLA, AND THE COW CREEK BAND OF UMPQUA TRIBE OF INDIANS, AND THE UNINCORPORATED COMMUNITIES OF GLIDE, GREEN, TRI-CITY, WINCHESTER, AND WINCHESTER BAY**

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2024

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*Cover image: Study area of the Douglas County Risk Report. Map depicts Douglas County, Oregon and communities included in this report.*

## WHAT'S IN THIS REPORT?

This report describes the methods and results of a natural hazard risk assessment for Douglas County communities. The results quantify the impacts of natural hazards to each community and enhance the decision-making process in planning for disaster.


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## GEOGRAPHIC INFORMATION SYSTEM (GIS) DATA

*See the digital publication folder for files.*
*Geodatabase is Esri® version 10.7 format. Metadata are embedded in the geodatabase and are also provided as separate .xml format files.*

**Douglas_County_Risk_Report_Data.gdb**

**Feature dataset: Asset_Data**

feature classes:

- Building_footprints (polygons)
- UDF_points (points)
- Communities (polygons)

**Raster data: Douglas_County_Depth_Grids.gdb**

- FL_Depth_10 (GRID)
- FL_Depth_50 (GRID)
- FL_Depth_100 (GRID)
- FL_Depth_500 (GRID)

**Metadata in .xml file format:**

Each dataset listed above has an associated, standalone .xml file containing metadata in the Federal Geographic Data Committee Content Standard for Digital Geospatial Metadata format.

# EXECUTIVE SUMMARY

This report was prepared for the communities of Douglas County, Oregon, with funding provided by the Federal Emergency Management Agency (FEMA). It describes the methods and results of a natural hazard risk assessment performed in 2023 and 2024 by the Oregon Department of Geology and Mineral Industries (DOGAMI) within Douglas County (herein referred to as the study area). The purpose of this project is to provide communities with detailed risk assessment information to enable them to understand and compare hazards and act to reduce their risk. The risk assessment results quantify the consequences of natural hazards to each community and support the decision-making process in planning for disaster.

We arrived at our results and conclusions by completing three main tasks: compiling an asset database, identifying and using the best available hazard data, and performing a natural hazard risk assessment.

- In the first task, we created a comprehensive asset database for Douglas County by synthesizing assessor data, Federal Emergency Management Agency (FEMA) Hazus®-MH general building stock information, and building footprint data. This work resulted in a single dataset of building points and their associated building characteristics (e.g., construction materials, number of floors, usage, etc.). Using these data, we were able to represent accurate spatial locations and vulnerabilities on a building-by-building basis.
- The second task was to identify and use the most current and appropriate hazard datasets for the study area. Most of the hazard datasets used in this report were created by DOGAMI and produced using peer-reviewed methods and with high-resolution, lidar topographic data. Although not all the data sources used in the report provide complete, countywide information, each hazard dataset used was the best available at the time of the analysis. Data sources and coverage are discussed in detail for each hazard in **Assessment Overview and Results.**
- In the third task, we analyzed risk using Esri® ArcGIS Desktop® software. We took two risk assessment approaches: (1) estimated loss (in dollars) to buildings from floods and earthquakes using the Hazus-MH methodology, and (2) calculated the number of buildings, their value, and associated populations exposed to earthquake, and flood scenarios, or susceptible to varying levels of hazard from landslides, channel migration, and wildfire. Details on recurrence intervals, susceptibility, hazard levels and other particulars are discussed in detail for each hazard in **Assessment Overview and Results.**

The findings and conclusions of this report show the wide range of potential impacts hazards could have on the communities of Douglas County. A Cascadia Subduction Zone (CSZ) earthquake (Mw-9.0) and subsequent tsunami will cause extensive damage and losses for coastal portions of the county and moderate damage for areas farther from the coast. Moderate damage and losses would occur for some areas in Douglas County near the epicenter of a local crustal earthquake. We demonstrate the potential for reduction in earthquake damages and losses through seismic retrofits using the building code simulations in the Hazus-MH earthquake model. Flooding is identified as a threat for communities along the South Umpqua, North Umpqua, and Umpqua rivers and we quantify the number of elevated structures that are less vulnerable to flood hazard. The southern and eastern parts of the county are at significant risk from landslide hazard. There is extensive risk throughout most of the county from wildfire hazard. We also find that the highest potential for population displacement is associated with wildfire (40%) and landslide (11%) hazards.

Results were broken out for the following geographic areas:

- Unincorporated Douglas County (rural)
- City of Drain
- City of Glendale
- City of Oakland
- City of Riddle
- City of Sutherlin
- City of Yoncalla
- Community of Glide
- Community of Tri-City
- Community of Winchester Bay
- City of Canyonville
- City of Elkton
- City of Myrtle Creek
- City of Reedsport
- City of Roseburg
- City of Winston
- Cow Creek Band of Umpqua Tribe of Indians*
- Community of Green
- Community of Winchester

*This federally recognized Indian Tribal Government is referred to as the Cow Creek Umpqua Tribe within this report.

**Selected countywide results**

Total buildings: 73,438

Total estimated building value: $23.6 billion

**Cascadia Subduction Zone Magnitude 9.0 Earthquake Scenario**[a]
Red-tagged buildings[b]: 2,583
Yellow-tagged buildings[c]: 7,886
Loss estimate: $2 billion

**Cascadia Subduction Zone Magnitude 9.0 Tsunami Inundation**
Number of buildings exposed: 861 Exposed building value: $204 million

**Hypothetical Crustal Fault Magnitude 6.8 Scenario**
Red-tagged buildings[b]: 2,307
Yellow-tagged buildings[c]: 6,468
Loss estimate: $1.77 billion

**100-year Flood Scenario**
Number of buildings damaged: 4,111
Loss estimate: $218 million

**Landslide Exposure (High and Very High-Susceptibility)**
Number of buildings exposed: 9,024
Exposed building value: $2.4 billion

**Wildfire Exposure (High and Moderate Risk):**
Number of buildings exposed: 31,046
Exposed building value: $10 billion

[a]Results reflect damages caused by earthquake to buildings outside of the tsunami zone. Earthquake and tsunami results combined estimate the total damages from a CSZ M9.0 event.
[b]Red-tagged buildings are considered to be uninhabitable due to complete damage.
[c]Yellow-tagged buildings are considered to be of limited habitability due to extensive damage.

The information presented in this report is designed to increase awareness of natural hazard risk, to support public outreach efforts, and to aid local decision-makers in developing comprehensive plans and natural hazard mitigation plans. This study can help emergency managers identify vulnerable critical facilities and develop contingencies in their response plans. The results of this study are designed to be used to help communities identify and prioritize mitigation actions that will improve community resilience.

# 1.0 INTRODUCTION

> **Key Terms:**
> - *Vulnerability:* Characteristics that make people or assets more susceptible to a natural hazard.
> - *Risk:* Likelihood of occurrence multiplied by consequence; the degree of probability that a loss or injury may occur as a result of a natural hazard.

A *natural hazard* is an environmental phenomenon that can have negative consequences for humans. Where natural hazards have the potential to damage assets or harm people, the result is natural hazard *risk*. A natural hazard risk assessment identifies the applicable hazards and analyzes their consequences on the built environment and population, including the cost of recovery. Risk assessments provide key foundational information that can be used to develop mitigation plans, strategies, and actions, so that steps can be taken to prepare for a potential hazard event.

This is a multi-hazard risk assessment analyzing the consequences to buildings and resident population in Douglas County. It provides a detailed and comprehensive analysis of natural hazard risk and provides a comparative perspective not previously available. In this report, we describe our assessment results, which quantify the various levels of risk that each hazard presents to Douglas County communities.

Douglas County encompasses a very large area in the southwestern part of Oregon. It is located at the very southern end of the Willamette Valley and spans from the Cascade Range to the Oregon Coast. Douglas Coast is subject to natural hazards including: earthquakes, tsunami, riverine and coastal flooding, landslides, and wildfire. This region of Oregon ranges from sparsely to moderately developed urban areas that transition into large uninhabited areas.

## 1.1 Purpose

The purpose of this project is to help communities in the study area better understand their natural hazards and risk, and increase resilience to earthquakes (including ground shaking, liquefaction and coseismic landslides), tsunami, riverine and coastal flooding, landslides and wildfire. This is accomplished by using the best available, most accurate and detailed information about these hazards to assess the number of people and buildings at risk.

The main objectives of this study are to:

- compile a database of critical facilities, tax assessor data, buildings, and population distribution data,
- incorporate and use existing data from the most current geologic, hydrologic, and wildfire hazard studies,
- perform exposure and Hazus–based risk analyses, and
- share this report widely so that all interested parties have access to its information and data.

The body of this report describes our methods and results. Two primary methods (Hazus-MH loss estimation and exposure) were used to assess risk, depending on the type of hazard. These methods are described in the **Methods** section. Countywide results are reported for each hazard in **Community Risk Profiles**. Results for individual communities are detailed in **Appendix A: Community Risk Profiles**. **Appendix B** and **Appendix C** contains the detailed risk assessment tables used to generate the countywide results and community risk profiles. **Appendix D** provides additional explanation of the Hazus-MH methodology. **Appendix E** defines acronyms and other terms used in this report. **Appendix F** contains tabloid-size maps showing the spatial extent of the hazards, assets, and population across Douglas County. These appendices can be helpful in clarifying the summarized results in each hazard section.

## 1.2 Study Area

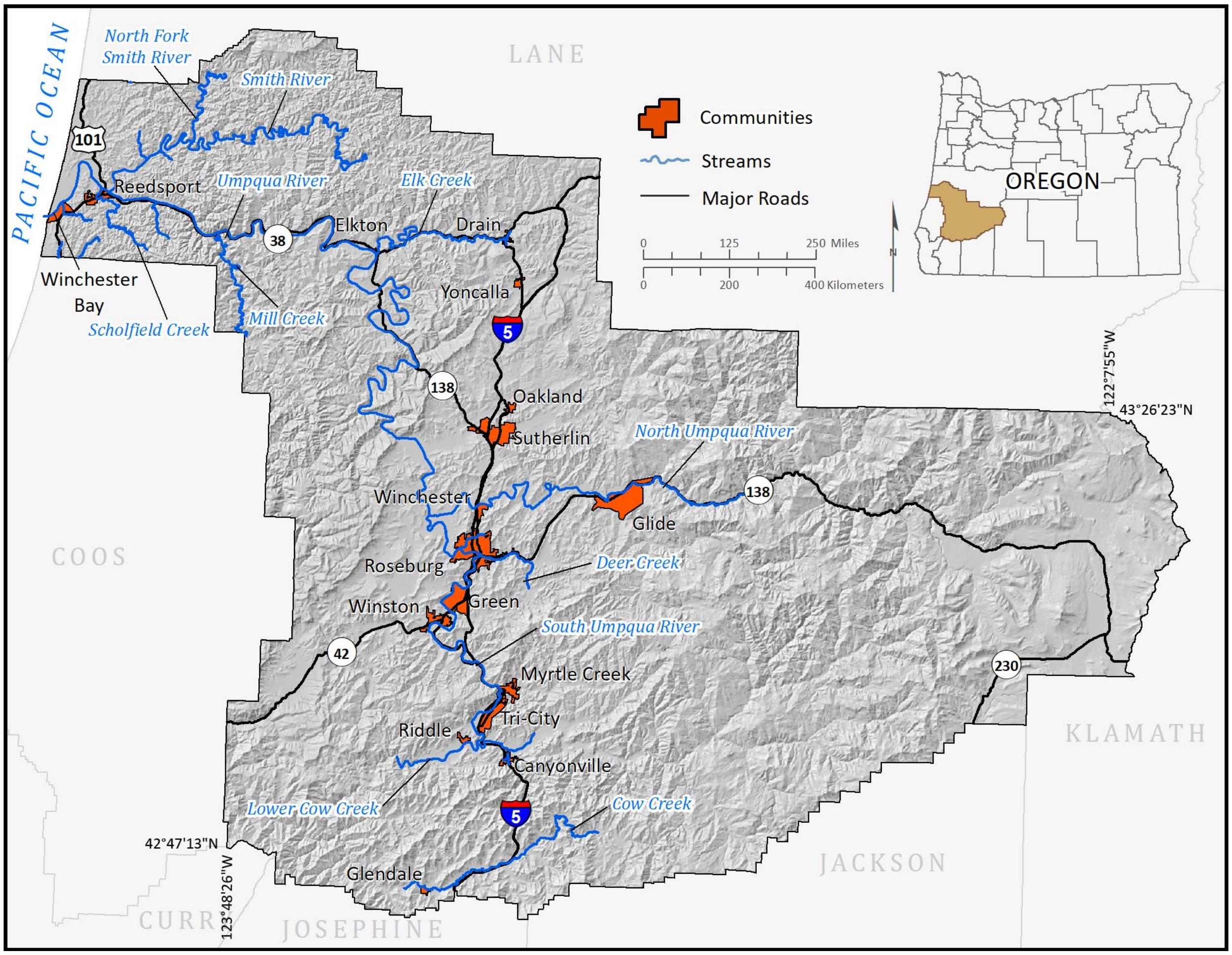
The study area for this project includes the entirety of Douglas County, Oregon (**Figure 1-1**). Douglas County is located in the southwestern part of the state; the county is bordered by Lane County on the north, Klamath County on the east, Jackson County, Josephine County, and Curry County on the south, and Coos County on the west. There is also a western coastal part of the county that borders the Pacific Ocean. The total area of Douglas County is 13,129 $km^2$ (5,069 $mi^2$). A large part of Douglas County is mountainous timberland, especially in the southeastern part of the county. Most of the developed parts of the county are centrally located along Interstate 5 or in the west along the coast.

The geography of Douglas County consists of very rugged areas in the eastern and southern portions of the county where the Calapooya Mountains of the Cascade Range meet the Klamath Mountains. Mount Thielsen is located near the eastern border of the county, rising to 2,799 meters (9,184 feet). Most of the county is heavily forested with the Umpqua National Forest making up a significant portion of the eastern part of the county. The watershed of the Umpqua River closely resembles the county boundaries itself, which ultimately empties into the Pacific Ocean at Winchester Bay.

Douglas County has approximately 112,000 people, the ninth most populated county in Oregon, based on an 2022 estimates from the Portland State University (PSU) Population Research Center https://www.pdx.edu/population-research/population-estimate-reports. Most residents live in the central part of the county along Interstate 5. The city of Roseburg, the county seat, is the county's most populus area with approximately 24,000 residents. Other incorporated communities of the study area are Canyonville, Drain, Elkton, Glendale, Myrtle Creek, Oakland, Reedsport, Riddle, Sutherlin, Winston, and Yoncalla (**Figure 1-1**). The unincorporated communities that were examined in this study were Glide, Green, Tri-City, Winchester, and Winchester Bay.

The Cow Creek Band of Umpqua Tribe of Indians ("Cow Creek Umpqua Tribe") is a federally recognized Tribal community whose trust lands lie discontinuously across parts of central Douglas County. For this risk assessment, only the Cow Creek Umpqua Tribe's trust lands were examined. The results of natural hazard risk analysis include only results for buildings located on these trust lands.

**Figure 1-1. Study area: Douglas County with communities in this study identified.**




Note: Countywide results for each hazard are presented in Chapter 3. Individual community risk profiles are presented in Appendix A

## 1.3 Project Scope

For this risk assessment, we limited the project scope to natural hazards affecting buildings and population because of data availability, the strengths and limitations of the risk assessment methodology, and funding availability. We did not directly analyze consequences to the local economy, community lifelines, stored hazardous materials, land values, socially vulnerable populations, infrastructure (e.g., transportation, power, water, gas, communication, and sewage), or the environment. Depending on the natural hazard, we used one of two methodologies: loss estimation or exposure. Loss estimation was modeled using Hazus®-MH (FEMA, 2012a, 2012b, 2012c), a tool developed by FEMA for calculating damage to buildings from flood and earthquake. Exposure is a simpler method, in which buildings are categorized based on their location relative to various hazard zones. City and county population numbers from the PSU Population Research Center data was used to distribute people into residential structures based on square footage (https://www.pdx.edu/population-research/population-estimate-reports).

A critical component of this risk assessment is a countywide building inventory developed from building footprint data and the Douglas County tax assessor database (acquired 2018). The other key component is a suite of datasets that represent the currently best available science for a variety of natural hazards. The geologic hazard scenarios were selected by DOGAMI staff based on their expert knowledge of the datasets; all datasets are DOGAMI publications except for wildfire hazard data. In addition to geologic hazards, we included wildfire hazard in this risk assessment. The following is a list of hazards considered in this study and what risk assessment methodologies were applied. See **Table 1-1** for data sources.

Earthquake Risk Assessment

- Hazus-MH loss estimation from a CSZ earthquake magnitude (Mw) 9.0 scenario. Includes earthquake induced or “coseismic” liquefaction, soil amplification class, and landslides.
- Hazus-MH loss estimation from a hypothetical local crustal fault Mw 6.8 scenario. Includes coseismic liquefaction, soil amplification class, and landslides.

Tsunami Risk Assessment

- Exposure to five potential CSZ tsunami scenarios

Flood Risk Assessment

- Hazus-MH loss estimation to four recurrence intervals of riverine flooding (10%, 2%, 1%, and 0.2% annual chance)
- Hazus-MH loss estimation for 1% recurrence interval of coastal flooding
- Exposure to 1% annual chance recurrence interval

Landslide Risk Assessment

- Exposure based on Landslide Susceptibility Index

Wildfire Risk Assessment

- Exposure based on wildfire burn probability

**Table 1-1. Hazard data sources for Douglas County.**

| Hazard | Scenario or Classes | Spatial Extent | Data Source |
|---|---|---|---|
| Earthquake | CSZ Mw-9.0 | Regional | DOGAMI (Madin and others, 2021) |
| | Hypothetical local crustal fault Mw-6.8 | Countywide | Hazus-MH custom settings |
| -Coseismic landslide | Susceptibility – wet (3-10 hazard classes) | Statewide | DOGAMI (Madin and others, 2021) |
| -Coseismic liquefaction | Susceptibility (1-5 classes) | ″ | ″ |
| -Coseismic soil amplification class | National Earthquake Hazards Reduction Program (A-F classes) | ″ | ″ |
| Tsunami | CSZ Earthquake Source:<br>Small (300 yr)<br>Medium (425-525 yr)<br>Large (650-800 yr)<br>XL (1,050-1,200 yr)<br>XXL (1,200 yr) | Oregon Coast | DOGAMI (Priest and others, 2013) |
| Flood | Depth Grids:<br>10% (10-yr)<br>2% (50-yr)<br>1% (100-yr)<br>0.2% (500-yr) | Countywide | DOGAMI; derived from FEMA (2021) data included in GIS data for this report |
| Landslide | Susceptibility (Low, Moderate, High, Very High) | Statewide | DOGAMI (Burns and others, 2016) |
| | Deposits<br>″ | Coastal Douglas Co<br>″ | DOGAMI (Burns and others, 2021a,b)<br>″ |
| Wildfire | Burn Probability (Low, Moderate, High) | Regional (Pacific Northwest, US) | ODF (Gilbertson-Day and others, 2018) |

## 1.4 Previous Studies

Several earthquake and tsunami hazards risk studies have been conducted in the preceding decades prior to this report. Some studies utilized a much lower level of detailed building information and site-specific earthquake hazard input (Wang, 1998). Other studies very thoroughly examined specific hazards that are more broadly examined in this report (Gabel and others, 2018; Wang and Franczyk, 2020; Allan and others, 2022a; Allan and others, 2022b). Comparative analysis was not part of the scope of this project, however, a summary of each is provided here.

A previous earthquake risk assessment that included Douglas County was conducted by DOGAMI (Wang, 1998). Wang (1998) ran two general level Hazus-MH earthquake analyses, a Mw 8.5 CSZ earthquake and a 500-year probabilistic earthquake scenario, for the entire state of Oregon. Douglas County was estimated to experience a 7% loss ratio in the Mw 8.5 CSZ scenario due to its proximity to the earthquake source.

In 2018, DOGAMI published Open-File Report O-18-05, *Tsunami evacuation analysis of Florence and Reedsport, Lane and Douglas Counties, Oregon* (Gabel and others, 2018) that evaluates evacuation speeds necessary for pedestrians to reach safe areas before the tsunami arrives. The analysis uses DOGAMI's maximum generated tsunami scenario (XXL) and calculates pedestrian travel speeds based on least-cost path distances and tsunami arrival times.

DOGAMI Open-File Report O-20-02, *Oregon Coastal Hospital Resilience Project* (Wang and Franczyk, 2020) assists coastal hospitals with their efforts toward building disaster resilience. Risk and impact to hospitals from a Mw 9 CSZ earthquake and tsunami including water, power, and transportation disruptions are discussed along with target response and recovery goals and recommendations for future work, including strengthening partnerships and coastal transportation planning.

DOGAMI Open-File Report O-22-06 (Allan and others, 2022a) is a rigorous analysis of the various impacts to property, critical infrastructure, and the permanent and temporary populations of Douglas County coastal communities from three potential CSZ earthquake and corresponding tsunamis (XXL, Large, and Medium). Allan and others (2022a) used previously developed tsunami evacuation modeling ("Beat the Wave"), detailed demographics from the 2020 U.S. Census and temporary visitor estimates, and the FEMA Hazus Tsunami Model to help the coastal communities of Douglas County prepare for this potential disaster.

DOGAMI Open-File report O-22-07, *Umpqua River Tsunami Modeling: Toward Improved Maritime Planning Response* by Allan and others (2022b) evaluates tsunami modeling results for both distant and local tsunamis for the Umpqua River estuary. Allan and others (2022b) provide guidance for vessels operating in the mouth of the Umpqua River and within the estuary during a variety of tsunami scenarios.

# 2.0 METHODS

Where natural hazards have the potential to damage assets or harm people, the result is natural hazard *risk*. We used a quantitative approach through two modes of analysis, Hazus-MH loss estimation and exposure, to assess the level of risk to assets and people from natural hazards.

## 2.1 Hazus-MH Loss Estimation

We used Hazus-MH version 6.0 (FEMA, 2022), which was the latest version available when we began this risk assessment. According to FEMA (FEMA, 2022a, p. 1-1), "The Hazus Loss Estimation Methodology provides state, local, tribal, and territorial officials with a decision support software for estimating potential losses from four natural hazards: floods, hurricanes, earthquakes, and tsunamis. This loss estimation capability enables users to anticipate the consequences of natural hazard events and develop plans and strategies for reducing risk […]. The use of this standardized methodology provides nationally comparable estimates that allow the federal government to plan natural hazard responses and guide the allocation of resources to stimulate risk mitigation efforts."

***Key Terms:***

- *Loss estimation:* Damage in terms of value that occurs to a building in an earthquake or flood scenario, as modeled with Hazus-MH methodology. This is measured as the cost to repair or replace the damaged building in US dollars.
- *Loss ratio:* Percentage of estimated loss relative to the total value.

Hazus-MH can be used in different modes depending on the level of detail required. Given the high spatial precision of the building inventory data and quality of the natural hazard data available for this study, we chose the user-defined facility (UDF) mode. This mode makes loss estimations for individual buildings relative to their "cost," which we then aggregate to the community level to report loss ratios. Costs used in this mode are associated with rebuilding using new materials, also known as replacement cost. Replacement cost is determined using a method called RSMeans valuation (Charest, 2017) and is calculated by multiplying the building area (in square feet) by a standard cost per square foot. These standard rates per square foot are in tables within the default Hazus-MH database.

Damage functions are at the core of Hazus-MH. The damage functions stored within the Hazus-MH data model were developed and calibrated from the observed results of past disasters. We estimated damage and loss by intersecting building locations with natural hazard layers and applying damage functions based on the hazard severity (e.g., depth of flooding) and building characteristics (e.g., first floor height).

**Figure 2-1** illustrates the range of building loss estimates from a Hazus-MH flood analysis. In this example, most buildings within the 100-year flood zone are estimated to experience losses ranging from >0 to >15%. Buildings with a first-floor height above the level of flooding and those outside the flood zone are expected to experience no losses.

Figure 2-1. **100-year flood zone of the South Umpqua River and building loss estimates example in city of Roseburg, Oregon.**

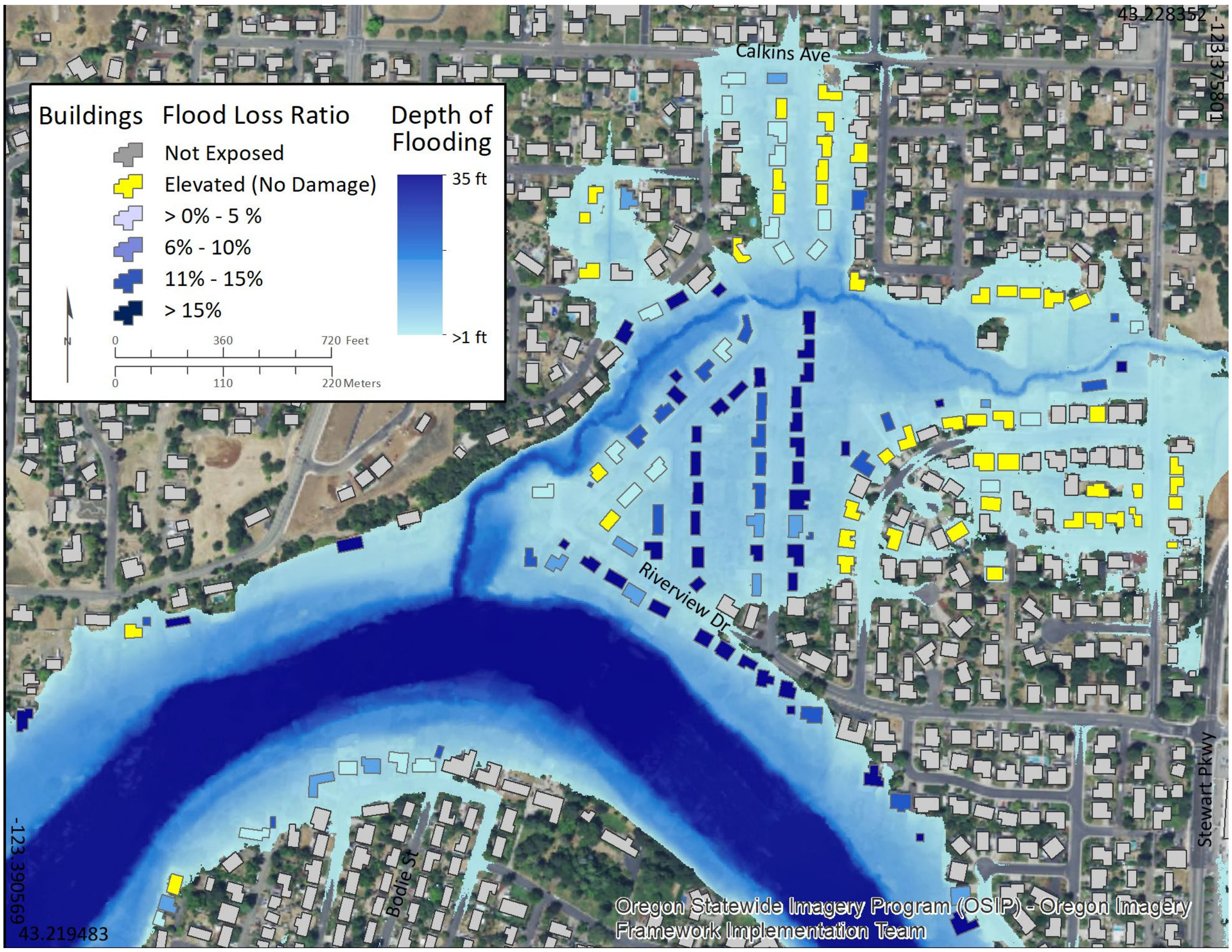



Image source: Oregon Statewide Imagery Program, 2018

Depth grid: Derived from the effective FEMA Flood Insurance Rate Map data for Douglas County, 2021

## 2.2 Exposure

Since loss estimation using Hazus-MH is not available for all types of natural hazards, we used exposure analysis to assess tsunami, landslide, and wildfire risk. Exposure methodology identifies the buildings and population that are within a particular natural hazard zone. This is an alternative to the more detailed loss estimation method for those natural hazards that do not have available damage models like in Hazus. It provides a way to easily quantify what is and is not threatened. Exposure results are communicated in terms of total building value exposed, rather than a loss estimate. For example, **Figure 2-2** shows buildings that are exposed to different levels of landslide susceptibility with building footprints colored based on what susceptibility zone the center of the building is within.

> ***Key Terms:***
> - *Exposure:* Determination of whether a building is within or outside of a hazard zone. No loss estimation is modeled.
> - *Building value:* Total monetary value of a building. This term is used in the context of exposure.

Exposure is used for tsunami, landslide, and wildfire hazards. For comparison with loss estimates, exposure is also used for the 1% annual chance flood (100-year flood), that is a flood that has a 1% chance of occurrence in any given year.

**Figure 2-2. Landslide susceptibility areas and building exposure example in Glide, Oregon.**

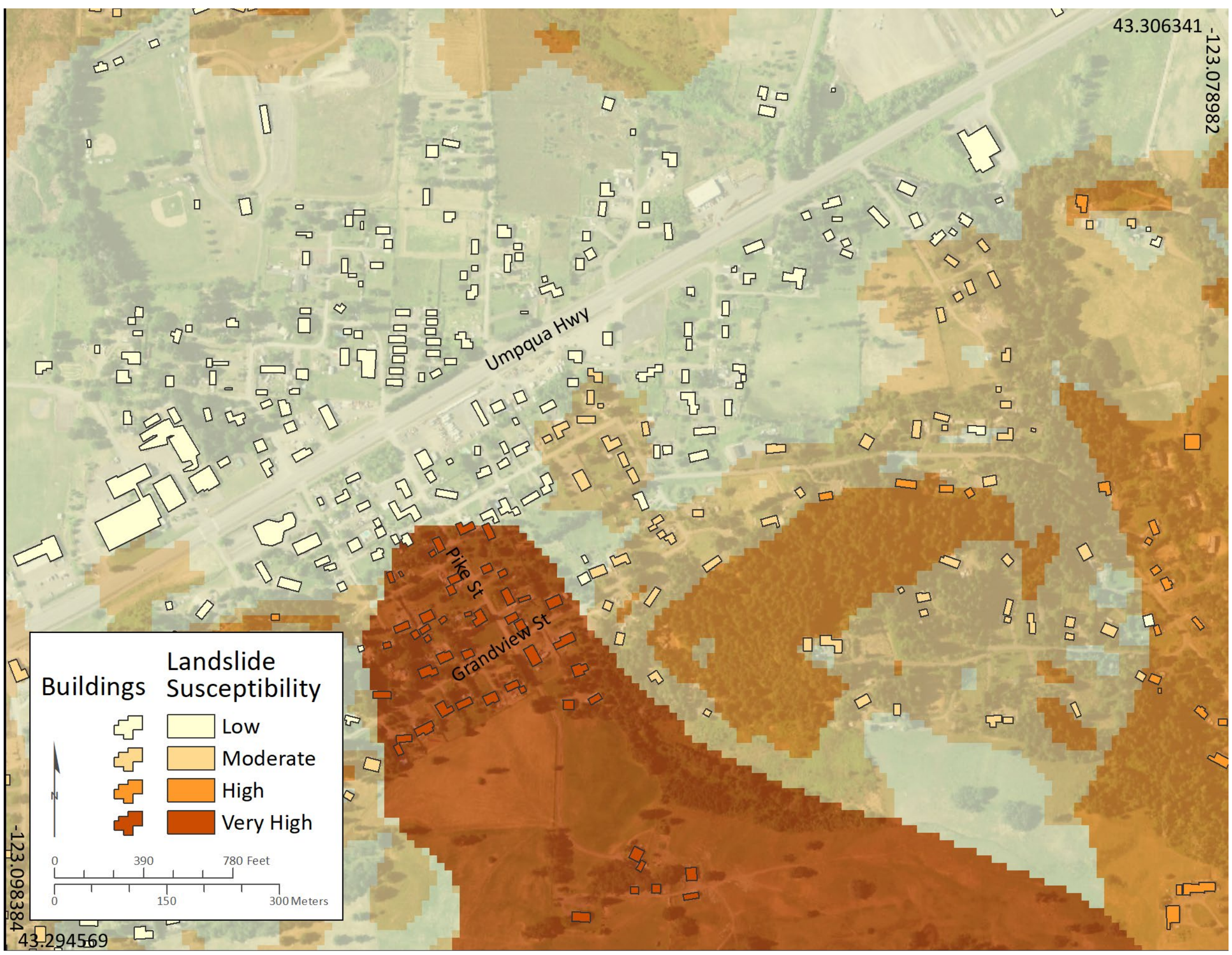



Image source: Oregon Statewide Imagery Program, 2018

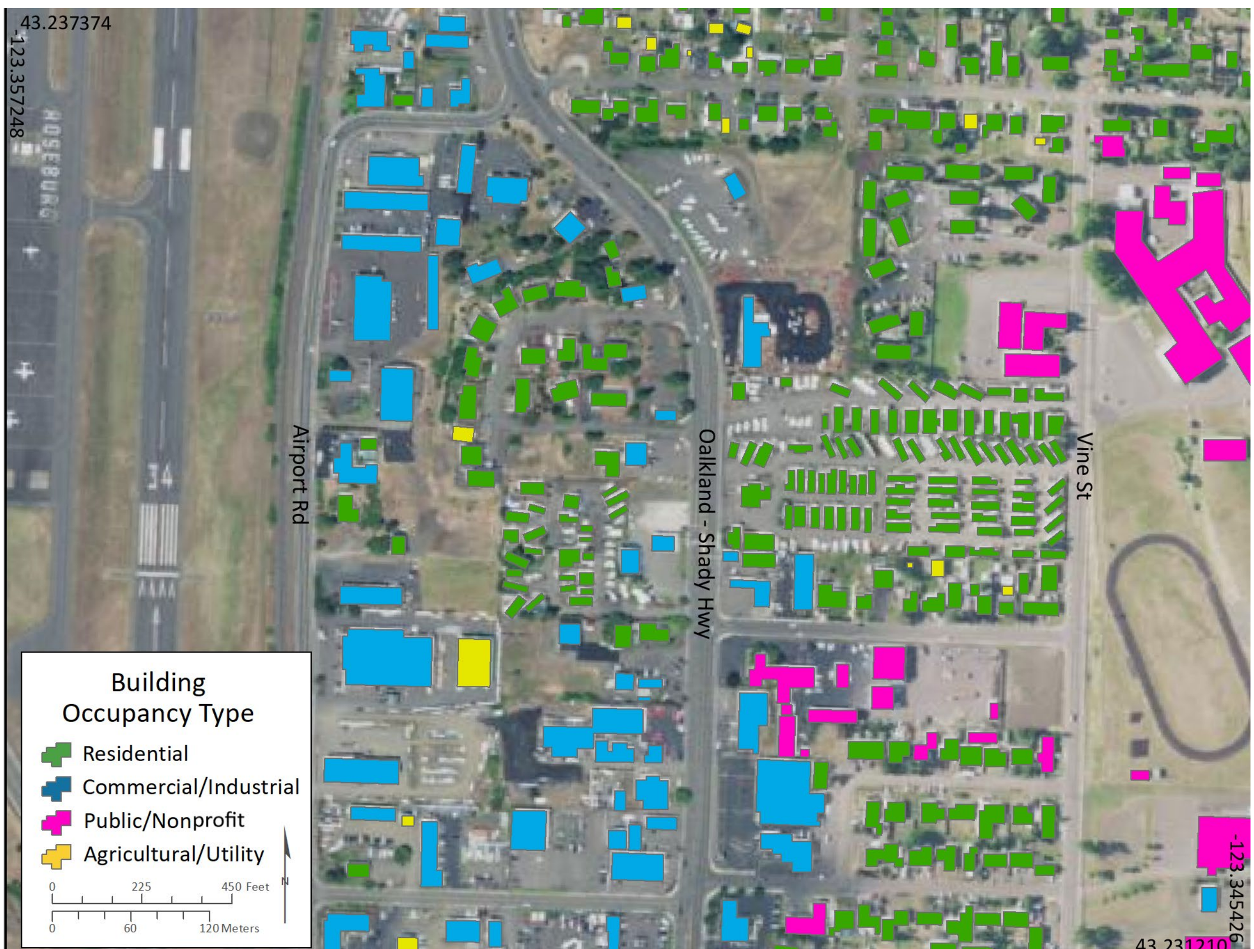
Landslide data source: Landslide susceptibility overview map of Oregon, (Burns and others, 2016)

## 2.3 Building Inventory

A key piece of the risk assessment is the countywide building inventory. This inventory consists of all buildings larger than 9.3 square meters (100 square feet), as determined from existing building footprints (Williams, 2021). **Figure 2-3** shows an example of building inventory occupancy types used in the Hazus-MH and exposure analyses in the City of Roseburg. See also **Appendix B: Table B-1** and **Appendix F: Plate 1.**

To use the building inventory within Hazus-MH, we converted the building footprint polygons to points and migrated them into a UDF database with standardized field names and attribute domains. The UDF database formatting allows for the correct damage function to be applied to each building. Hazus-MH version 2.1 technical manuals (FEMA, 2022a,b,c) provide references for acceptable field names, field types, and attributes. The fields and attributes used in the UDF database (including building seismic codes) are discussed in more detail in **Appendix D.2.2**.

Figure 2-3. **Building occupancy types, city of Roseburg, Oregon.**




The number of buildings and total building value per community varies significantly in Douglas County, with 142 buildings and $48 million for Elkton to 9,678 buildings and $4.2 billion for Roseburg (**Table**

2-1). A table detailing the occupancy class distribution by community is included in **Appendix B: Detailed Risk Assessment Tables**.

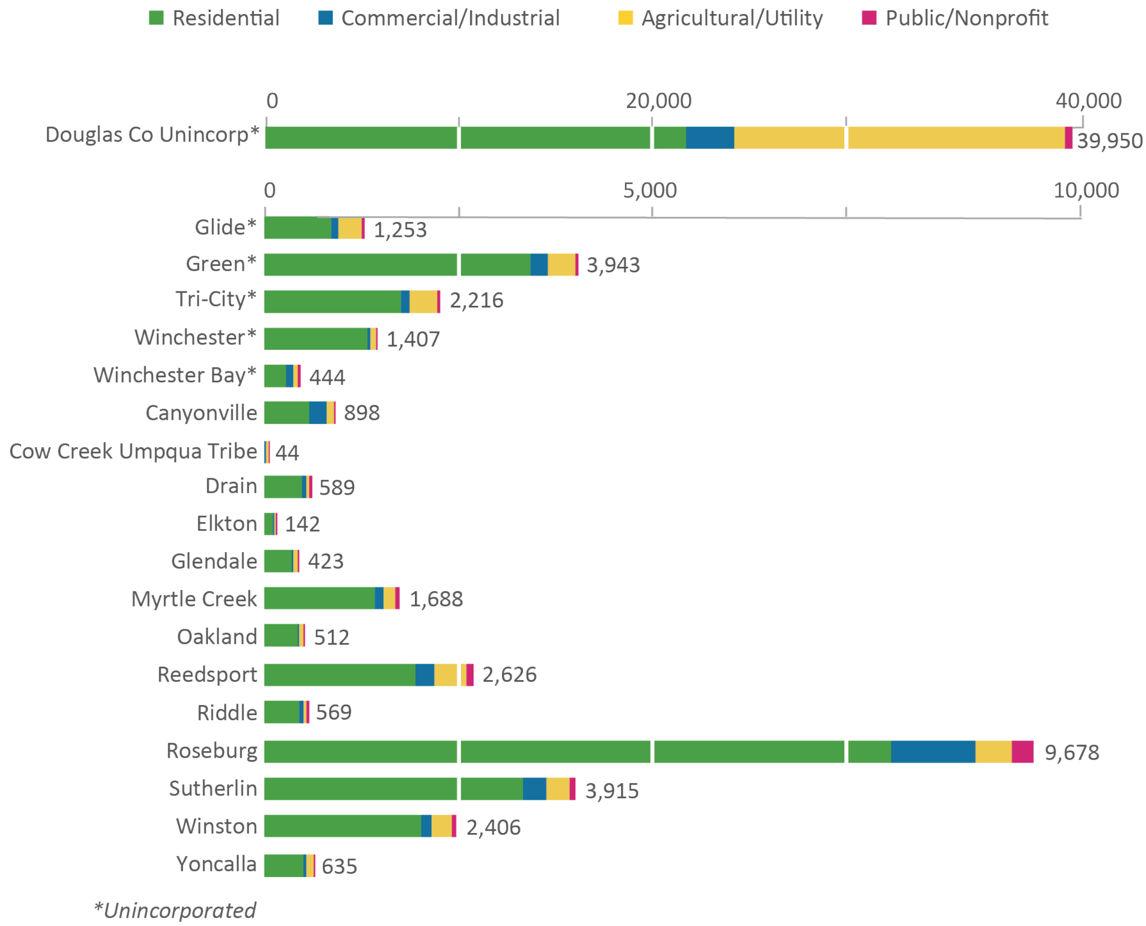
**Table 2-1. Douglas County building inventory.**

| Community | Total Number of Buildings | Percentage of Total Buildings | Estimated Total Building Value ($) | Percentage of Total Building Value |
|---|---|---|---|---|
| Unincorp. Douglas Co (rural) | 39,950 | 54% | 12,117,248,000 | 51% |
| Glide | 1,253 | 1.7% | 404,529,000 | 1.7% |
| Green | 3,943 | 5.4% | 1,170,115,000 | 5.0% |
| Tri-City | 2,216 | 3.0% | 613,037,000 | 2.6% |
| Winchester | 1,407 | 1.9% | 387,530,000 | 1.6% |
| Winchester Bay | 444 | 0.6% | 72,506,000 | 0.3% |
| Total Unincorporated County | 49,213 | 67% | 14,764,964,000 | 63% |
| Canyonville | 898 | 1.2% | 274,677,000 | 1.2% |
| Cow Creek Umpqua Tribe | 44 | 0.1% | 24,655,000 | 0.1% |
| Drain | 589 | 0.8% | 226,400,000 | 1.0% |
| Elkton | 142 | 0.2% | 48,153,000 | 0.2% |
| Glendale | 423 | 0.6% | 127,625,000 | 0.5% |
| Myrtle Creek | 1,688 | 2.3% | 531,074,000 | 2.3% |
| Oakland | 512 | 0.7% | 179,224,000 | 0.8% |
| Reedsport | 2,626 | 3.6% | 667,084,000 | 2.8% |
| Riddle | 569 | 0.8% | 174,784,000 | 0.7% |
| Roseburg | 9,678 | 13% | 4,226,793,000 | 18% |
| Sutherlin | 3,915 | 5.3% | 1,332,097,000 | 5.6% |
| Winston | 2,406 | 3.3% | 749,929,000 | 3.2% |
| Yoncalla | 635 | 0.9% | 184,859,000 | 0.8% |
| Total County | 73,338 | 100.0% | 23,512,318,000 | 100.0% |

The building inventory was developed from a statewide building footprints dataset developed by Williams (2021). The building footprints provide a spatial location and 2D representation of a structure. The total number of buildings within the study area was 73,338. Buildings are defined as permanent structures with walls and a roof that can be occupied by people (Williams, 2021). Other structures, such as dams, water tanks/towers, sewage and water treatment tanks, tents, small garden sheds, hoop-houses or other plastic-covered greenhouses, and grain silos, were not considered buildings and were not included in this analysis.

The Douglas County assessor data was originally supplied to DOGAMI in 2018 and was incorporated into building footprints. The assessor data contains an array of information about each improvement (e.g., building). The characteristics of the building footprints that were added after the 2018 information were visually identified from recent aerial imagery during this project. The building footprints were converted into points and were used in the risk assessment for both loss estimation and exposure analyses. Roseburg, Green, and Sutherlin are communities with a high total number of buildings and residential use is the most common countywide (**Figure 2-4**).

**Figure 2-4. Community building value in Douglas County by occupancy class.**




Critical facilities, including hospitals, schools, fire stations, police stations, emergency operations, and military facilities, are important to note because these facilities play a crucial role in emergency response. Other critical infrastructure considered include public works and water treatment facilities. We embedded identifying characteristics into the critical facilities in the UDF database so they could be highlighted in the results. Critical facilities data came from the DOGAMI Statewide Seismic Needs Assessment (SSNA; Lewis, 2007). We updated the SSNA data by reviewing Google Maps™ and consultation with local stakeholders. Communities that have critical facilities that can function during and immediately after a natural disaster are more resilient than those with critical facilities that are inoperable after a disaster. Critical facilities are present throughout the county with most in Roseburg and Reedsport ( **Table 2-2**). Critical facilities are listed for each community in **Appendix A**.

**Table 2-2. Douglas County critical facilities inventory.**

| | Hospital & Clinic | | School | | Police/Fire | | Emergency Services | | Military | | Other* | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Community** | Count | Value ($) | Count | Value ($) | Count | Value ($) | Count | Value ($) | Count | Value ($) | Count | Value ($) | Count | Value ($) |
| *(all dollar amounts in thousands)* | | | | | | | | | | | | | | |
| Unincorp. Douglas Co (rural) | 0 | 0 | 5 | 83,100 | 20 | 16,971 | 0 | 0 | 0 | 0 | 2 | 2,000 | 27 | 100,071 |
| Glide | 0 | 0 | 2 | 25,772 | 1 | 3,256 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 29,029 |
| Green | 0 | 0 | 2 | 16,734 | 0 | 961 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 17,695 |
| Tri-City | 0 | 0 | 2 | 34,153 | 1 | 1,572 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 35,725 |
| Winchester | 0 | 0 | 1 | 11,075 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 11,075 |
| Winchester Bay | 0 | 0 | 0 | 0 | 1 | 506 | 0 | 0 | 1 | 3,715 | 0 | 0 | 2 | 4,221 |
| Total Unincorp. County | 0 | 0 | 12 | 170,833 | 23 | 23,267 | 0 | 0 | 1 | 3,715 | 2 | 2,000 | 38 | 199,816 |
| Canyonville | 1 | 1,000 | 1 | 5,357 | 1 | 3,214 | 0 | 0 | 0 | 0 | 2 | 2,000 | 5 | 11,571 |
| Cow Creek Umpqua Tribe | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 738 | 1 | 738 |
| Drain | 1 | 1,000 | 1 | 8,440 | 1 | 2,181 | 1 | 923 | 0 | 0 | 3 | 3,000 | 7 | 15,544 |
| Elkton | 0 | 0 | 0 | 0 | 1 | 1,509 | 0 | 0 | 0 | 0 | 1 | 1,000 | 2 | 2,509 |
| Glendale | 0 | 0 | 1 | 12,197 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 12,197 |
| Myrtle Creek | 0 | 0 | 2 | 17,152 | 2 | 5,120 | 0 | 0 | 0 | 0 | 2 | 2,000 | 6 | 24,272 |
| Oakland | 0 | 0 | 3 | 27,132 | 2 | 2,358 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 29,490 |
| Reedsport | 2 | 20,508 | 2 | 66,629 | 2 | 3,563 | 0 | 0 | 0 | 0 | 2 | 2,260 | 8 | 92,960 |
| Riddle | 0 | 0 | 2 | 20,715 | 1 | 1,700 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 22,415 |
| Roseburg | 1 | 38,378 | 8 | 143,931 | 3 | 5,536 | 1 | 8,034 | 0 | 0 | 0 | 0 | 13 | 195,879 |
| Sutherlin | 0 | 0 | 4 | 30,290 | 1 | 5,905 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 36,195 |
| Winston | 0 | 0 | 4 | 54,738 | 2 | 2,776 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 57,514 |
| Yoncalla | 0 | 0 | 1 | 8,780 | 0 | 750 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 9,530 |
| Total County | 5 | 60,886 | 41 | 566,194 | 39 | 57,879 | 2 | 8,957 | 1 | 3,715 | 13 | 12,998 | 104 | 710,630 |

Note: Facilities with multiple buildings were consolidated into one building.

* Category includes buildings that are not traditional (emergency response) critical facilities but considered critical during an emergency based on input from local stakeholders (e.g., water treatment facilities or airports).

## 2.4 Community Lifelines

Lifelines are important structures that, when functioning during or immediately after an emergency, can enable a community to meet the health, safety, and economic needs of its residents. Lifelines provide these fundamental services that can minimize direct and indirect impacts from a natural disaster and expediate the recovery process. These services meet a community's day-to-day needs and when not functioning are highly disruptive and can exacerbate the negative consequences due to a natural disaster. In this report lifelines include bridges, fuel supply, food distribution, financial institutions, and high-occupancy buildings. We obtained data regarding lifelines from information provided by local stakeholders and the Oregon Department of Transportation (ODOT) (ODOT, 2023). Some lifeline categories, such as water treatment and airports, are included in the critical facilities dataset in this report. Other lifeline categories that are not examined in this report include power distribution, communications, highways, hazardous storage, and some aspects of water infrastructure.

Bridges are lifelines that are considered highly important infrastructure and are vital to public safety. During a natural disaster, bridges are crucial for emergency response, evacuation, and recovery. Bridges that are functioning after a disaster increase community's resilience from natural hazards. They facilitate the transportation of goods and services for relief. We identified bridges that could be at risk from a given hazard. A list of all bridges that are greater than 500 feet in length within Douglas County are included in **Appendix C: Vulnerability Assessment of Lifelines**.

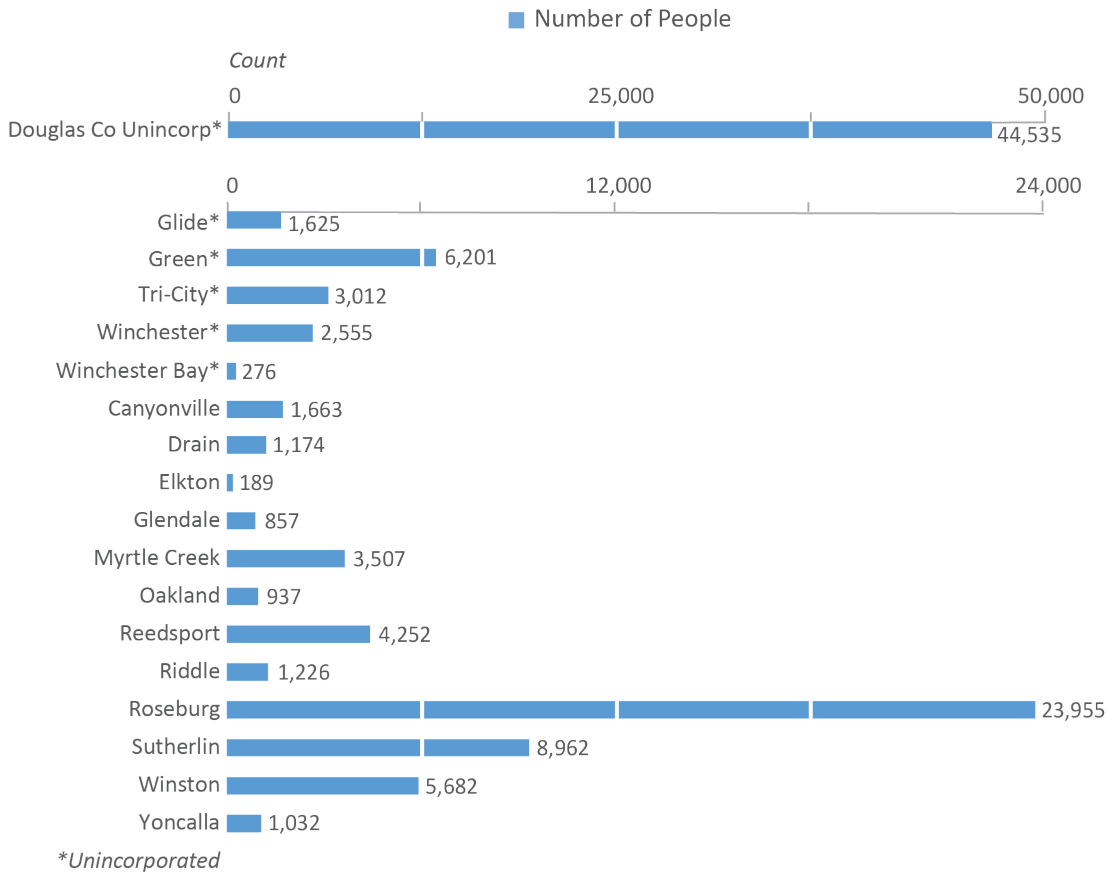
Some of the communities of Douglas County provided a list of fuel supply, food distribution, and high occupancy buildings. DOGAMI derived a list of financial institutions based on the county assessor dataset. We conducted a risk assessment for each structure identified in the list for the natural hazards examined in this report. These facilities were anonymized at the community level to address privacy concerns; however, individual structures can be obtained in the GIS database included with this report. The results of this analysis are included in **Appendix C: Vulnerability Assessment of Lifelines**.

## 2.5 Population

One purpose of the UDF database design was so that we could estimate the number of people at risk from natural hazards. Within the UDF database, the PSU Population Research Center estimates of permanent residents was distributed proportionally among residential buildings based on building area. Estimates for every incorporated community, as well as the entire county, were available from the PSU data (**Figure 2-5**). We did not examine the impacts of natural hazards on nonpermanent populations (e.g., tourists), whose total numbers fluctuate seasonally. Due to lack of information within the assessor database, we cannot distinguish between vacation homes and primary residences. Therefore, our method distributes some of the permanent residents into possible vacation homes.

From the PSU Population Research Center data, we assessed the risk of the 111,715 residents in Douglas County that could be affected by a natural hazard scenario. For each natural hazard, except for the earthquake scenario, a simple exposure analysis was used to find the number of potentially displaced residents within a hazard zone. For the earthquake scenario the number of potentially displaced residents was based on residents in buildings estimated to be significantly damaged by the earthquake.

**Figure 2-5. Population by Douglas County community.**




# 3.0 ASSESSMENT OVERVIEW AND RESULTS

In this risk assessment, we considered five natural hazards (e.g., earthquakes, tsunami, riverine and coastal flooding, landslides, and wildfire) that pose risk to Douglas County. The assessment describes both localized vulnerabilities and the widespread challenges that affect all communities. While results of this risk assessment do not typically represent singular hazard events, they do quantify the potential overall level of risk present for assets and residents. The loss estimation and exposure results, as well as the rich dataset included with this report, can lead to greater understanding of the potential consequences of natural disasters. Communities can become more resilient to future disasters by utilizing the results in natural hazard plan updates and developing future action items for risk reduction.

In this section, results are presented for the entire study area. The study area includes all unincorporated areas, tribal trust lands, and designated communities within Douglas County. Individual community results are in **Appendix A: Community Risk Profiles.**

## 3.1 Earthquake

An earthquake is a sudden movement of rock along a fault in the earth's crust, which abruptly releases strain that has accumulated over time. This movement produces waves of shaking that spread in all directions. If an earthquake occurs near populated areas, it may cause casualties, economic disruption, and extensive property damage (Madin and Burns, 2013).

Two earthquake-induced hazards are liquefaction and landslides. Liquefaction occurs when saturated soils substantially lose bearing capacity due to ground shaking, causing the soil to behave like a liquid; this action can be a source of tremendous damage (Kramer, 1996). Coseismic landslides are mass movement of rock, debris, or soil induced by ground shaking. Both of these hazards are site specific and will only occur in locations where conditions permit. All earthquake losses in this report include damages derived from shaking, as well as liquefaction and landslide factors.

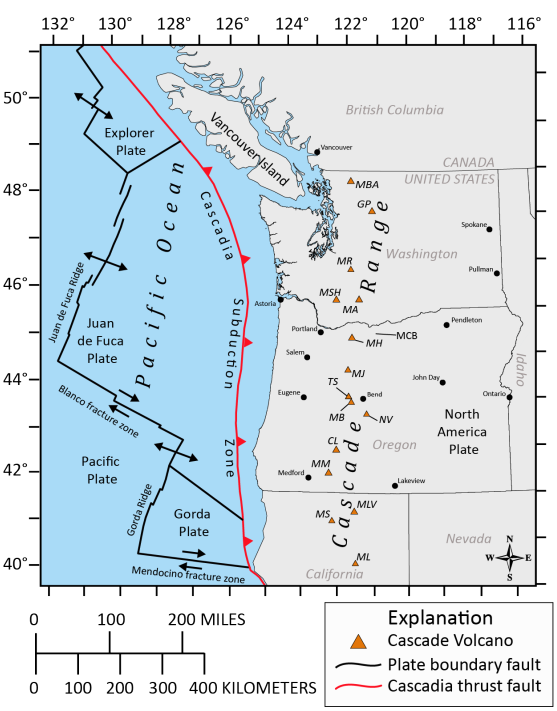
> **Understanding the connection between CSZ earthquakes and tsunamis**
>
> During a large CSZ earthquake, the sudden uplift of the North American plate along the CSZ margin is likely to displace enough water to produce a tsunami that will have an impact along the Oregon coast. The proximity of the CSZ to the coastal areas of Oregon make them especially threatened by earthquakes and tsunamis (Madin and Burns, 2013).
>
> Although we discuss CSZ earthquakes and tsunamis as separate hazards in this report, these hazards are closely associated. Their widespread effects and almost simultaneous occurrence present a challenge to planners and communities.

The region of southwest Oregon is a seismically active area, with some damaging earthquakes occurring within the historic record. For example, the West Klamath Lake fault zone is an active fault zone located near the city of Klamath Falls. Starting on September 20, 1993, and over the next three months, earthquakes ranging from Mw 4.2 to 6.0 shook the area around Klamath Falls. There were two recorded fatalities associated with the earthquakes and several buildings, including the Klamath County courthouse, were damaged. Damages in total amounted to $10 million due to the earthquake (Wiley and others, 1993). There was no recorded damage within Douglas County from this earthquake.

### Scenarios: CSZ and a hypothetical local crustal fault earthquake

Just off Oregon's coast, the Juan de Fuca tectonic plate slides under the North America plate. Oregon (along with the rest of the Pacific Northwest and the nation) sits on the North America plate. This area of interaction between the two plates is known as the Cascadia subduction zone (CSZ). The pressure and friction created by this convergent motion builds potential energy at the plate boundary until the overriding plate (North America) suddenly slips, releasing energy that manifests as strong shaking spread over a wide area (**Figure 3-1**). Earthquakes as large as Mw 8 to 9 occur along the CSZ on average every

**Figure 3-1. CSZ plate interaction**

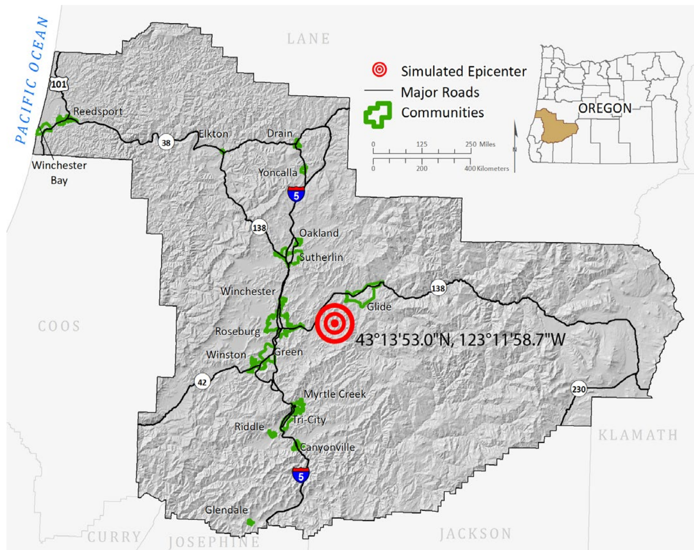


230-540 years and scientists estimate a 16-22% chance of one happening in the next 50 years (Goldfinger and others, 2012, 2017).

Unlike the CSZ, which is a plate boundary system between the Juan de Fuca and North America plates and is a source of very large earthquakes. Crustal faults are another result of the interaction between tectonic plates where planar fractures occur in the earth's crust along blocks of rock that are displaced relative to one another and are known as faults. Despite their comparatively small size, crustal earthquakes can cause significant damage due to their proximity to the surface and the built environment.

Another risk factor associated with the CSZ event is coseismic subsidence. According to Peterson and others (1997), a CSZ earthquake can result in coastal subsidence of up to 1–3 meters (~10 feet). DOGAMI estimates as much as 2.4–3.4 m (7.9–11.2 ft) of coseismic subsidence along the Douglas County coastline for the XXL scenario (Priest et al, 2013 and Witter et al, 2011). Low-lying developed areas near beaches and estuaries are most susceptible to this long-term hazard. A significant and permanent lowering of coastal terrain would expose buildings and infrastructure to tidal inundation and storm surge in low-lying coastal areas that were formerly above high tide (Madin and Burns, 2013). Analysis of this potentially significant hazard is beyond the scope of this project.

**Figure 3-2. Hypothetical scenario epicenter**




The other earthquake scenario examined for this report is a hypothetical local crustal fault scenario. While it is likely that faults exist in the area, the USGS Quaternary fault database does not identify any damage-producing earthquake faults in or near the study area. Without having any location constraints (i.e., a specific fault) to select an epicenter, the epicenter location for this hypothetical crustal scenario was placed near more densely developed areas. This was done to better represent a worst-case scenario for this type of crustal earthquake. This hypothetical epicenter was located 8 miles due east of Roseburg with a Mw 6.8 (**Figure 3-2**). Damage produced from this hypothetical scenario would be far more localized than a CSZ event and would cause more intense shaking in the vicinity of the epicenter. The effects from either earthquake scenario present a challenge for planners preparing for hazard impacts.

We examined earthquake shaking and ground failure hazards produced from both earthquake scenarios, however the likelihood of a damaging CSZ earthquake occurring is far higher than any nearby crustal earthquake. According to the National Seismic Hazard Map (Frankel and others, 2000), 75% of earthquake risk in Douglas County is due to a CSZ-related earthquake; in comparison, crustal earthquakes make up 4% of the earthquake risk. The remaining risk is from an earthquake generated anywhere in the "intraslab" zone, which is a different type of earthquake that we are not considering in this report; in part because the CSZ and local crustal earthquakes are more likely to be damaging.

### 3.1.1 Data sources: CSZ

Most of the hazard data inputs for our Hazus-MH earthquake analysis were originally created for the Oregon Seismic Hazard Database, release 1.0 (OSHD-1), which included ground shaking and site-specific data for a CSZ Mw 9.0 event (Madin and others, 2021). Wirth and others (2021) of the U.S. Geological Survey (USGS) ran 30 CSZ Mw 9.0 simulations that represented the variability of shaking that Madin and others (2021) used to develop the ground shaking datasets in the OSHD-1. At the time of writing, this is the most up to date earthquake simulations and site-specific data available.

Hazus-MH offers two methods for estimating loss from earthquake: probabilistic and deterministic (FEMA, 2012b). A probabilistic scenario uses USGS National Seismic Hazard Maps, which are derived from seismic hazard curves calculated on a grid of sites across the United States that describe the annual frequency of exceeding a set of ground motions as a result of all possible earthquake sources (USGS, 2017). A deterministic scenario is based on a specific seismic event, which in this case is the Mw 9.0 CSZ event. We selected the deterministic scenario method because the CSZ event is the most likely large earthquake to impact this area (Goldfinger and others, 2012, 2017). We used the deterministic method along with the UDF database so that loss estimates could be calculated on a building-by-building basis.

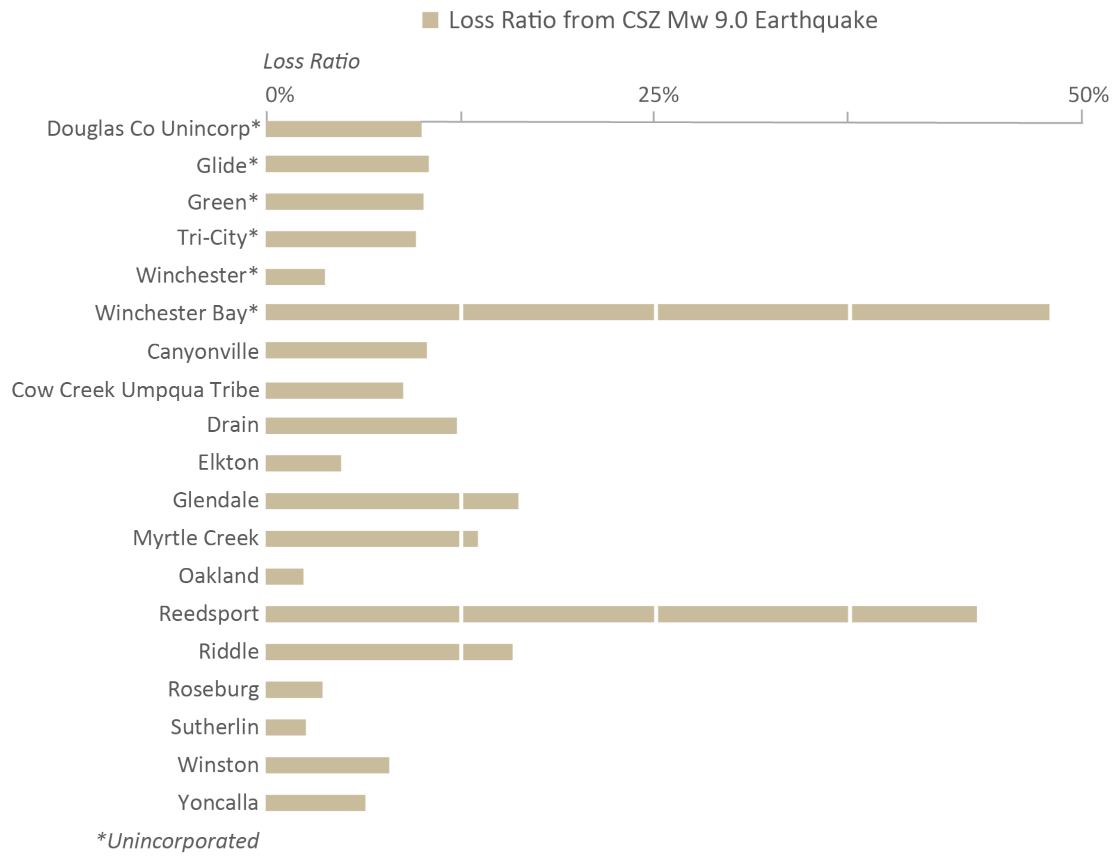
The following hazard layers used for the loss estimation analysis are derived from work conducted by Madin and others (2021): National Earthquake Hazard Reduction Program (NEHRP) soil classification, peak ground acceleration (PGA), peak ground velocity (PGV), spectral acceleration at 1.0 second period and 0.3 second period (SA10 and SA03), and liquefaction and landslide susceptibility. The liquefaction and landslide susceptibility layers together with PGA were used by the Hazus-MH tool to calculate probability and magnitude of permanent ground deformation.

While the loss estimates and exposure results of the earthquake and tsunami presented in this report both describe a single CSZ scenario, the hazard data used in these analyses are the product of different sources that equates to a slightly different event magnitude. The Medium-sized tsunami scenario was modeled with a Mw 8.9 CSZ earthquake (Priest and others, 2013). The earthquake bedrock ground motions from a Mw 9.0 CSZ earthquake were produced by Wirth and others (2021) and then modified to include site class soil factors (Madin and others, 2021). While the tsunami scenario is associated with a specific amount of slip needed to generate a tsunami, the earthquake model is independent of slip with the earthquake energy distributed over the length of the rupture zone. Irrespective of these differences, the two scenarios represent similar levels of severity and were a determining factor for their use in this report.

### 3.1.2 Countywide results: CSZ

The CSZ event will produce severe ground shaking and widespread ground failure, as well as a large and swift-moving tsunami (Madin and Burns, 2013). Due to the nearly simultaneous timing of these two natural hazards, we have parsed loss estimate results to avoid double counting. That is, earthquake-caused losses that occurred within the (Medium-sized) tsunami zone are not included in the overall earthquake loss estimate, because damage from the tsunami would override any damage caused by the earthquake. Based on tsunami events within the past 20 years in Japan, Sumatra, and Chile, we assumed that buildings are a complete loss within the entirety of the tsunami inundation area (Bauer and others, 2020). Tsunami results are provided in **Section 3.2**. **Figure 3-3** shows the loss estimates by community for Douglas County from a CSZ Mw-9.0 event without the effects from tsunami.

**Figure 3-3. Earthquake loss ratio from CSZ Mw-9.0 by Douglas County community, without tsunami inundation.**



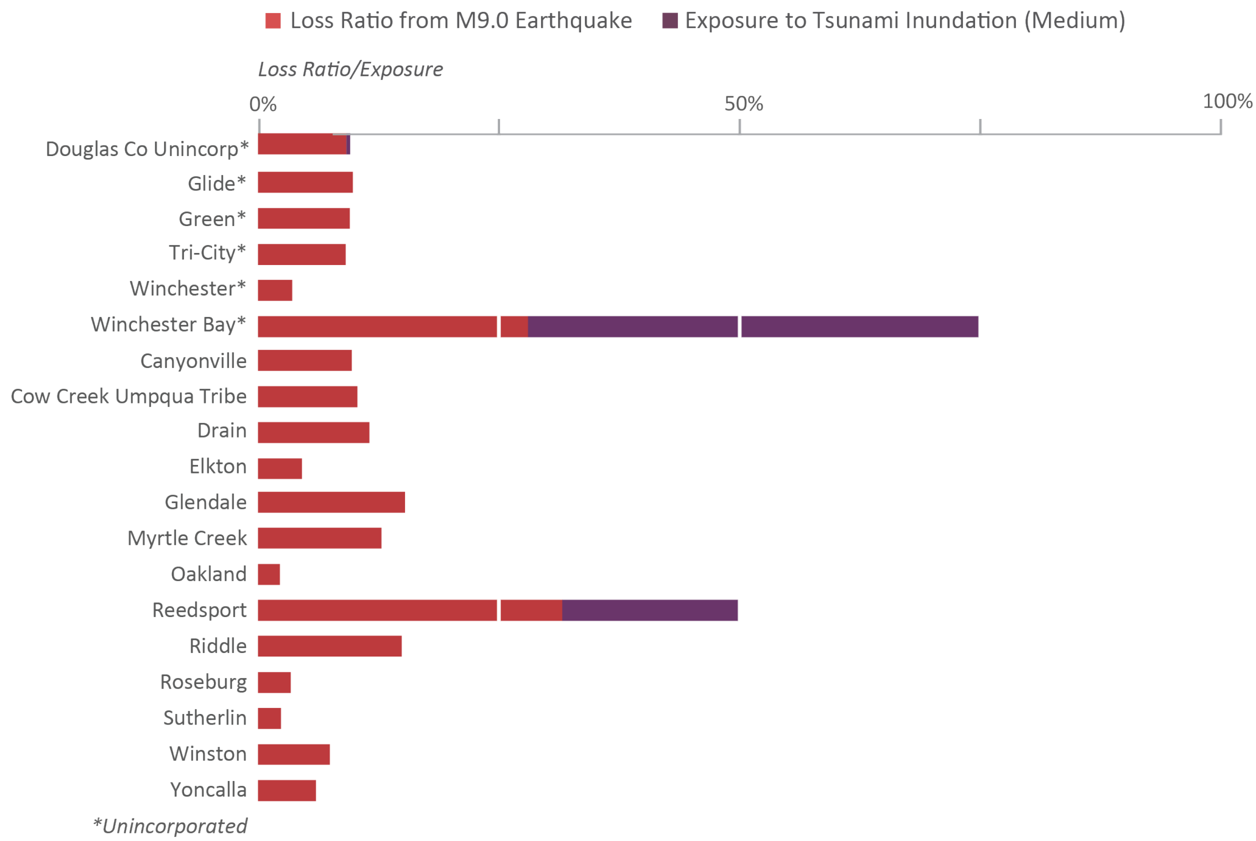

Because an earthquake can affect a wide area, every building in Douglas County will be shaken by a Mw 9.0 CSZ earthquake. Due to their proximity to the CSZ, ground shaking and building damage is expected to be significantly higher in Reedsport and Winchester Bay. Hazus-MH loss estimates (see **Table B-2)** for each building are based on a formula where coefficients are multiplied by each of the five damage-state percentages (i.e., none, low, moderate, extensive, and complete). These damage states are correlated to loss ratios that are then multiplied by the total building replacement value to obtain a loss estimate (FEMA, 2022b). Earthquake loss estimates reported are for buildings that are located *outside* of the (Medium-sized) tsunami inundation zone. **Figure 3-4** shows loss ratios from the CSZ event (both tsunami and earthquake) for the communities of Douglas County.

In keeping with earthquake damage reporting conventions, we used the Applied Technology Council (ATC)-20 post-earthquake building safety evaluation color-tagging system to represent damage states (Applied Technology Council, 2015). Red-tagged buildings correspond to a Hazus-MH damage state of “complete,” which means the building is uninhabitable. Yellow-tagged buildings are in the “extensive” damage state, indicating limited habitability. The number of red or yellow-tagged buildings we report for each community is based on an aggregation of the probabilities for individual buildings (FEMA, 2022b).

Critical facilities were considered nonfunctioning if the Hazus-MH earthquake analysis showed that a building, or complex of buildings, had a greater than 50% chance of being at least moderately damaged (FEMA, 2022b). Because building-specific information is more readily available for critical facilities and are of high importance after a disaster, we chose to report the results of these buildings individually.

The number of potentially displaced residents from our CSZ earthquake scenario was based on the formula (FEMA, 2022b): ([Number of Occupants] * [Probability of Complete Damage]) + (0.9 * [Number of Occupants] * [Probability of Extensive Damage]).

**Figure 3-4. Mw 9.0 CSZ event loss ratio in Douglas County, for both earthquake and tsunami inundation.**




Note: Due to the nearly simultaneous timing of a CSZ earthquake and tsunami, loss estimate results have been parsed to avoid double counting. That is, buildings within the (Medium-sized) tsunami zone are reported on the basis of exposure alone, while buildings outside the tsunami zone are reported on the basis of Hazus-MH earthquake loss estimates. Tsunami losses to buildings are assumed to be complete within the inundation area.

The results indicate that Douglas County will incur losses of nearly $2 billion or 8.4% of its total building assets due to a Mw 9.0 CSZ earthquake. These results are strongly influenced by proximity to the CSZ, for example Reedsport and Winchester Bay (**Figure 3-4**), where ground shaking will be more intense than other locations in Douglas County.

Areas of the county that are farther inland from the coast can see damages that are more influenced by ground deformation from liquefaction. Moderate to high liquefaction susceptibility exists throughout the Umpqua River valley, which increases the risk from earthquake hazard. Most developed areas in Douglas County are in proximity to river floodplains, which tend to be composed of highly liquefiable soil.

**Douglas countywide Mw 9.0 CSZ earthquake results (not including buildings or population within the Medium-sized tsunami zone):**

- Number of red-tagged buildings: 2,583
- Number of yellow-tagged buildings: 7,886
- Loss estimate: $1,983,120,000
- Loss ratio: 8.4%
- Nonfunctioning critical facilities: 25 of 104
- Potentially displaced population: 3,500

Although damage caused by coseismic landslides was not specifically looked at in this report, it likely contributes to the estimated damage from the earthquake hazard in Douglas County. Landslide exposure in susceptibility zones show that 10% of buildings in Douglas County are within a very high or high susceptibility zone. We infer that a similar percentage of the total earthquake losses estimated in this study may be due to coseismic landslide.

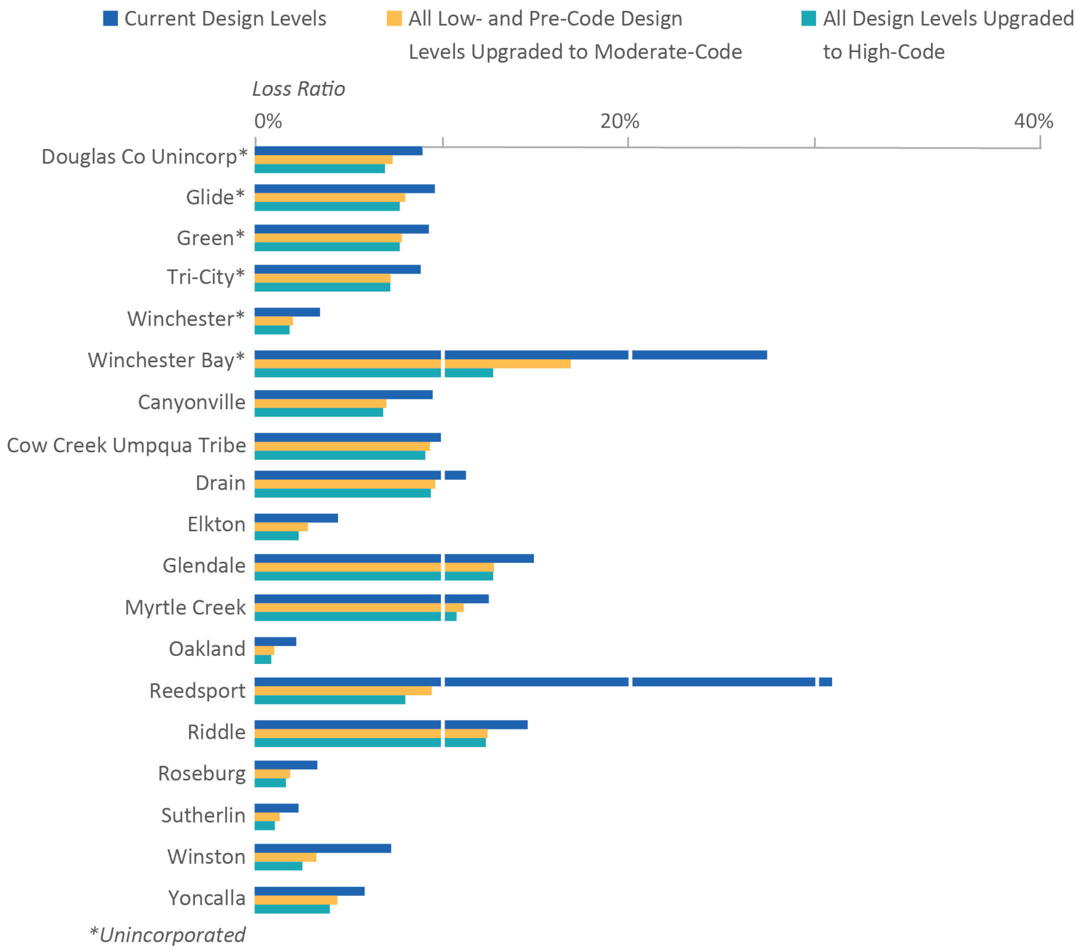
Building vulnerabilities such as the age of the building stock and occupancy type are also contributing factors in loss estimates. The first seismic buildings codes were implemented in Oregon in the 1970's (Judson, 2012) and by the 1990's modern seismic building codes were being enforced. Over half of Douglas County's buildings were built before the 1990's. In Hazus-MH, manufactured homes are one occupancy type that performs poorly in earthquake damage modeling. Communities that are composed of an older building stock and more vulnerable occupancy types are expected to experience more damage from earthquake than communities with fewer of these vulnerabilities.

If pre- and low-code buildings could be seismically retrofitted to higher code standards, earthquake risk would be greatly reduced. In this study, a simulation in Hazus-MH earthquake analysis shows that loss ratios drop from 2,583 to 1,546, when all pre- and low-code buildings are upgraded to at least moderate code level. While retrofits can decrease earthquake vulnerability, for areas of high landslide or liquefaction susceptibility, additional geotechnical mitigation may be necessary to have an effect on losses. Two simulations of a Mw 9.0 CSZ earthquake where all pre- and low-code buildings are upgraded to moderate code standards or to high code standards show significant reductions in loss estimates (**Figure 3-5**).

***Key Terms:***

- *Seismic retrofit:* Structural modification to a building that improves its resilience to earthquake.
- *Design level:* Hazus-MH terminology referring to the quality of a building's seismic building code (i. e. pre, low, moderate, and high). Refer to **Appendix C.2.3** for more information.

**Figure 3-5. Mw 9.0 CSZ earthquake loss ratio in Douglas County, with simulated seismic building code upgrades.**




Note: Loss estimates shown are for buildings outside the tsunami zone only and are reported on the basis of Hazus-MH earthquake loss estimates. Tsunami losses to buildings are assumed to be complete within the inundation area.

### 3.1.3 Data sources: Hypothetical local crustal fault scenario

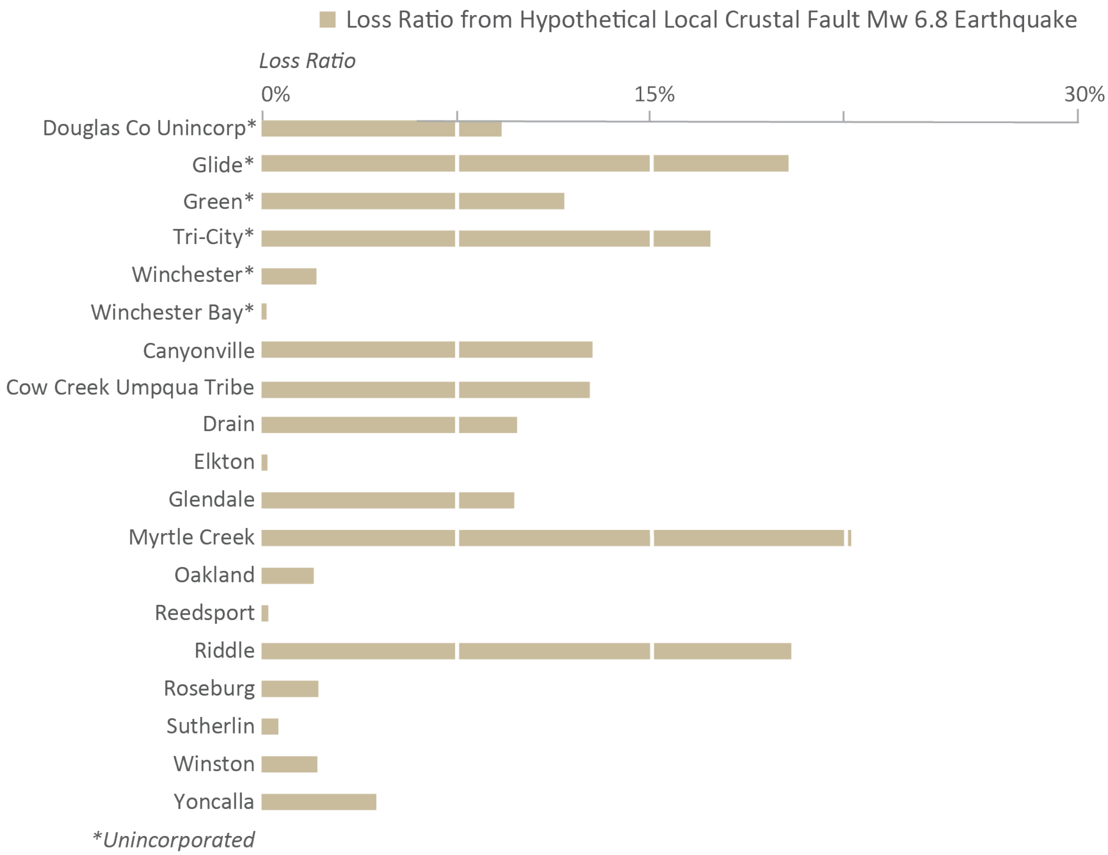
A crustal fault scenario with a magnitude of 6.8 and an arbitrarily selected epicenter was chosen as the best scenario for communicating an earthquake risk for Douglas County other than the CSZ scenario. The default Hazus-MH earthquake scenario settings provided a recommended attenuation function, which models the decrease of ground shaking intensity as earthquake waves are absorbed by the ground, for use in a simulated earthquake event. The epicenter was manually selected and was located at the closest proximity to buildings within the study area.

The following hazard layers used for our loss estimation are derived from work conducted by Madin and others (2021): National Earthquake Hazard Reduction Program (NEHRP) soil classification, landslide susceptibility (wet), and liquefaction susceptibility. The liquefaction and landslide susceptibility layers were used by the Hazus-MH tool to calculate the probability and magnitude of permanent ground deformation caused by these factors. Hazus-MH uses a characteristic magnitude value to calculate the impacts of liquefaction and landslides. For this study, we used Mw 6.8 as the characteristic event because it is the typical magnitude for a damaging crustal earthquake for this region.

### 3.1.4 Countywide results: hypothetical local crustal fault scenario

While a CSZ event will cause substantial widespread damage throughout the entire study area, our results indicate a local crustal fault Mw 6.8 earthquake will cause significant damage (15 – 20% in losses) in the communities in the vicinity of the epicenter. Because an earthquake can affect a wide area, it will also cause damage in the other communities in Douglas County, but to a lesser degree. **Figure 3-6** shows loss ratios from this crustal earthquake scenario for the communities of Douglas County.

**Figure 3-6. Earthquake loss ratio from hypothetical local crustal fault Mw 6.8 earthquake Douglas County community.**




The results indicate that Douglas County will incur losses nearing $1.8 billion or 7.5% of its total building assets in the event of a Mw 6.8 earthquake similar to one simulated in this study. These results are strongly influenced by the proximity of buildings to the epicenter of the simulated earthquake. In addition, communities along the Umpqua River and its tributaries are in areas of highly liquefiable soils. Liquefaction would exacerbate the level of risk from this earthquake scenario for any communities within a 48.2 km (~30 mi) range of the epicenter.

**Douglas County countywide crustal scenario Mw 6.8 earthquake results:**

- Number of red-tagged buildings: 2,303
- Number of yellow-tagged buildings: 6,446
- Loss estimate: $1,762,766,000
- Loss ratio: 7.5%
- Nonfunctioning critical facilities: 22 of 104
- Potentially displaced population: 2,340

### 3.1.5 Areas of significant risk

We identified locations within the study area that are comparatively at greater risk from earthquake hazard based on results from either the CSZ or the hypothetical crustal fault scenarios:

- Buildings in high liquefaction-susceptible areas near the coast and along the Umpqua River (includes Winchester Bay and Reedsport) are at higher risk to damage from coseismic liquefaction-induced ground deformation. The ground shaking intensity will be far greater in this area compared to other parts of Douglas County.
- Areas near the epicenter of a hypothetical fault earthquake scenario and with large areas of liquefaction soils are likely to incur a significant amount of damage. The communities that are near the epicenter are expected to experience higher estimated loss ratios compared to other communities in the study due to the level of shaking and ground deformation likely to occur.
- Older buildings that are more vulnerable to earthquake shaking in the communities of Reedsport, Roseburg, Riddle, Myrtle Creek, and Tri-City contribute to the level of estimated losses.
- 25 of the 104 critical facilities in the study area are estimated to be nonfunctioning due to a CSZ earthquake like the one simulated in this study and 22 are estimated to be nonfunctioning due to a hypothetical fault earthquake.

## 3.2 Cascadia Subduction Zone Tsunami

Tsunamis are a natural hazard threat that exists for many of the communities along the Oregon coast. The tsunami scenario addressed in this report is caused by the abrupt movement of the seafloor accompanying an earthquake. In a megathrust earthquake, like the CSZ event, the sudden uplift of seafloor is converted into wave energy (Priest and others, 2013). While not included in this report, other important processes that may trigger a tsunami include landslides that start below the water surface and landslides or meteorites that enter a deep body of water from above the water surface (Witter and others, 2011). Tsunamis can travel thousands of miles across oceans, so that a particular coastal area may be susceptible to two different types of tsunami hazard (Priest and others, 2013):

- Tsunamis caused by distant sources and that travel across the ocean basin, and
- Tsunamis caused by local sources such as the CSZ and that occur immediately adjacent to a coast.

During a CSZ earthquake, the sudden uplift of a portion of the North American plate along the CSZ margin is likely to produce a tsunami that will have an impact along the Oregon coast. This locally generated tsunami poses a significant risk to low-lying coastal and estuarine developed areas in Douglas County due to the limited warning time of an approaching tsunami. Tsunami inundation zone maps created by DOGAMI can serve as a tool for planning and mitigation efforts. We chose the "Medium" tsunami scenario shown on these maps to describe the level of risk to communities, because, according to Priest and others (2013), the Medium scenario tsunami is the most likely to occur with an average return interval of 425 to 525 years. For life safety purposes, the XXL scenario is used for evacuation maps.

### 3.2.1 Data sources

The tsunami hazard data used in this report are from Priest and others (2013). Priest and others (2013) modeled areas of expected inundation from five local (CSZ) tsunami scenarios and two distant-source scenarios and created a series of inundation maps. The distant-source tsunami scenarios were not used in this report. The local tsunami scenarios used in this report for exposure analysis were CSZ "t-shirt" sizes of Small (Sm), Medium (M), Large (L), Extra Large (XL), and Extra-Extra Large (XXL).

The CSZ tsunami scenarios that were developed by Priest and others (2013) are based on "time intervals over which the maximum amount of coseismic slip accumulates (creating a "slip deficit") and is then released during full ruptures of the ~1,000 km (~600 mi) long megathrust fault zone." Slip deficit time intervals simply put, are the intervals between CSZ events and their corresponding earthquake and tsunami sizes. The slip deficit time intervals for each local-source tsunami scenario are as follows (Priest and others, 2013):

- XXL 1,200 years
- XL 1,050–1,200 years
- L 650–800 years
- M 425–525 years
- Sm 300 years

The estimated annual recurrence (percentage chance in a given year) rates are from Witter and others (2011) and are:

- XXL = unknown (not seen in the 10,000-year record)
- XL = <1/10,000 = <0.01%
- L = 1/3,333 = 0.03%
- M = 1/1,000 = 0.1%
- Sm = 1/2,000 = 0.05%

For this risk assessment, DOGAMI compared the locations of buildings and critical facilities to the geographic extent of the local-source tsunami inundation zones to assess the exposure for each community. The exposure results shown below are based on the M scenario only (see **Table B-4** for all scenarios). The total dollar value of exposed buildings was summed for the study area and is reported below. We were also able to estimate the number of people at risk from tsunami hazard. See **Appendix A: Community Risk Profiles** and **Appendix B: Detailed Risk Assessment Tables** for cumulative multi-scenario analysis results.

### 3.2.2 Countywide results

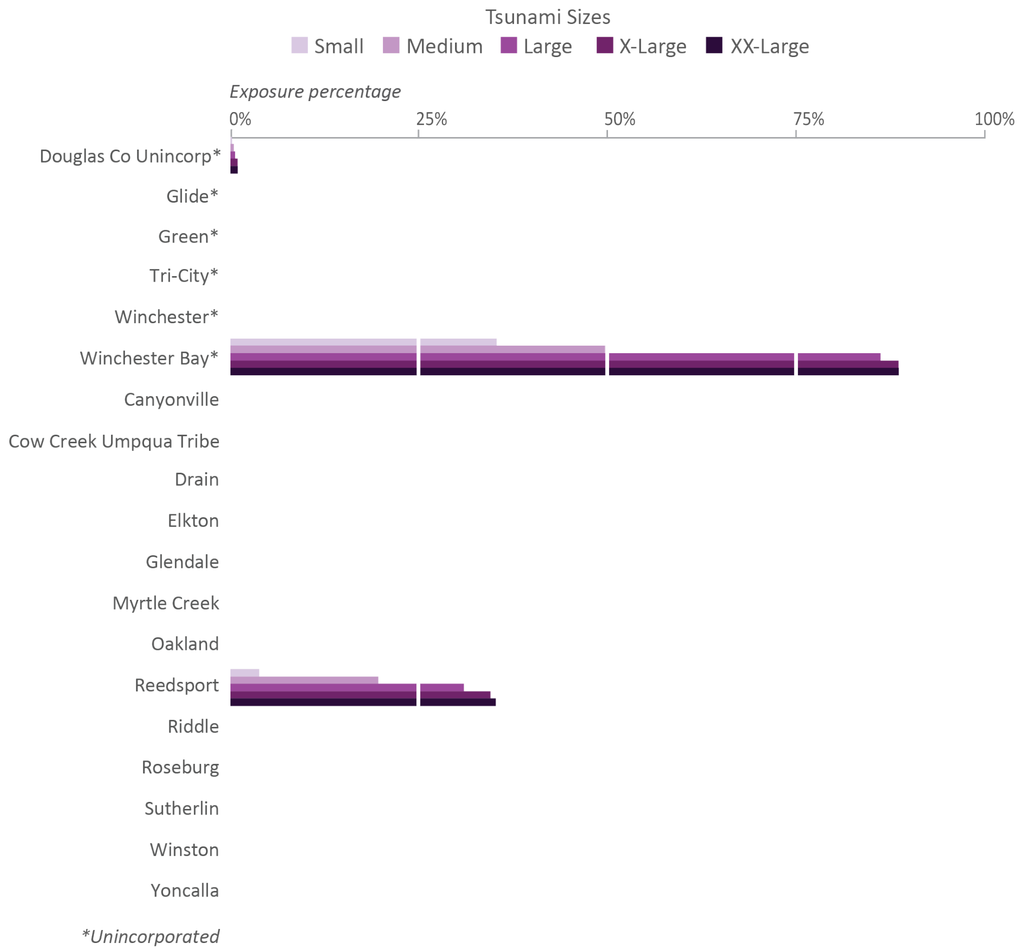
The coastal zones and other upstream portions of the Umpqua River that are influenced by tides within Douglas County would be impacted by the largest of the DOGAMI-calculated tsunami scenarios. The number of permanent residents of Douglas County within a tsunami zone ranges from ~850 (M scenario) to ~1,800 (XXL scenario). However, the Medium-sized tsunami was chosen to describe the level of risk because that is the scenario that is most likely to occur. For life safety purposes, the XXL scenario is used for evacuation maps. Douglas County's communities built along and near the mouth of the Umpqua River are at a higher risk from tsunami hazard than communities farther inland.

**Douglas County countywide CSZ tsunami exposure (Medium tsunami scenario):**

- Number of buildings exposed: 861
- Exposure value: $204,443,000
- Percentage of exposure value: 0.9%
- Critical facilities exposed: 4 of 104
- Potentially displaced population: 854

The combination of earthquake and tsunami will have a significant impact to the entire coastal and tidal portions of the Umpqua River within Douglas County. Low-lying areas in coastal communities are predicted to be within tsunami inundation zones. Areas near the coast, like Winchester Bay, are within all five CSZ scenarios, whereas Reedsport (and nearby areas) would only be impacted by the Medium-sized tsunami scenario, or larger. Approximately 1% of the county's buildings have exposure to tsunami inundation from the Medium-sized scenario. In the communities of Reedsport, Gardiner (not specifically examined in this report), and Winchester Bay, a very high percentage of development is exposed to tsunami hazard. Approximately 850 to 1,800 permanent residents could be impacted from a CSZ tsunami event and require medical and shelter services. Because there is high risk of tsunami along the coast and tidal areas of Douglas County, awareness is important for the emergency response immediately after the event and for future planning and mitigation efforts in these areas (**Figure 3-7**).

**Figure 3-7. Tsunami inundation exposure by Douglas County community.**




### 3.2.3 Areas of vulnerability or risk

We identified locations within the study area that are comparatively more vulnerable or at greater risk from a Medium-sized CSZ-sourced tsunami:

- Nearly every building in the community of Winchester Bay is at risk from tsunami hazard.
- Buildings along the Umpqua River and Schofield Creek in Reedsport are at risk from tsunami hazard.
- An area of buildings north of Reedsport (unincorporated community of Gardiner) along the Umpqua River are at risk from tsunami.

## 3.3 Flooding

The frequency and severity of flooding may change over time due to changes in land use including development, waterways, watershed management, precipitation patterns, and changes in climate This study represents our current understanding of flood hazards and flood risk, but we recognize that flood models and risk assessments will need to be updated with changing conditions.

In its most basic form, a flood is an accumulation of water over normally dry areas, typically due to excessive rain or snowmelt. Floods become hazardous to people and property when they inundate an area where development has occurred, causing losses. Floods are a commonly occurring natural hazard in Linn County and have the potential to create public health hazards and public safety concerns, close and damage major highways, destroy railways, damage structures, and cause major economic disruption. More rare flood issues such as flash flooding, ice jams, post-wildfire floods, and inundation due to a dam breach were not examined in this report.

A typical method for determining flood risk is to identify the probability and impact of flooding. The annual probabilities calculated for flood hazard used in this report are 10%, 2%, 1%, and 0.2%, henceforth referred to as 10-year, 50-year, 100-year, and 500-year scenarios, respectively. The ability to assess the probability of a flood, and the level of accuracy of that assessment is influenced by modeling advancements, better understanding of hydrologic factors, and longer periods of record for the stream or water body in question.

The major rivers and creeks within the county are the North Umpqua, South Umpqua, and Umpqua Rivers and Cow, Lower Cow, Elk, Mill, and Scholfield Creeks. In addition, there are several tributaries to these major streams that have mapped flood zones. All the mapped streams are subject to flooding and could cause damage to buildings in the floodplain.

Within the last 60 years there have been several major floods of note for Douglas County, 2 of which caused major flooding throughout the Umpqua River basin. In December of 1964 heavy rainfall on snow caused major flooding on the Umpqua, South Umpqua, and North Umpqua rivers, including many of their tributaries, at historic levels. These floods, known as the “Christmas Flood,” caused damage to the communities of Elkton, Glendale, Myrtle Creek, Reedsport, and Roseburg. Another notable major flood in Douglas County occurred in 1974 on the Umpqua River, Canyon Creek, and Cow Creek which impacted communities built along those streams. The levees built in 1970 around most of Reedsport prevented widespread damage from the 1974 flooding (FEMA, 2021).

The consequences of flooding are determined by adverse effects to human activities within the natural and built environment. These adverse conditions can be reduced through mitigation efforts, such as elevating structures above the expected level of flooding or removing structures through FEMA’s property acquisition (“buyout”) program.

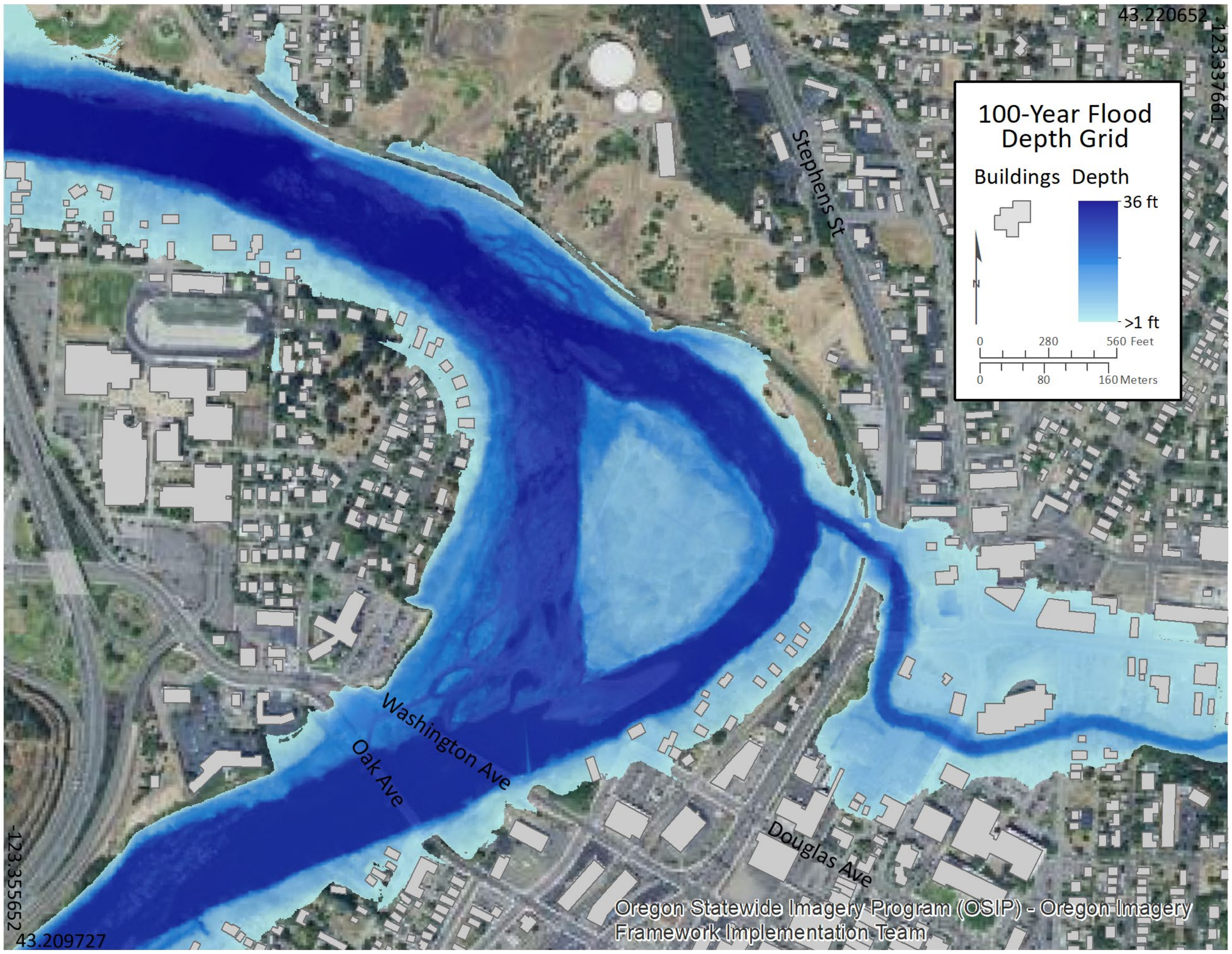
### 3.3.1 Data sources

The Flood Insurance Study (FIS) and Flood Insurance Rate Maps (FIRMs) for Douglas County were updated in 2021 (FEMA, 2021); this was the primary data source for the flood risk assessment in this report. This data source was adopted in 2021 by Douglas County to regulate flood zones. Further information regarding the National Flood Insurance Program (NFIP) related statistics can be found on the FEMA website: https://nfipservices.floodsmart.gov/reports-flood-insurance-data. While no place is completely risk-free from flood hazard, this was the only flood data source that was available for the analysis.

DOGAMI developed the 10-, 50-, 100-, and 500-year depth grids from detailed stream information and high-resolution lidar collected in 2008, 2012, and 2015 (Umpqua River 2008, Rogue River 2012, and Upper Umpqua 3DEP 2015 project - Oregon Lidar Consortium; see https://www.oregon.gov/dogami/lidar/pages/collectinglidar.aspx). The set of depth grids were used in this risk assessment to determine the level to which buildings are impacted by flooding.

Depth grids are raster GIS datasets in which each digital pixel value represents the depth of flooding at that location within the flood zone (**Figure 3-8**). Depth grids for four riverine flooding scenarios (10-, 50-, 100-, and 500-year) were used for loss estimations and, for comparative purposes, exposure analysis.

**Figure 3-8. Flood depth grid example of the South Umpqua River in the city of Roseburg, Oregon.**




Building loss estimates are determined in Hazus-MH by overlaying building data on a depth grid. Hazus-MH uses individual building information, specifically the first-floor height above ground and the presence of a basement, to calculate the loss ratio from a particular depth of flood.

For Douglas County, occupancy type and basement presence attributes were available from the assessor database for most buildings. Where individual building information was not available from assessor data, we used oblique imagery and street-level imagery to estimate these important building attributes. Only buildings in a flood zone or within 152 meters (500 feet) of a flood zone were examined closely in this manner for more accurate information on first-floor height and basement presence. Because our analysis accounted for building first-floor height, buildings that have been elevated above the flood level were not given a loss estimate—but we did count residents in those structures as displaced. We did not look at the duration that residents would be displaced from their homes due to flooding. For information about structures exposed to flooding but not damaged, see the **Exposure analysis** section.

### 3.3.2 Countywide results

For this risk assessment, we imported the countywide UDF data and depth grids into Hazus-MH and ran a flood analysis for four flood scenarios (10-, 50-, 100-, and 500-year). We used the 100-year flood scenario as the primary scenario for reporting flood results (also see Appendix F: **Plate 7**). The 100-year flood has traditionally been used as a reference level for flooding and is the standard probability that FEMA uses for regulatory purposes. See **Table B-5** for multi-scenario cumulative results.

**Douglas County countywide 100-year flood loss:**

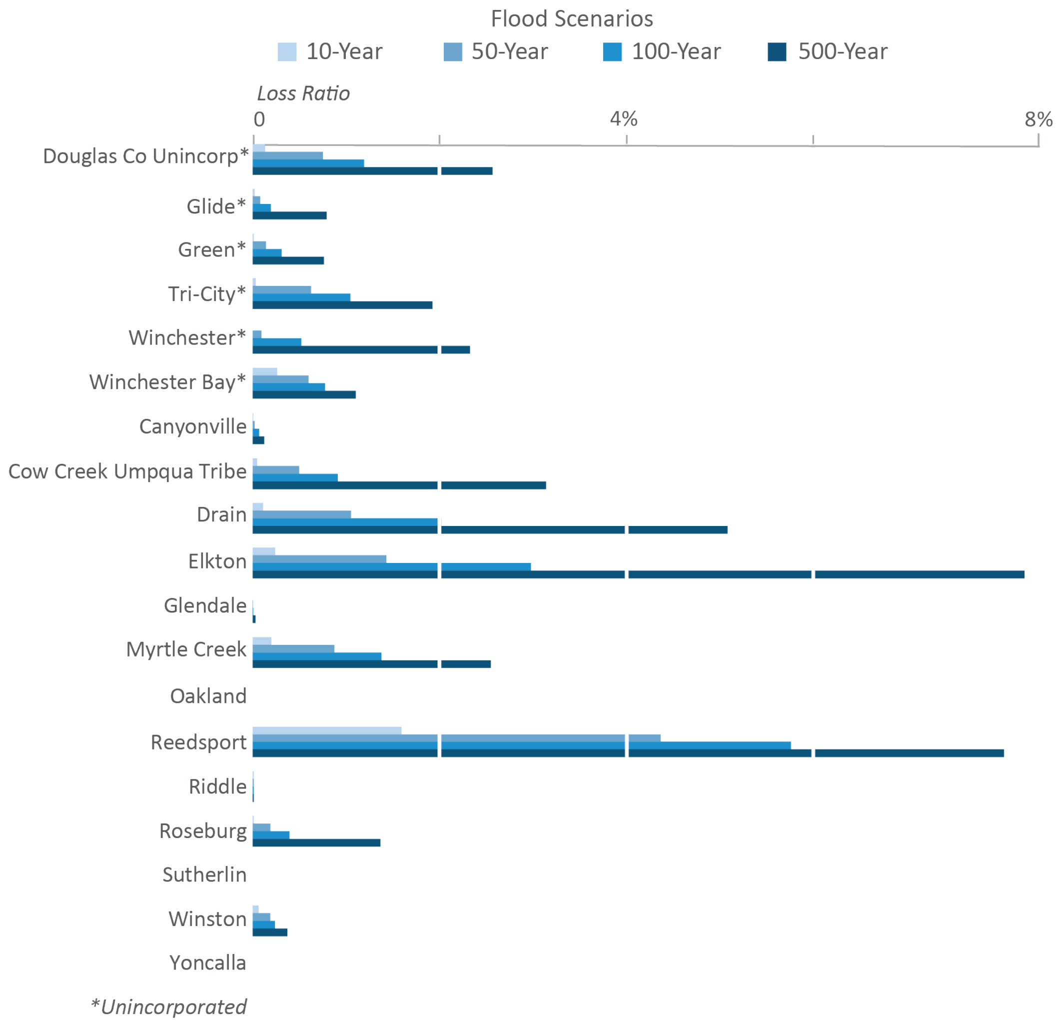
- Number of buildings damaged: 4,111
- Loss estimate: $218,493,000
- Loss ratio: 0.9%
- Damaged critical facilities: 9 of 104
- Potentially displaced population: 7,252

### 3.3.3 Hazus-MH analysis

The Hazus-MH loss estimate for the 100-year flood scenario for the entire county is over $200 million. While the loss ratio of flood damage for the entirety of Douglas County is 0.9%, the consequences to areas of development near flood-prone streams is significant (Figure 3-9). In communities where most residents are not within flood designated zones, the loss ratio may not be as helpful for assessing the level of risk and impact from flooding as the actual replacement cost and number of residents displaced. The Hazus-MH analysis also provides useful information for individual communities so that planners can identify problems and consider which mitigating activities will provide the greatest resilience to flooding.

The main flooding problems within Douglas County are primarily in the areas of Reedsport and Elkton and, to a lesser extent, Drain, Tri-City, and some unincorporated areas in the county (**Figure 3-9**). Within these communities, there are multiple buildings at risk from flooding. Most flood-exposed buildings in the study area are residential structures located along the South Umpqua River, North Umpqua River, and Umpqua River and its tributaries.

**Figure 3-9. Ratio of flood loss estimates by Douglas County community.**




### 3.3.4 Exposure analysis

Separate from the Hazus-MH flood analysis, we conducted an exposure analysis by overlaying building locations on the 100-year flood extent. We did this to estimate the number of buildings that are elevated above the level of flooding and the number of displaced residents. This was done by comparing the number of undamaged buildings from Hazus-MH with the number of exposed buildings in the flood zone. A high proportion (6.6%) of Douglas County's buildings were found to be within designated flood zones. Of the 4,833 buildings that are exposed to flooding, we estimate that 732 are above the height of the 100-year flood. This evaluation also estimates that 7,251 residents might have mobility or access issues due to surrounding water. See Appendix B: **Table B-6** for communitywide results of flood exposure.

### 3.3.5 Dam Safety

Dam safety is highly important when considering flood hazards. Dams are crucial structures designed to store and control water flow, but their failure can lead to catastrophic consequences during periods of heavy rainfall and flooding. Ensuring the safety of dams involves rigorous monitoring, regular inspections, and maintenance procedures. Structural integrity is a key concern, as any weaknesses or deficiencies in the dam's construction could be exacerbated by the force of floodwater, potentially leading to a breach. Thus, it is crucial to implement stringent engineering standards and employ advanced technologies to assess the stability and reliability of dams, especially in flood-prone areas. Regular evaluation of spillways, embankments, and foundation conditions is necessary to identify potential risks and promptly address them to minimize the likelihood of dam failure during floods.

In addition to structural considerations, dam safety also encompasses effective flood management strategies. This includes establishing comprehensive flood forecasting and warning systems to provide timely alerts to downstream communities and emergency responders. Such systems rely on real-time data collection and analysis, which enables authorities to anticipate flood events and take appropriate actions. Regular communication and coordination among dam operators, local authorities, and the public are vital to ensure that evacuation plans and emergency protocols are in place and well understood. By implementing a holistic approach to dam safety, including both structural integrity and effective flood management, the risks associated with flood hazards can be minimized, protecting lives and infrastructure in flood-prone regions.

The USACE Dam Inventory (https://nid.sec.usace.army.mil/#/) is a large dataset of most of the dams in the U.S. and its territories. The dataset allows users to download specific information about dams for a specific location. The type, size, function, and hazard potential, among other details, are available from the Dam Inventory. The USACE first published a dam inventory in 1975 and since that time has continued to develop the Dam Inventory dataset.

DOGAMI used the USACE Dam Inventory to identify specific dams that were considered High, Significant, or Low from a natural hazard impact perspective. Meaning, in the event of a dam failure or breach would there be a potential for loss of life or other significant damage.

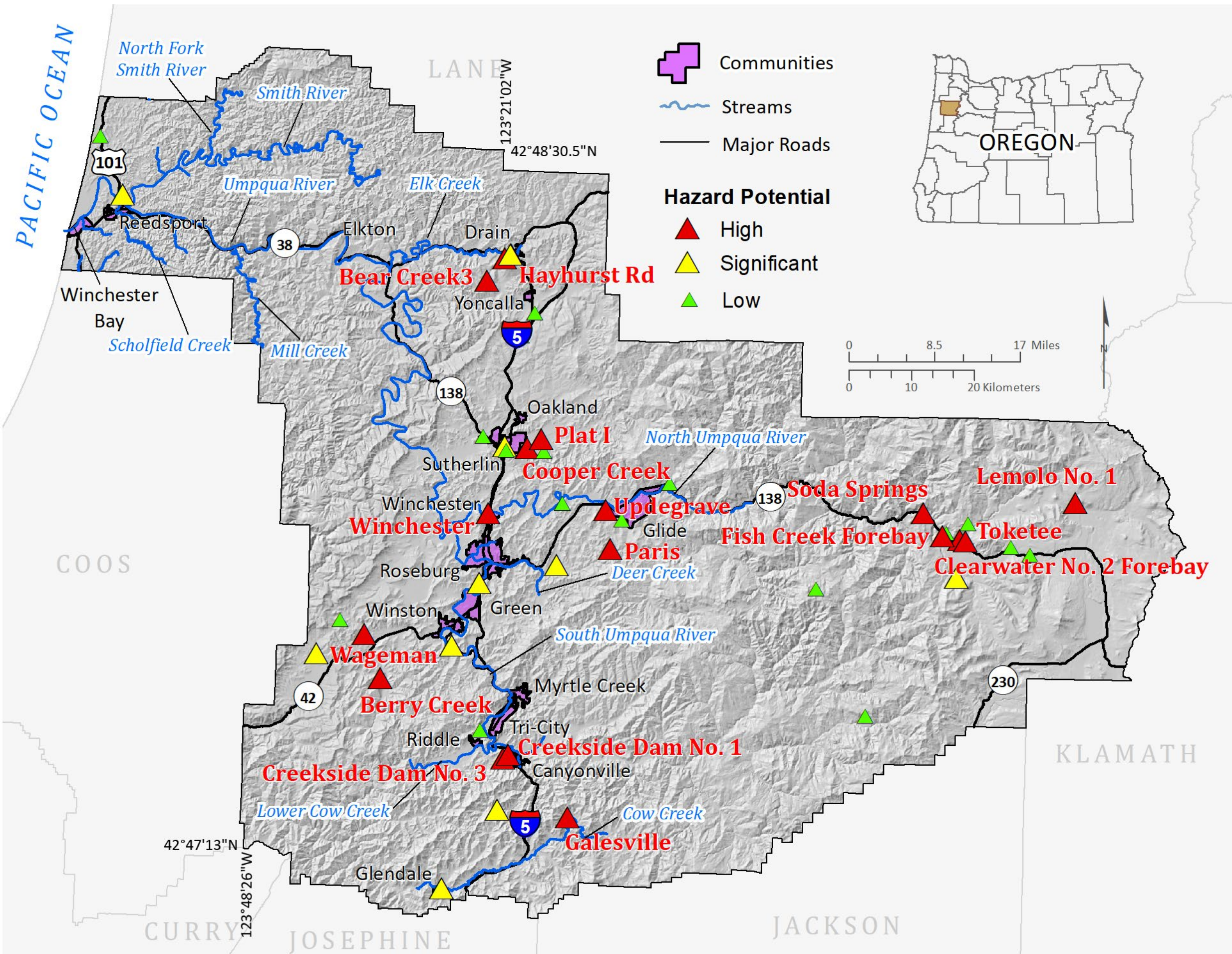
There are 45 dams in the USACE Dam Inventory for Douglas County, most of which are privately operated farm dams (**Appendix B, Table B-6**). There are 17 dams in Douglas County that are considered high hazard dams (**Figure 3-10**). The largest (by storage volume) high hazard dam is the county-owned Galesville Dam that forms the Galesville Reservoir and is located a few miles northeast of the unincorporated communities of Azalea and Galesville along Cow Creek. Another large high hazard dam in Douglas County is the Berry Creek Dam and is owned by Douglas County. This dam was built for water supply and irrigation and is located several miles to the southwest of Winston and forms the Ben Irving Reservoir. No inundation data was available for any of the high hazard dams in Douglas County.

### 3.3.6 Future conditions: flood hazard

Climate change has had a significant impact on flood hazards around the world, exacerbating the frequency, intensity, and magnitude of flooding events (Dalton and others, 2023). The interplay between climate change and flood hazards is a complex phenomenon influenced by various factors such as rising temperatures, changing precipitation patterns, and altered hydrological cycles. These changes have profound implications for human populations, ecosystems, and infrastructure, leading to a range of impacts.

According to the report examining climate projections by the Oregon Climate Change Research Institute (OCCRI) (Dalton and others, 2023), climate change will have an impact on flood hazards for some areas in Douglas County. Flooding that is exacerbated by climate change in Douglas County is expected to be worse at high elevations but may not increase frequency at lower elevations. Some of the worst flooding for Douglas County occurs when rain-on-snow events occur, especially when moisture and warmer temperatures are transported as atmospheric rivers. Predictive models indicate that more frequent atmospheric rivers are likely to occur along the West Coast as air temperatures continue to increase (Dalton and others, 2023). Warm temperatures, more extreme storms, including atmospheric rivers, and an increase in the proportion of precipitation falling as rain instead of snow all will contribute to an increase of flood risk in Douglas County.

**Figure 3-10. High hazard potential dams in Douglas County.**




## 3.3.7 Areas of significant risk

We identified locations within the study area that are comparatively at greater risk of flood hazard:

- Many residential structures along the South Umpqua River in the community of Tri-city are at risk from flooding.
- Many residential structures in the area where North and South Myrtle creeks converge are at risk from flooding.
- All along the South Umpqua River, in the unincorporated county, many farm and residential structures are exposed to flood hazard. This is especially true for the concentration of buildings south of Winston.

- A large area of shallow flooding between the South Umpqua River and Roberts Creek in the community of Green is exposed to flood hazard.
- There are many areas of shallow flooding along the Umpqua River in Roseburg and one concentrated area of flood-exposed building at the Newton Creek confluence.
- The city of Elkton is at risk from flooding along the Umpqua River and Elk Creek confluence.
- A large portion of Reedsport is behind a levee that is undetermined to prevent widespread 100-year flooding within the community. Flood exposure to 760 buildings and over $37 million in potential losses from a 100-year flood is estimated for the leveed areas in Reedsport.

## 3.4 Landslide Susceptibility

Landslides are downslope mass movements of rock, debris, or soil. Landslides can occur in many sizes, at different depths, and with varying rates of movement. Generally, they are large, deep, and slow moving or small, shallow, and rapid. Factors that influence landslide type include slope steepness, water content, and underlying geology. Many triggers can cause a landslide: intense rainfall, earthquakes, or human-induced factors like water concentration, excavation along a landslide toe or loading at the top. Landslides can cause severe damage to buildings and infrastructure. Fast-moving landslides may pose life safety risks and can occur throughout Oregon (Burns and others, 2016). The most common landslide types in Douglas County are debris flows and shallow- and deep-seated landslides.

Because landslides are a site-specific hazard that occur over much smaller spatial extents than most other natural hazards, measuring the risk associated with future landslides for a large area can be difficult. Landslide susceptibility measures the likelihood that a given location will experience a landslide in the future based on a variety of factors including slope, geology, soil type, and the presence of pre-existing landslides.

This study represents our current understanding of landslide susceptibility to measure the risk of landsliding in Douglas County. However, precipitation patterns, land use, wildfire events, land and forest management strategies, and changing climate may increase or decrease the susceptibility to landslides.

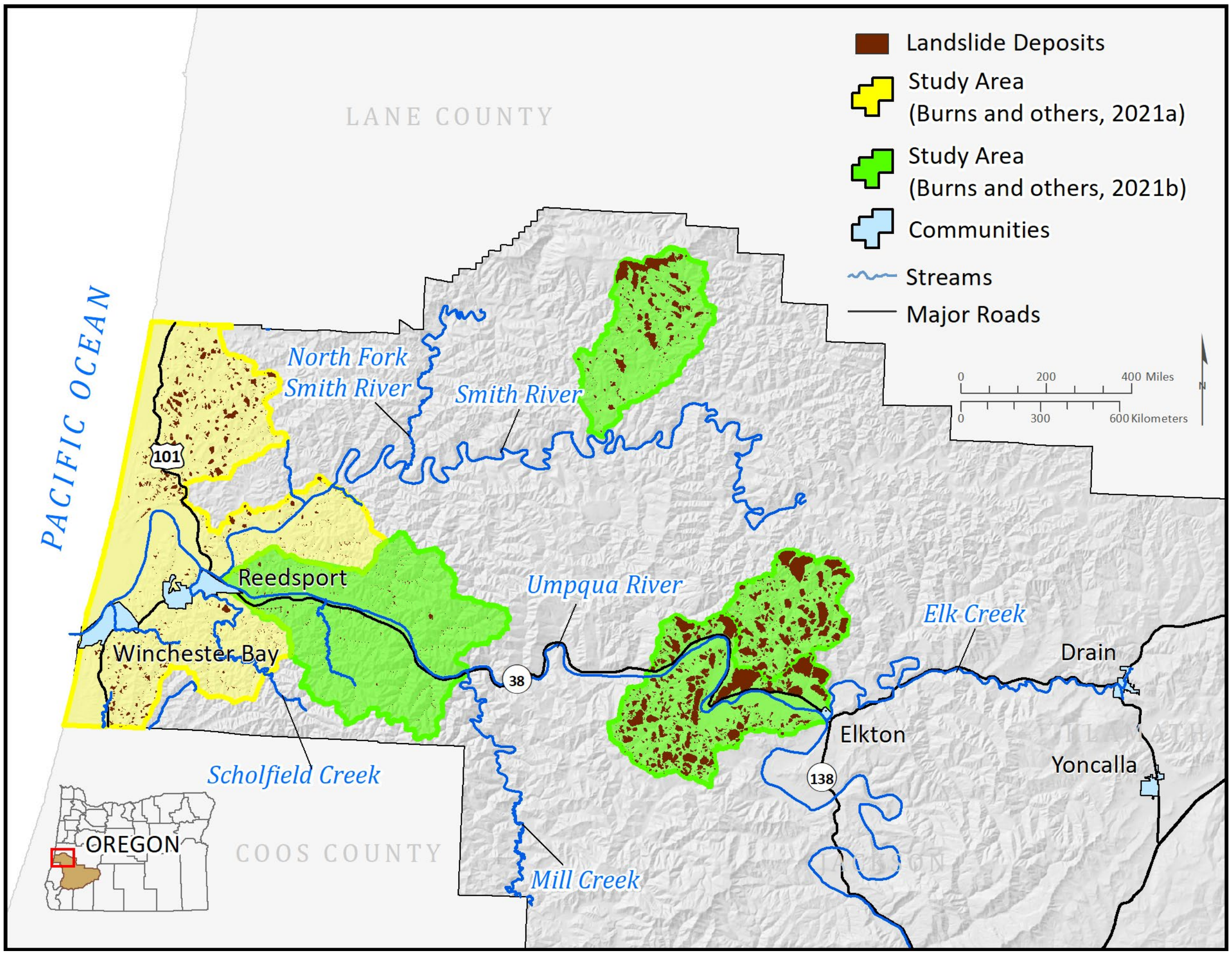
### 3.4.1 Data sources

We used the data from the statewide landslide susceptibility map (Burns and others, 2016) and recent landslide inventory mapping in Douglas County (Burns and others, 2021a; Burns and others, 2021b) (**Figure 3-11**) based on lidar using methods outlined by Burns and Madin (2009) for the landslide analysis. The statewide susceptibility layer is an analysis of multiple landslide datasets.

Burns and others (2016) used the Statewide Landslide Information Database for Oregon (SLIDO) along with maps of generalized geology and slope to create a landslide susceptibility overview map of Oregon that shows the likelihood a slope will fail in the future using the categories: Very High, High, Moderate, and Low. Mapped landslides from SLIDO data directly define the Very High landslide susceptibility zone, while other SLIDO data coupled with statistical results from generalized geology and slope maps define the other relative susceptibility zones (Burns and others, 2016).

SLIDO, release 3.2 (Burns and Watzig, 2014) was used in the Burns and others (2016) statewide susceptibility analysis, which preceded the new lidar-based inventory mapping of Burns and others (2021a, b) and thus this newer mapping was not incorporated into the statewide map.

**Figure 3-11. Recent lidar-based landslide mapping in coastal Douglas County.**




SLIDO is a compilation of past studies; some studies were completed very recently using new technologies, like lidar-derived topography, and some studies were performed more than 50 years ago. Consequently, SLIDO data vary greatly in scale, scope, and focus and thus in accuracy and resolution across the state. Statewide landslide susceptibility map data have the inherent limitations of SLIDO and of the generalized geology and slope maps used to create the map. Therefore, the statewide landslide susceptibility map varies significantly in quality across the state, depending on the quality of the input datasets. Another limitation is that susceptibility mapping does not include some aspects of landslide hazard, such as runout, where the momentum of the landslide can carry debris beyond the zone deemed to be a high hazard area.

We used the data from the combined Statewide Landslide Susceptibility Map (Burns and others, 2016) and new landslide mapping (Burns and others, 2021a, b) in this report to identify the general level of susceptibility of a given area to landslide hazards, primarily shallow and deep landslides. We overlaid building and critical facilities data on landslide susceptibility zones to assess the exposure for each community (see **Table B-6**). The total dollar value of exposed buildings was summed for the study area and is reported below. We also estimated the number of people threatened by landslides. Land value losses due to landslides and potentially hazardous unmapped areas that may pose real risk to communities were not examined for this report.

### 3.4.2 Countywide results

Most of the buildings in Douglas County have a low level of exposure to landslide hazard. Most of the inhabited parts of Douglas County are near or within the valley floor of the Umpqua River and some of its tributaries, which typically indicates a low level of exposure to landslide hazard. Areas with terrain that have moderate to steep slopes or areas at the base of steep hillsides will have higher levels of risk of landslide hazard. These areas are in more rural parts of the county where less buildings and people are present. The percentage of building value exposed to very high and high landslide susceptibility is approximately 10% for the entire study area.

We combined High and Very High susceptibility areas as the primary scenarios to provide a general sense of community risk for planning purposes (see Appendix F, **Plate 8**). We determined the best way to communicate the level of landslide risk to communities was by combining the exposure results for both susceptibility zones. The High and Very High susceptibility zones represent areas most susceptible to landslides with the greatest impact to the community.

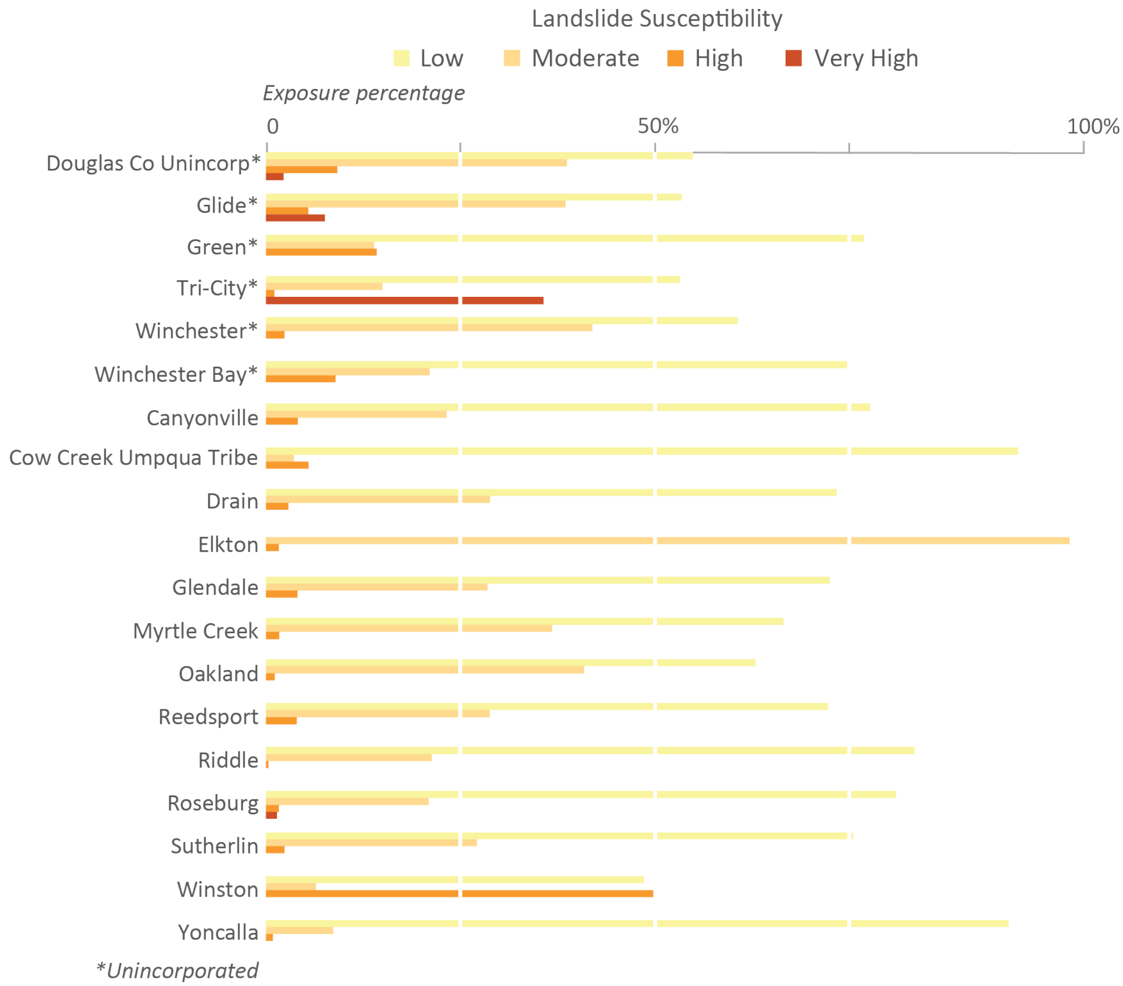
For this risk assessment we compared building locations to geographic extents of the landslide susceptibility zones (**Figure 3-12**). The exposure results shown below are for the High and Very High susceptibility zones. See **Appendix B: Detailed Risk Assessment Tables** for exposure analysis results of all susceptibility categories.

**Douglas County countywide landslide exposure (High and Very High susceptibility):**

- Number of buildings: 9,024
- Value of exposed buildings: $2,372,608,000
- Percentage of total county value exposed: 10%
- Critical facilities exposed: 5 of 104
- Potentially displaced population: 12,513

There are a few areas in Douglas County that have concentrated levels of exposure to landslide hazard. A high concentration of residential structures in Tri-City are built on existing landslides and are at very high risk from landslide hazard. The communities of Green and Winston also have many areas where development has occurred on steep slopes. Since landslide hazard is present for some areas in Douglas County, it may present challenges for planning and mitigation efforts. Awareness of nearby areas of landslide hazard is beneficial to reducing risk for every community and rural area of Douglas County.

**Figure 3-12. Landslide susceptibility exposure by Douglas County community.**




### 3.4.3 Future conditions: landslide hazard

Climate change will have an impact on landslide hazards in some landslide-prone areas where an increase in precipitation occurs. The frequency and magnitude of precipitation events can influence the probability of landslides occurring by saturating soils and prolonging the period during which soils remain saturated. Saturated soils increase landslide risk because the soils are heavier, and the presence of water reduces friction in the potential landslide material. In addition, areas that have recently burned are far more likely to fail after heavy rainfall.

According to the report examining climate projections by OCCRI (Dalton and others, 2023), while the level of extreme precipitation (e.g., atmospheric rivers) will increase in Douglas County, the projected range of days with precipitation will not exceed a threshold where landslide risk increases. However, precipitation is only one factor of several that influence landslide risk and this analysis does not account for all aspects of landslide hazard.

### 3.4.4 Areas of significant risk

We identified locations within the study area that are comparatively at greater risk to landslide hazard:

- Many residential buildings in the southern part of the community of Tri-City are located on an existing landslide (as is currently mapped) and are at very high risk from landslide hazard.
- There is significant exposure to landslide hazard for the eastern half of the community of Winston.
- Some communities in Douglas County may be at higher or lower risk than what the data show, lidar-based landslide mapping would provide a better understanding of the risk.

## 3.5 Wildfire

Wildfires are a natural part of the ecosystem in Oregon. However, wildfires can present a substantial hazard to life and property in growing communities. The most common wildfire conditions include hot, dry, and windy weather; the inability of fire protection forces to contain or suppress the fire; the occurrence of multiple fires that overwhelm committed resources; and a large fuel load (dense vegetation). Once a fire has started, its behavior is influenced by numerous conditions, including fuel, topography, weather, drought, and development (Gilbertson-Day and others, 2018). Post-wildfire natural hazards can also present risk. These usually include floods, debris flows, and landslides. Post-wildfire geologic hazards were not evaluated in this project.

The 2023 Douglas Community Wildfire Protection Plan (CCWPP) recommended that the county develop policies addressing fire restriction enforcement, wildland urban interface standards, and building code enforcement related to emergency access. Forests cover large portions of the county and play an important role in the local economy, but also surround homes and businesses (DCWPP, 2023). Contact the Douglas County Planning Department for specific requirements related to the county's comprehensive plan.

In the Fall of 2020 very, large wildfires occurred in the region, with the Archie Creek Fire burning large portions of Douglas County. This wildfire was determined a "megafire" because it eventually grew to be over 100,000 acres. The Archie Creek wildfire burned over 131,000 acres by the time it was contained (Northwest Interagency Coordination Center website, accessed 5/6/2024). Evacuation orders were in place for the entire county during the emergency. The entire city of Glide and the Rock Creek area (northeast Douglas County) were evacuated. The fires resulted in severe damage to the built and natural environment in Douglas County with nearly 140 structures destroyed according to the Oregon Department of Emergency Management[1]. This disaster directly demonstrates the level of wildfire risk in the county.

The frequency, intensity, and severity of wildfires may change over time due to changes in climate, drought conditions, urbanization, and how we manage our forested lands. This study represents our current understanding of wildfire hazards and wildfire risk, but we recognize that wildfire models and risk assessments will need to be updated with time and changing conditions.

### 3.5.1 Data sources

The Pacific Northwest Quantitative Wildfire Risk Assessment (PNRA): Methods and Results (Gilbertson-Day and others, 2018) is a comprehensive report that includes a database of spatial information related to wildfire hazard developed by the United States Forest Service (USFS) for the states of Oregon and Washington. The steward of this database in Oregon is the Oregon Department of Forestry (ODF). The database was created to assess the level of risk residents and structures have to wildfire. For this project,

[1] https://storymaps.arcgis.com/stories/6e1e42989d1b4beb809223d5430a3750

the burn probability dataset, a dataset included in the PNRA database, was used to measure the risk to communities in Douglas County.

Using guidance from ODF, we categorized the Burn Probability dataset into low, moderate, and high-hazard zones for the wildfire exposure analysis. Burn probability is derived from simulations using many elements, such as, weather, ignition frequency, ignition density, and fire modeling landscape (Gilbertson-Day and others, 2018).

Burn probabilities (mean annual burn probability) were grouped into 3 hazard categories:

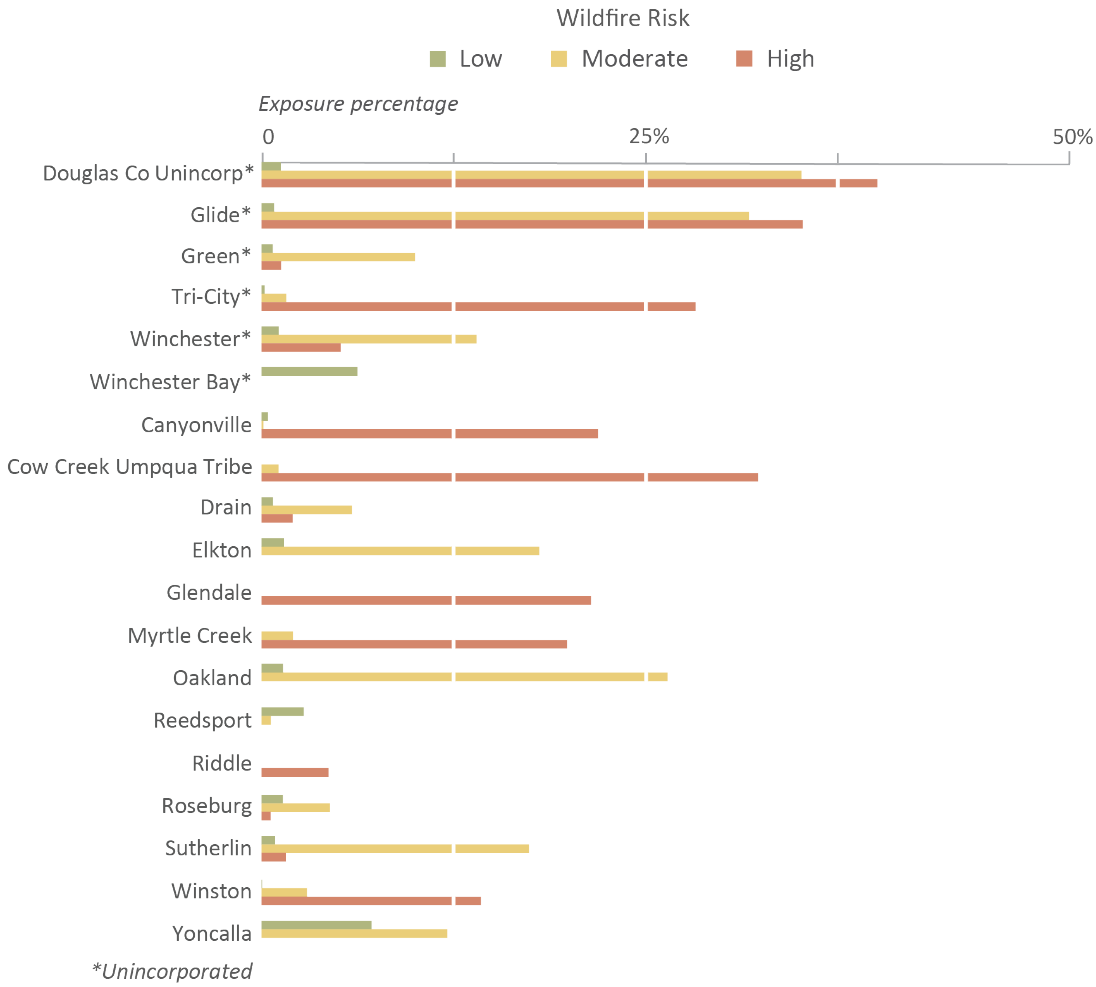
- Low wildfire hazard (0.0001 – 0.0002 or 1/10,000-year – 1/5,000-year)
- Moderate wildfire hazard (0.0002 – 0.002 or 1/5,000-year – 1/500-year)
- High wildfire hazard (0.002 – 0.04 or 1/500-year – 1/25-year)

We overlaid the buildings layer and critical facilities on each of the wildfire hazard zones to determine exposure. In certain areas no wildfire data is present which indicates areas that have minimal risk to wildfire hazard (see **Appendix B**). The total dollar value of exposed buildings in the study area is reported in the following section. We also estimated the number of people threatened by wildfire. Land value losses, infrastructure, and environmental impacts due to wildfire were not examined for this project.

### 3.5.2 Countywide results

The High hazard category was chosen as the primary scenario for this report because it represents areas that have the highest potential for losses. However, low hazard is not the same as no hazard. Moderate wildfire risk is included with high risk in the assessment of exposure, because under certain conditions moderate hazard zones can be very susceptible to burn. In combining the High and Moderate risk categories within Douglas County, we can emphasize areas where lives and property are most at risk (**Figure 3-13**).

**Figure 3-13. Wildfire risk by Douglas County community.**




**Douglas County countywide wildfire exposure (High or Moderate Risk):**

- Number of buildings: 37,333
- Value of exposed buildings: $10,267,443,000
- Percentage of total county value exposed: 44%
- Critical facilities exposed: 13 of 104
- Potentially displaced population: 44,737

For this risk assessment, the building locations were compared to the geographic extent of the wildfire risk categories. Nearly every community in Douglas County has a very significant exposure to high wildfire hazard. Thousands of buildings in the heavily forested unincorporated parts of Douglas County, as well as most of the communities in the central and eastern part of the county, are exposed to High or Moderate wildfire hazard (see Appendix F: **Plate 9**). There is a very high risk from wildfire in the communities of Glide, Green, Tri-City, Winchester, Canyonville, Elkton, Glendale, Myrtle Creek, Oakland, Sutherlin, and Winston. The wildland-urban interface in nearly every community in Douglas County has at least some risk of wildfire. See **Appendix B: Detailed Risk Assessment Tables** for multi-scenario analysis results.

### 3.5.3 Future conditions: wildfire hazard

Climate change has been recognized as a significant factor contributing to the increased frequency and severity of wildfires in various parts of the world (IPCC, 2021). The impacts of climate change on wildfire hazards are multifaceted and pose significant challenges to ecosystems, communities, and economies. Climate change increases the likelihood of wildfires through increased temperatures, drought conditions, reduced snowpack, altered precipitation patterns, and changes in vegetation.

The frequency, intensity, and size of wildfires are expected to continue to increase for the Pacific Northwest. According to Jones and others (2022) the wildfire season for forests in the Northwest U. S. has increased 43% from 1979 to 2019. The number of high fire danger days per year in Douglas County are projected to increase 12 days (range -6 to 27) by the 2050s, from the current average per year of 36.5. In addition, the number of days where vapor pressure deficit is extreme (another factor that impacts wildfire hazard) is expected to increase by 27 days (range 9 to 43) in the next 30 years from the current average per year of 24.5 (Dalton and others, 2023).

### 3.5.4 Areas of significant risk

We identified locations within the study area that are comparatively at greater risk to wildfire hazard:

- While the Archie Creek wildfire that occurred in the fall of 2020 caused widespread and devastating damage to areas along the North Umpqua River, that wildfire was not specifically examined in this report. However, the areas that burned will be at risk from indirect hazards such as post-wildfire debris flows, rock falls, and flash flooding. The data used in this risk assessment, both asset and hazard information, originated prior to the date of this fire.
- All communities and unincorporated areas in the forested, mountainous portions of the county (southern and western) are at high risk from wildfire. The risk from wildfire is greatest in the wildland-urban interface zones in the communities of Douglas County.

## 4.0 CONCLUSIONS

The purpose of this study is to provide a better understanding of potential impacts from multiple natural hazards at the community scale. We accomplished this by using the latest natural-hazard mapping and loss estimation tools or exposure analysis to quantify risk to buildings and potential displacement of permanent residents. This detailed approach provides new context for the county's risk reduction efforts. We note several important findings based on the results of this study:

- **Significant damage and losses for coastal portions of Douglas County and moderate damage of areas farther from the coast can occur from a CSZ Mw-9.0 earthquake and tsunami**—Results from the Mw-9.0 CSZ earthquake scenario demonstrate that every community in Douglas County will experience some level of impact and disruption from such an event. Results show that a CSZ event (earthquake and tsunami) would cause building losses ranging from 40% to 50% for coastal communities. We estimate that most communities farther inland can expect building value losses ranging from 10% to 25%. Many buildings along the Umpqua River and its major tributaries could see earthquake damage due to ground deformation related to liquefaction. High vulnerability within the building inventory (primarily unreinforced masonry) also contributed to expected losses in the county. The coastal communities of Winchester Bay and Reedsport can expect a very high percentage of losses due to tsunami. The vulnerability of the building inventory from age of construction, the proximity to the CSZ event, the amount of development on liquefiable soils, and the amount of exposure to tsunami hazard all contribute to the estimated levels of losses expected in Douglas County.

- **Moderate damage and losses for some areas in Douglas County can occur from local crustal earthquake similar to the one simulated in this study**—Based on the results of this local crustal-scenario Mw-6.8 earthquake, some communities in Douglas County will experience moderate impact and disruption. Results show that such an earthquake can cause building losses ranging from 15% to 20% for buildings near the hypothetical epicenter. Some communities can expect earthquake damage due to proximity to the epicenter (i.e., severe shaking) and ground deformation related to liquefaction. High vulnerability within the building inventory (primarily unreinforced masonry) also contributed to losses expected in the county.
- **Retrofitting buildings to modern seismic building codes can reduce damages and losses from earthquake shaking**—Seismic building codes have a major influence on earthquake shaking damage estimated in this study. We found that retrofitting to at least moderate code was the most efficient mitigation strategy because the additional benefit from retrofitting to high code was minimal. In our simulation of upgrading buildings to at least moderate code, the estimated loss for the entire study area was reduced from 8.4% to 6.2% for a CSZ event and 7.5% to 6% for a local crustal event. Communities with older buildings constructed below the moderate seismic code standards are both the most vulnerable and have the greatest potential for risk reduction. For example, the city of Reedsport could reduce losses from 32% to 10% for a CSZ event by retrofitting all buildings to at least moderate code. While seismic retrofits are an effective strategy for reducing earthquake shaking damage, it should be noted that earthquake-induced hazards, including liquefaction and landslides, require different geotechnical mitigation strategies.
- **Many communities in Douglas County are at significant risk from flooding**—Many buildings within the floodplain are vulnerable to significant damage from flooding. At first glance, Hazus-MH flood loss estimates may give a false impression of lower risk because they show lower damages within individual communities relative to other hazards we examined. This is likely due to the difference between the type of results from loss estimation and exposure analysis, as well as the limited area impacted by flooding. Flooding is one of the most frequently occurring natural hazards and thus commonly has repetitive losses that occur over recurrence intervals of tens to hundreds of years versus earthquake hazards with recurrence intervals of hundreds to thousands of years. We estimate that an average of 15% building value loss occurs for buildings within the 100-year flood zone. The areas most vulnerable to flood hazard within the study are all along the South Umpqua River, North Umpqua River, and the Umpqua River and its tributaries, most specifically, the confluence of Elk Creek with the Umpqua River in Elkton and the confluence of Newton Creek with the Umpqua River in Roseburg.
- **Elevating structures in the flood zone reduces vulnerability**—We used flood exposure analysis in addition to Hazus-MH loss estimation to identify buildings that were not damaged but were within the area expected to experience a 100-year flood. By using both analyses in this way, the number of elevated structures within the flood zone could be quantified. This showed possible mitigation needs in flood loss prevention and the effectiveness of past activities. For example, in the city of Roseburg, an estimated 219 buildings exposed to flooding are elevated above the base flood elevation. Based on the number of buildings exposed to flooding throughout the county, many would benefit from being elevated above the level of flooding.
- **Landslide risk is significant for the southern and eastern parts of the county**—The recent landslide mapping used in this study was created using lidar and modern methods to develop

very accurate landslide hazard maps. We used exposure analysis to assess the threat from landslide hazards. Over 12,000 people in Douglas County live on High or Very High landslide susceptibility areas, including the developed areas along the South Umpqua River, a residential area in the southern part of Tri-City, and the eastern half of Winston.

- **Wildfire risk is high for large portions of the county—**Exposure analysis shows that buildings in rural southern and eastern Douglas County are at the highest risk from wildfire for the county, however moderate wildfire risk is also present for most of the rest of the county. The mountainous and forested parts of the county and in wildland urban interface areas are at the greatest risk from wildfire in the county. Nearly 40% of the buildings in the unincorporated county are in areas of high wildfire hazard. Twenty to 35% of buildings in the communities of Glide, Tri-City, Canyonville, Cow Creek Umpqua Tribe, Glendale, and Myrtle Creek are in areas of high wildfire hazard.
- **Most of the study area's critical facilities are at greatest risk from a CSZ event hazard relative to other hazards in the study area—** Because of their importance during and after a natural disaster, we identified and examined critical facilities. We have estimated that 28% (25 of 104) of Douglas County's critical facilities will be nonfunctioning after a CSZ Mw-9.0 earthquake and tsunami and 21% (22 of 104) will be nonfunctioning after a hypothetical crustal fault Mw-6.8 earthquake. We found that 13 critical facilities are exposed to wildfire hazard.
- **The biggest causes of displacement to population are wildfire, landslide, and flood hazards—**Potential displacement of permanent residents from natural hazards was estimated within this report. We estimated that there is risk to 40% of the population in the county from wildfire hazard. Landslide hazard is a potential threat to 11% of permanent residents, making them vulnerable to displacement. Flood hazard is a potential threat to 6.2% of permanent residents, making them vulnerable to displacement.
- **The results allow communities the ability to compare across hazards and prioritize their needs—**Each community within the study area was assessed for natural hazard exposure and loss. This allows for comparison of risk for a specific hazard between communities. It also allows for a comparison between different hazards for each community, though care must be taken to distinguish loss estimates and exposure results. The loss estimates and exposure analyses can assist in developing plans that address the concerns of those individual communities.

# 5.0 LIMITATIONS

There are several limitations to keep in mind when interpreting the results of this risk assessment.

- **Spatial and temporal variability of natural hazard occurrence** – With the exception of earthquakes, other hazards like flood, landslide, channel migration, and wildfire are extremely unlikely to occur across the fully mapped extent of the hazard zones. For example, areas mapped in the 100-year flood zone will be prone to flooding on occasion in certain watersheds during specific events, but not all at once throughout the entire county or even an entire community. While we report the overall impacts of a given hazard scenario, the losses from a single hazard event probably will not be as severe and widespread.
- **Loss estimation for individual buildings** – Hazus-MH is a model, not reality, which is an important factor when considering the loss ratio of an individual building. On-the-ground mitigation, such as elevation of buildings to avoid flood loss, has been only minimally captured.

Also, due to a lack of building material information, assumptions were made about the distribution of wood, steel, and unreinforced masonry buildings. Loss estimation is most insightful when individual building results are aggregated to the community level because it reduces the impact of data outliers.

- **Loss estimation versus exposure** – We recommend careful interpretation of exposure results. This is due to the spatial and temporal variability of natural hazards (described above) and the inability to perform loss estimations due to the lack of Hazus-MH damage functions. Exposure is reported in terms of total building value, which could imply a total loss of the buildings in a particular hazard zone, but this is not the case. Exposure is simply a calculation of the number of buildings and their value and does not make estimates about the level to which an individual building could be damaged.
- **Population variability** – Some of the communities in Douglas County have vacation homes and rentals, which are typically occupied during the summer. Our estimates of potentially displaced people rely on permanent populations published in the PSU Population Research Center estimates of permanent residents. As a result, we are slightly underestimating the number of people that may be in harm's way on a summer weekend.
- **Data accuracy and completeness** – Some datasets in our risk assessment had incomplete coverage or lacked high-resolution data within the study area. We used lower-resolution data where there was incomplete coverage or where high-resolution data was not available. We made assumptions to amend areas of incomplete data coverage based on reasonable methods described within this report. Data layers in which assumptions were made to fill gaps are building footprints, population, some building specific attributes, and landslide susceptibility. Many of the datasets included known or suspected artifacts, omissions, and errors, however repairing these problems was beyond the scope of the project and are areas needing additional research. We are aware that some uncertainty has been introduced from these data amendments at an individual building scale, but at community-wide scales the effects of the uncertainties are slight.
- **Changing Conditions** – This assessment did not account for potential changes in climate, land use, or population; it is a snapshot of Douglas County's current risk from natural hazards. Human-induced climate change poses a significant and widespread risk to people around the world. In Oregon, climate change is expected to impact the frequency and intensity of floods, wildfires, and landslides, but quantifying this impact was beyond the scope of this study.

# 6.0 RECOMMENDATIONS

The following actions are needed to better understand hazards and reduce risk to natural hazard through mitigation planning. These implementation areas, while not comprehensive, touch on all phases of risk management and focus on awareness and preparation, planning, emergency response, mitigation funding opportunities, and hazard-specific risk reduction activities.

## 6.1 Awareness and Preparation

Natural hazard awareness is crucial to lowering risk and lessening the impacts of natural hazards. When community members understand their risk and know the role that they play in preparedness, the community will become a much safer place to live. Awareness and preparation not only reduce the initial impact from natural hazards, but they also reduce the time a community needs to recover from a disaster, commonly referred to as "resilience."

This report is intended to provide local officials with a comprehensive and authoritative profile of natural hazard risk to underpin their public outreach efforts.

Messaging can be tailored to stakeholder groups. For example, outreach to homeowners could focus on actions they can take to reduce risk to their property. The DOGAMI Homeowners Guide to Landslides (https://www.oregon.gov/dogami/Landslide/Documents/ger_homeowners_guide_landslides.pdf) provides a variety of risk reduction options for homeowners who live in high landslide susceptibility areas. This guide is one of many existing resources. Agencies partnering with local officials in the development of additional effective resources could help reach a broader community and user groups.

## 6.2 Planning

This report can help local decision-makers develop their local plans by identifying geohazards and associated risks to the community. The primary framework for accomplishing this is through the comprehensive planning process. The comprehensive plan sets the long-term trajectory of capital improvements, zoning, and urban growth boundary expansion, all of which are planning tools that can be used to reduce natural hazard risk.

Another framework is the natural hazard mitigation plan (NHMP) process. NHMP plans focus on characterizing natural hazard risk and identifying actions to reduce risk. Additionally, the information presented here can be a resource when updating the mitigation actions and inform the vulnerability assessment section of the NHMP plan.

While there are many similarities between this report and an NHMP, the primary difference is that the risk assessment is not a planning document. Additional differences can be the hazards or critical facilities examined in each report. Differences between the reports may be due to data availability or limited methodologies for specific hazards. The critical facilities considered in this report may not be identical to those listed in a typical NHMP due to the lack of damage functions in Hazus-MH for nonbuilding structures and to different considerations about emergency response during and after a disaster.

## 6.3 Emergency Response

Critical facilities will play a major role during and immediately after a natural disaster. This study can help emergency managers identify vulnerable critical facilities and develop contingency plans. Additionally, detailed mapping of potentially displaced residents can be used to re-evaluate evacuation routes and identify vulnerable populations to target for early warning.

The building database that accompanies this report presents many opportunities for future pre-disaster mitigation, emergency response, and community resilience improvements. Vulnerable areas can be identified and targeted for awareness campaigns. These campaigns can be aimed at pre-disaster mitigation through, for example, improvements of the structural connection of a building's frame to its foundation. Emergency response entities can benefit from the use of the building dataset through identification of potential hazards and populated buildings before and during a disaster. Both reduction of the magnitude of the disaster and a decrease in the response time contribute to a community's overall resilience.

## 6.4 Mitigation Funding Opportunities

Several state and federal funding options are available to communities that are susceptible to natural hazards and have specific cost-effective mitigation projects they wish to accomplish. The Oregon Office of Emergency Management (OEM) State Hazard Mitigation Officer (SHMO) can provide communities assistance in determining eligibility, finding mitigation grants, and navigating the mitigation grant application process. OEM has produced a document that can assist local officials in applying for mitigation funds.[2]

At the time of writing this report, FEMA has five programs that assist with mitigation funding for natural hazards: Hazard Mitigation Grant Program (HMGP), HMGP Post-Fire Assistance, Pre-Disaster Mitigation (PDM) Grant Program, Building Resilient Infrastructure and Communities (BRIC) grant program, and Flood Mitigation Assistance (FMA) (https://www.fema.gov/grants/mitigation). The SHMO can help with finding further opportunities for earthquake and tsunami assistance and funding.

## 6.5 Hazard-Specific Risk Reduction Actions

### 6.5.1 Earthquake

- Evaluate critical facilities for seismic preparedness by identifying structural deficiencies and vulnerabilities to dependent systems (e.g., water, fuel, power).
- Evaluate vulnerabilities of critical facilities. We estimate that 28% of critical facilities (**Appendix A: Community Risk Profiles**) will be damaged by a CSZ earthquake scenario described in this report, which will have many direct and indirect negative effects on first-response and recovery efforts.
- Identify communities and buildings that would benefit from seismic upgrades.

### 6.5.2 Mw 9.0 CSZ tsunami

- Visit www.OregonTsunami.org to learn more about the hazard and ways to increase preparedness. Evaluate your community's evacuation plan and review DOGAMI's *Beat the Wave* evacuation modeling reports in the area.
- Use approved guides on preparing for tsunamis (e.g., Oregon Department of Land Conservation and Development (DLCD) guide on preparing for the CSZ tsunami) https://www.oregon.gov/LCD/OCMP/Pages/Tsunami-Planning.aspx
- Evaluate the community evacuation plan, including consideration for viable vertical evacuation options.

### 6.5.3 Flood

- Map areas of potential flood water storage areas.
- Identify structures that have repeatedly flooded in the past and would be eligible for FEMA's "buyout" program.
- Additional risk reduction strategies may be found on FEMA's website at https://www.ready.gov/floods.

[2] https://www.oregon.gov/OEM/Documents/Oregon_Hazard_Mitigation_Grant_Program_Handbook.pdf

### 6.5.4 Landslide

- Create modern landslide inventory and susceptibility maps.
- Monitor ground movement in high susceptibility areas.
- Evaluate risks to transportation networks and land value losses due to landslides in future risk assessments.
- Study the risk from landslides that are experience channel erosion at the toe of the landslide.
- Additional risk reduction strategies may be found on FEMA's website at https://www.ready.gov/landslides-debris-flow.

### 6.5.5 Wildfire-related geologic hazards

- Evaluate post-wildfire geologic hazards including flood, debris flows, and landslides.
- Additional risk reduction strategies may be found on FEMA's website at https://www.ready.gov/wildfires.

## 7.0 ACKNOWLEDGMENTS

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# 9.0 APPENDICES

# APPENDIX A. COMMUNITY RISK PROFILES

A risk analysis summary for each community is provided in this section to encourage ideas for natural hazard risk reduction. Increasing disaster preparedness, public hazards communication, and education, ensuring functionality of emergency services, and ensuring access to evacuation routes are actions that every community can take to reduce their risk. This appendix contains community specific data to provide an overview of the community and the level of risk from each natural hazard analyzed. In addition, for each community a list of critical facilities and assumed impact from individual hazards is provided.

## A.1 Unincorporated Douglas County (Rural)

**Table A-1. Unincorporated Douglas County (rural) hazard profile.**

**Community Overview**

| Community Name | Population | Number of Buildings | Critical Facilities[1] | Total Building Value ($) |
|---|---|---|---|---|
| Unincorporated Coastal Douglas County | 44,535 | 39,950 | 27 | 12,117,248,000 |

**Hazus Analysis Summary**

| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Damaged Buildings | Damaged Critical Facilities | Loss Estimate ($) | Loss Ratio |
|---|---|---|---|---|---|---|---|
| Flood[2] | 1% Annual Chance | 3,116 | 7.0% | 2,249 | 1 | 137,976,000 | 1.1% |
| *Earthquake** | *CSZ M9.0 Deterministic* | 1,242 | 2.8% | 6,202 | 7 | 1,107,849,148 | 9.1% |
| Earthquake (within Tsunami Zone) | | 27 | 0.1% | 80 | 1 | 29,277,469 | 0.2% |
| Earthquake | Hypothetical local crustal fault Mw-6.8 | 1082 | 2.4% | 5,376 | 4 | 1,056,653,000 | 8.7% |

**Exposure Analysis Summary**

| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Exposed Buildings | Exposed Critical Facilities | Building Value ($) | Exposure Ratio |
|---|---|---|---|---|---|---|---|
| *Tsunami* | *CSZ M8.9–Medium* | 99 | 0.2% | 152 | 1 | 47,433,000 | 0.4% |
| Landslide | High and Very High Susceptibility | 5,444 | 12% | 5,480 | 1 | 1,341,269,000 | 11% |
| Wildfire | High and Medium Hazard | 34,785 | 78.1% | 32,225 | 7 | 8,736,175,000 | 72.1% |

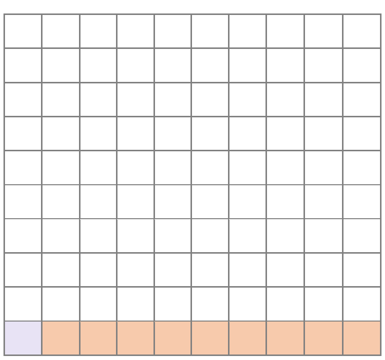
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-1.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

**Figure A-1. Unincorporated Douglas County loss ratio from CSZ event.**



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. In order to avoid double counting to buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value.

= Estimated losses due to tsunami.

= Estimated losses due to earthquake (outside of tsunami zone).

## Table A-2. Unincorporated Douglas County (rural) critical facilities.

| | Flood 1% Annual Chance | CSZ 9.0 Earthquake Moderate to Complete Damage | CSZ Tsunami Medium-sized scenario | Hypothetical local crustal fault Mw-6.8 Moderate to Complete Damage | Landslide High and Very High Susceptibility | Wildfire High or Moderate Risk |
|---|---|---|---|---|---|---|
| **Critical Facilities by Community** | **Exposed** | **>50% Prob.** | **Exposed** | **>50% Prob.** | **Exposed** | **Exposed** |
| Azalea RFPD | - | - | - | - | - | X |
| Camas Valley FD | - | - | - | - | - | - |
| Camas Valley School | - | X | - | - | - | - |
| Days Creek FD | - | - | - | - | - | X |
| Diamond Lake VFD | - | - | - | - | - | X |
| Douglas County Fire District 2 | - | - | - | - | - | - |
| Douglas County Fire District 2 - Dixonville Station #1 | - | X | - | X | - | - |
| Douglas County Fire District 2 - Fire Station #4 - Winchester | - | - | - | - | - | - |
| Douglas County Fire District 2 - Melrose Station | - | - | - | - | - | - |
| Fair Oaks RFPD | - | X | - | X | - | X |
| Gardiner RFPD | X | X | X | - | - | - |
| Glendale FD #1 | - | - | - | - | - | - |
| Glendale High School | - | - | - | - | - | - |
| Kellogg Volunteer FD | - | - | - | - | - | - |
| Lookingglass Elementary School | - | - | - | X | - | - |
| Lookingglass VFD | - | - | - | - | - | - |
| Melrose Elementary School | - | X | - | - | - | - |
| Milo RFPD | - | - | - | X | - | - |
| North Douglas County Fire & EMS | - | X | - | - | - | - |
| North Douglas Fire & EMS - Station #6 | - | - | - | - | - | - |
| Scottsburg RFPD | - | - | - | - | X | - |
| Sutherlin FD | - | - | - | - | - | - |
| Tenmile RFPD | - | - | - | - | - | - |
| Tiller RFPD | - | X | - | - | - | X |
| Umpqua Community College | - | X | - | - | - | - |

## A.2 Unincorporated Community of Glide

### Table A-3. Unincorporated community of Glide hazard profile.

| Community Overview | | | | |
|---|---|---|---|---|
| Community Name | Population | Number of Buildings | Critical Facilities[1] | Total Building Value ($) |
| Glide | 1,625 | 1,253 | 3 | 404,529,000 |

| Hazus-MH Analysis Summary | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Damaged Buildings | Damaged Critical Facilities | Loss Estimate ($) | Loss Ratio |
| Flood[2] | 1% Annual Chance | 33 | 2.0% | 15 | 0 | 749,000 | 0.2% |
| Earthquake | CSZ Mw-9.0 Deterministic | 48 | 3.0% | 220 | 1 | 39,695,047 | 9.8% |
| Earthquake | Hypothetical local crustal fault Mw-6.8 | 115 | 7.1% | 354 | 3 | 80,622,000 | 20% |

| Exposure Analysis Summary | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Exposed Buildings | Exposed Critical Facilities | Building Value ($) | Exposure Ratio |
| Landslide | High and Very High Susceptibility | 266 | 16.4% | 189 | 0 | 50,153,000 | 12.4% |
| Wildfire | High and Moderate Risk | 1,224 | 75.3% | 893 | 0 | 259,543,000 | 64.2% |

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with “First floor height” above the level of flooding (base flood elevation).

### Table A-4. Unincorporated community of Glide critical facilities.

| | Flood 1% Annual Chance | CSZ 9.0 Earthquake Moderate to Complete Damage | CSZ Tsunami Medium-sized scenario | Hypothetical local crustal fault Mw-6.8 Moderate to Complete Damage | Landslide High and Very High Susceptibility | Wildfire High or Moderate Risk |
|---|---|---|---|---|---|---|
| **Critical Facilities by Community** | **Exposed** | **>50% Prob.** | **Exposed** | **>50% Prob.** | **Exposed** | **Exposed** |
| Glide Elementary School | - | - | - | X | - | - |
| Glide High School | - | X | - | X | - | - |
| Glide RFPD | - | - | - | X | - | - |

## A.3 Unincorporated Community of Green

### Table A-5. Unincorporated community of Green hazard profile.

| Community Overview | | | | |
|---|---|---|---|---|
| Community Name | Population | Number of Buildings | Critical Facilities[1] | Total Building Value ($) |
| Green | 6,201 | 3,943 | 2 | 1,170,115,000 |

| Hazus-MH Analysis Summary | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Damaged Buildings | Damaged Critical Facilities | Loss Estimate ($) | Loss Ratio |
| Flood[2] | 1% Annual Chance | 408 | 6.6% | 187 | 0 | 3,440,000 | 0.3% |
| Earthquake | CSZ Mw-9.0 Deterministic | 209 | 3.4% | 765 | 0 | 111,047,082 | 9.5% |
| Earthquake | Hypothetical local crustal fault Mw-6.8 | 287 | 4.6% | 773 | 2 | 135,001,000 | 12% |

| Exposure Analysis Summary | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Exposed Buildings | Exposed Critical Facilities | Building Value ($) | Exposure Ratio |
| Landslide | High and Very High Susceptibility | 928 | 15.0% | 542 | 0 | 158,649,000 | 13.6% |
| Wildfire | High and Moderate Risk | 659 | 10.6% | 405 | 0 | 126,479,000 | 10.8% |

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with “First floor height” above the level of flooding (base flood elevation).

### Table A-6. Unincorporated community of Green critical facilities.

| | **Flood 1% Annual Chance** | **CSZ 9.0 Earthquake Moderate to Complete Damage** | **Hypothetical local crustal fault Mw-6.8 Moderate to Complete Damage** | **Landslide High and Very High Susceptibility** | **Wildfire High or Moderate Risk** |
|---|---|---|---|---|---|
| **Critical Facilities by Community** | **Exposed** | **>50% Prob.** | **>50% Prob.** | **Exposed** | **Exposed** |
| Green Elementary School | - | - | X | - | - |
| Sunnyslope Elementary School | - | - | X | - | - |

## A.4 Unincorporated Community of Tri-City

### Table A-7. Unincorporated community of Tri-City hazard profile.

| Community Overview | | | | |
|---|---|---|---|---|
| Community Name | Population | Number of Buildings | Critical Facilities[1] | Total Building Value ($) |
| Tri-City | 3,012 | 2,216 | 3 | 613,037,000 |

| Hazus-MH Analysis Summary | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Damaged Buildings | Damaged Critical Facilities | Loss Estimate ($) | Loss Ratio |
| Flood[2] | 1% Annual Chance | 147 | 4.9% | 102 | 0 | 6,123,000 | 1.0% |
| Earthquake | CSZ Mw-9.0 Deterministic | 121 | 4.0% | 477 | 0 | 55,469,949 | 9.0% |
| Earthquake | Hypothetical local crustal fault Mw-6.8 | 212 | 7.0% | 680 | 2 | 104,039,000 | 17% |

| Exposure Analysis Summary | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Exposed Buildings | Exposed Critical Facilities | Building Value ($) | Exposure Ratio |
| Landslide | High and Very High Susceptibility | 1,054 | 35.0% | 769 | 0 | 214,817,000 | 35.0% |
| Wildfire | High and Moderate Risk | 925 | 30.7% | 708 | 1 | 175,479,000 | 28.6% |

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with “First floor height” above the level of flooding (base flood elevation).

### Table A-8. Unincorporated community of Tri-City critical facilities.

| | Flood 1% Annual Chance | CSZ 9.0 Earthquake Moderate to Complete Damage | Hypothetical local crustal fault Mw-6.8 Moderate to Complete Damage | Landslide High and Very High Susceptibility | Wildfire High or Moderate Risk |
|---|---|---|---|---|---|
| **Critical Facilities by Community** | **Exposed** | **>50% Prob.** | **>50% Prob.** | **Exposed** | **Exposed** |
| Tri-City Elementary School | - | - | X | - | - |
| Tri-City RFPD #4 | - | - | - | - | X |
| South Umpqua High School | - | - | X | - | - |

## A.5 Unincorporated Community of Winchester

### Table A-9. Unincorporated community of Winchester hazard profile.

| Community Overview | | | | |
|---|---|---|---|---|
| Community Name | Population | Number of Buildings | Critical Facilities[1] | Total Building Value ($) |
| Winchester | 2,555 | 1,407 | 1 | 387,530,000 |

| Hazus-MH Analysis Summary | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Damaged Buildings | Damaged Critical Facilities | Loss Estimate ($) | Loss Ratio |
| Flood[2] | 1% Annual Chance | 107 | 4.2% | 45 | 0 | 1,918,000 | 0.5% |
| Earthquake | CSZ Mw-9.0 Deterministic | 8 | 0.3% | 99 | 0 | 13,802,075 | 3.6% |
| Earthquake | Hypothetical local crustal fault Mw-6.8 | 8 | 0.3% | 51 | 0 | 8,453,000 | 2.2% |

| Exposure Analysis Summary | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Exposed Buildings | Exposed Critical Facilities | Building Value ($) | Exposure Ratio |
| Landslide | High and Very High Susceptibility | 54 | 2.1% | 24 | 0 | 8,824,000 | 2.3% |
| Wildfire | High and Moderate Risk | 435 | 17.0% | 193 | 0 | 71,079,000 | 18.3% |

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with “First floor height” above the level of flooding (base flood elevation).

### Table A-10. Unincorporated community of Winchester critical facilities.

| | Flood 1% Annual Chance | CSZ 9.0 Earthquake Moderate to Complete Damage | Hypothetical local crustal fault Mw-6.8 Moderate to Complete Damage | Landslide High and Very High Susceptibility | Wildfire High or Moderate Risk |
|---|---|---|---|---|---|
| **Critical Facilities by Community** | **Exposed** | **>50% Prob.** | **>50% Prob.** | **Exposed** | **Exposed** |
| Winchester Elementary | - | - | - | - | - |

## A.6 Unincorporated Community of Winchester Bay

**Table A-11. Unincorporated community of Winchester Bay hazard profile.**

**Community Overview**

| Community Name | Population | Number of Buildings | Critical Facilities[1] | Total Building Value ($) |
|---|---|---|---|---|
| Winchester Bay | 276 | 444 | 2 | 72,506,000 |

**Hazus Analysis Summary**

| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Damaged Buildings | Damaged Critical Facilities | Loss Estimate ($) | Loss Ratio |
|---|---|---|---|---|---|---|---|
| Flood[2] | 1% Annual Chance | 9 | 3.1% | 23 | 0 | 535,000 | 0.7% |
| *Earthquake** | *CSZ M9.0 Deterministic* | 64 | 23.2% | 155 | 1 | 20,243,765 | 27.9% |
| Earthquake (within Tsunami Zone) | | 65 | 23.7% | 147 | 1 | 13,987,184 | 19.3% |
| Earthquake | Hypothetical local crustal fault Mw-6.8 | 0 | 0% | 0 | 0 | 150,000 | 0.2% |

**Exposure Analysis Summary**

| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Exposed Buildings | Exposed Critical Facilities | Building Value ($) | Exposure Ratio |
|---|---|---|---|---|---|---|---|
| *Tsunami* | *CSZ M8.9 – Medium* | 128 | 46.5% | 219 | 1 | 33,940,000 | 46.8% |
| Landslide | High and Very High Susceptibility | 30 | 10.9% | 54 | 0 | 6,187,000 | 8.5% |
| Wildfire | High Hazard | 0 | 0.0% | 0 | 0 | 0 | 0.0% |

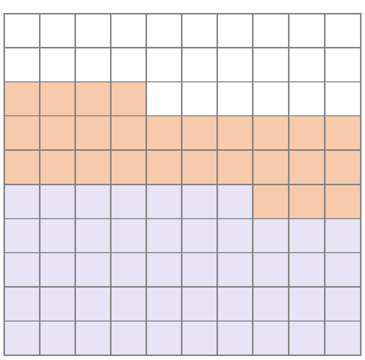
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-1.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with “First floor height” above the level of flooding (base flood elevation).

**Figure A-2. Unincorporated community of Winchester Bay loss ratio from CSZ event.**



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. In order to avoid double counting to buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value.

= Estimated losses due to tsunami.

= Estimated losses due to earthquake (outside of tsunami zone).

## Table A-12. Unincorporated community of Winchester Bay critical facilities.

| | Flood 1% Annual Chance | CSZ 9.0 Earthquake Moderate to Complete Damage | CSZ Tsunami Medium-sized scenario | Hypothetical local crustal fault Mw-6.8 Moderate to Complete Damage | Landslide High and Very High Susceptibility | Wildfire High or Moderate Risk |
|---|---|---|---|---|---|---|
| **Critical Facilities by Community** | **Exposed** | **>50% Prob.** | **Exposed** | **>50% Prob.** | **Exposed** | **Exposed** |
| US Coast Guard - Umpqua River Station | - | X | X | - | - | - |
| Winchester Bay RFPD | - | X | - | - | - | - |

## A.7 City of Canyonville

### Table A-13. City of Canyonville hazard profile.

| Community Overview | | | | | |
|---|---|---|---|---|---|
| Community Name | Population | Number of Buildings | Critical Facilities[1] | Total Building Value ($) | |
| Canyonville | 1,663 | 898 | 5 | 274,677,000 | |

| Hazus-MH Analysis Summary | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Damaged Buildings | Damaged Critical Facilities | Loss Estimate ($) | Loss Ratio |
| Flood[2] | 1% Annual Chance | 24 | 1.4% | 14 | 0 | 177,000 | 0.1% |
| Earthquake | CSZ Mw-9.0 Deterministic | 58 | 3.5% | 151 | 0 | 26,635,073 | 9.7% |
| Earthquake | Hypothetical local crustal fault Mw-6.8 | 75 | 4.5% | 165 | 2 | 34,791,000 | 13% |

| Exposure Analysis Summary | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Exposed Buildings | Exposed Critical Facilities | Building Value ($) | Exposure Ratio |
| Landslide | High and Very High Susceptibility | 76 | 4.6% | 40 | 0 | 10,753,000 | 3.9% |
| Wildfire | High and Moderate Risk | 358 | 21.5% | 212 | 0 | 57,988,000 | 21.1% |

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with “First floor height” above the level of flooding (base flood elevation).

### Table A-14. City of Canyonville critical facilities.

| Critical Facilities by Community | Flood 1% Annual Chance<br>Exposed | CSZ 9.0 Earthquake Moderate to Complete Damage<br>>50% Prob. | Hypothetical local crustal fault Mw-6.8 Moderate to Complete Damage<br>>50% Prob. | Landslide High and Very High Susceptibility<br>Exposed | Wildfire High or Moderate Risk<br>Exposed |
|---|---|---|---|---|---|
| Canyonville City Hall | - | - | X | - | - |
| Canyonville School | - | - | X | - | - |
| Canyonville/South Umpqua FD | - | - | - | - | - |
| Canyonville Urgent Care | - | - | - | - | - |
| Canyonville Water Treatment | - | - | - | - | - |

## A.8 Cow Creek Band of Umpqua Tribe of Indians

### Table A-15. Cow Creek Band of Umpqua Tribe of Indians hazard profile.

| Community Overview | | | | |
|---|---|---|---|---|
| Community Name | Population | Number of Buildings | Critical Facilities[1] | Total Building Value ($) |
| Cow Creek Umpqua Tribe | N/A | 44 | 1 | 24,655,000 |

| Hazus-MH Analysis Summary | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Damaged Buildings | Damaged Critical Facilities | Loss Estimate ($) | Loss Ratio |
| Flood[2] | 1% Annual Chance | N/A | N/A | 5 | 0 | 226,000 | 0.9% |
| Earthquake | CSZ Mw-9.0 Deterministic | N/A | N/A | 7 | 0 | 1,826,295 | 7.4% |
| Earthquake | Hypothetical local crustal fault Mw-6.8 | N/A | N/A | 12 | 0 | 3,104,000 | 13% |

| Exposure Analysis Summary | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Exposed Buildings | Exposed Critical Facilities | Building Value ($) | Exposure Ratio |
| Landslide | High and Very High Susceptibility | N/A | N/A | 4 | 0 | 1,061,000 | 4.3% |
| Wildfire | High and Moderate Risk | N/A | N/A | 19 | 1 | 7,855,000 | 31.9% |

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

### Table A-16. Cow Creek Band of Umpqua Tribe of Indians critical facilities.

| | Flood 1% Annual Chance | CSZ 9.0 Earthquake Moderate to Complete Damage | Hypothetical local crustal fault Mw-6.8 Moderate to Complete Damage | Landslide High and Very High Susceptibility | Wildfire High or Moderate Risk |
|---|---|---|---|---|---|
| **Critical Facilities by Community** | **Exposed** | **>50% Prob.** | **>50% Prob.** | **Exposed** | **Exposed** |
| Cow Creek Umpqua Tribe Water Treatment | - | - | - | - | X |

## A.9 City of Drain

### Table A-17. City of Drain hazard profile.

| Community Overview | | | | | | | |
|---|---|---|---|---|---|---|---|
| Community Name | | Population | Number of Buildings | | Critical Facilities[1] | Total Building Value ($) | |
| Drain | | 1,174 | 589 | | 7 | 226,400,000 | |
| **Hazus-MH Analysis Summary** | | | | | | | |
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Damaged Buildings | Damaged Critical Facilities | Loss Estimate ($) | Loss Ratio |
| Flood[2] | 1% Annual Chance | 441 | 37.6% | 170 | 1 | 4,362,000 | 1.9% |
| Earthquake | CSZ Mw-9.0 Deterministic | 44 | 3.8% | 121 | 2 | 26,077,059 | 11.5% |
| Earthquake | Hypothetical local crustal fault Mw-6.8 | 38 | 3.2% | 100 | 1 | 22,157,000 | 9.8% |
| **Exposure Analysis Summary** | | | | | | | |
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Exposed Buildings | Exposed Critical Facilities | Building Value ($) | Exposure Ratio |
| Landslide | High and Very High Susceptibility | 51 | 4.3% | 24 | 0 | 6,237,000 | 2.8% |
| Wildfire | High and Moderate Risk | 146 | 12.5% | 62 | 0 | 17,184,000 | 7.6% |

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with “First floor height” above the level of flooding (base flood elevation).

### Table A-18. City of Drain critical facilities.

| | Flood 1% Annual Chance | CSZ 9.0 Earthquake Moderate to Complete Damage | Hypothetical local crustal fault Mw-6.8 Moderate to Complete Damage | Landslide High and Very High Susceptibility | Wildfire High or Moderate Risk |
|---|---|---|---|---|---|
| **Critical Facilities by Community** | **Exposed** | **>50% Prob.** | **>50% Prob.** | **Exposed** | **Exposed** |
| Douglas County Sheriff's Office | X | X | - | - | - |
| Drain City Hall | - | - | - | - | - |
| Drain City Shops | - | - | - | - | - |
| Drain Wastewater Treatment | - | - | - | - | - |
| North Douglas County Fire and EMS | - | - | - | - | - |
| North Douglas Elementary School | - | - | - | - | - |
| Pacific Gateway Medical | - | X | X | - | - |

## A.10 City of Elkton

### Table A-19. City of Elkton hazard profile.

| Community Overview | | | | | |
|---|---|---|---|---|---|
| Community Name | Population | Number of Buildings | Critical Facilities[1] | Total Building Value ($) |
| Elkton | 189 | 142 | 2 | 48,153,000 |

| Hazus-MH Analysis Summary | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Damaged Buildings | Damaged Critical Facilities | Loss Estimate ($) | Loss Ratio |
| Flood[2] | 1% Annual Chance | 33 | 17.5% | 20 | 1 | 1,369,000 | 2.8% |
| Earthquake | CSZ Mw-9.0 Deterministic | 1 | 0.5% | 8 | 1 | 2,186,585 | 4.5% |
| Earthquake | Hypothetical local crustal fault Mw-6.8 | 0 | 0.0% | 0 | 0 | 167,000 | 0.3% |

| Exposure Analysis Summary | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Exposed Buildings | Exposed Critical Facilities | Building Value ($) | Exposure Ratio |
| Landslide | High and Very High Susceptibility | 2 | 0.9% | 3 | 0 | 769,000 | 1.6% |
| Wildfire | High and Moderate Risk | 42 | 22.2% | 30 | 0 | 8,347,000 | 17.3% |

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with “First floor height” above the level of flooding (base flood elevation).

### Table A-20. City of Elkton critical facilities.

| | **Flood 1% Annual Chance** | **CSZ 9.0 Earthquake Moderate to Complete Damage** | **Hypothetical local crustal fault Mw-6.8 Moderate to Complete Damage** | **Landslide High and Very High Susceptibility** | **Wildfire High or Moderate Risk** |
|---|---|---|---|---|---|
| **Critical Facilities by Community** | **Exposed** | **>50% Prob.** | **>50% Prob.** | **Exposed** | **Exposed** |
| Elkton RFPD | - | X | - | - | - |
| Elkton Water Plant | X | - | - | - | - |

## A.11 City of Glendale

### Table A-21. City of Glendale hazard profile.

| Community Overview | | | | | |
|---|---|---|---|---|---|
| Community Name | Population | Number of Buildings | Critical Facilities[1] | Total Building Value ($) | |
| Glendale | 857 | 423 | 4 | 127,625,000 | |

| Hazus-MH Analysis Summary | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Damaged Buildings | Damaged Critical Facilities | Loss Estimate ($) | Loss Ratio |
| Flood[2] | 1% Annual Chance | 12 | 1.4% | 1 | 0 | 7,000 | 0.0% |
| Earthquake | CSZ Mw-9.0 Deterministic | 61 | 7.1% | 122 | 0 | 19,416,666 | 15.2% |
| Earthquake | Hypothetical local crustal fault Mw-6.8 | 30 | 3.5% | 71 | 0 | 12,151,000 | 9.5% |

| Exposure Analysis Summary | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Exposed Buildings | Exposed Critical Facilities | Building Value ($) | Exposure Ratio |
| Landslide | High and Very High Susceptibility | 43 | 5.0% | 21 | 1 | 4,945,000 | 3.9% |
| Wildfire | High and Moderate Risk | 205 | 23.9% | 116 | 2 | 26,241,000 | 20.6% |

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with “First floor height” above the level of flooding (base flood elevation).

### Table A-22. City of Glendale critical facilities.

| | **Flood 1% Annual Chance** | **CSZ 9.0 Earthquake Moderate to Complete Damage** | **Hypothetical local crustal fault Mw-6.8 Moderate to Complete Damage** | **Landslide High and Very High Susceptibility** | **Wildfire High or Moderate Risk** |
|---|---|---|---|---|---|
| **Critical Facilities by Community** | **Exposed** | **>50% Prob.** | **>50% Prob.** | **Exposed** | **Exposed** |
| Glendale City Hall | - | - | - | - | - |
| Glendale Elementary School | - | - | - | - | - |
| Glendale Sewage Treatment | - | - | - | - | X |
| Glendale Water Treatment Plant | - | - | - | X | X |

## A.12 City of Myrtle Creek

### Table A-23. City of Myrtle Creek hazard profile.

| Community Overview | | | | | | | |
|---|---|---|---|---|---|---|---|
| Community Name | | Population | Number of Buildings | | Critical Facilities[1] | | Total Building Value ($) |
| Myrtle Creek | | 3,507 | 1,688 | | 6 | | 531,074,000 |
| **Hazus-MH Analysis Summary** | | | | | | | |
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Damaged Buildings | Damaged Critical Facilities | Loss Estimate ($) | Loss Ratio |
| Flood[2] | 1% Annual Chance | 177 | 5.0% | 109 | 2 | 6,980,000 | 1.3% |
| Earthquake | CSZ Mw-9.0 Deterministic | 171 | 4.9% | 397 | 1 | 67,776,663 | 12.8% |
| Earthquake | Hypothetical local crustal fault Mw-6.8 | 259 | 7.4% | 566 | 5 | 119,525,000 | 23% |
| **Exposure Analysis Summary** | | | | | | | |
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Exposed Buildings | Exposed Critical Facilities | Building Value ($) | Exposure Ratio |
| Landslide | High and Very High Susceptibility | 65 | 1.9% | 27 | 0 | 8,666,000 | 1.6% |
| Wildfire | High and Moderate Risk | 839 | 23.9% | 396 | 0 | 111,622,000 | 21.0% |

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with “First floor height” above the level of flooding (base flood elevation).

### Table A-24. City of Myrtle Creek critical facilities.

| | Flood 1% Annual Chance | CSZ 9.0 Earthquake Moderate to Complete Damage | Hypothetical local crustal fault Mw-6.8 Moderate to Complete Damage | Landslide High and Very High Susceptibility | Wildfire High or Moderate Risk |
|---|---|---|---|---|---|
| **Critical Facilities by Community** | **Exposed** | **>50% Prob.** | **>50% Prob.** | **Exposed** | **Exposed** |
| Coffenberry Middle School | - | - | X | - | - |
| Myrtle Creek City Hall | - | - | X | - | - |
| Myrtle Creek Elementary School | - | X | X | - | - |
| Myrtle Creek FD | X | - | - | - | - |
| Myrtle Creek Police Dept | - | - | X | - | - |
| Myrtle Creek Water Treatment | X | - | X | - | - |

## A.13 City of Oakland

### Table A-25. City of Oakland hazard profile.

| Community Overview | | | | | |
|---|---|---|---|---|---|
| Community Name | Population | Number of Buildings | Critical Facilities[1] | Total Building Value ($) | |
| Oakland | 937 | 512 | 5 | 179,224,000 | |

| Hazus-MH Analysis Summary | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Damaged Buildings | Damaged Critical Facilities | Loss Estimate ($) | Loss Ratio |
| Flood[2] | 1% Annual Chance | 0 | 0.0% | 0 | 0 | 0 | 0.0% |
| Earthquake* | CSZ Mw-9.0 Deterministic | 1 | 0.1% | 5 | 0 | 4,052,445 | 2.3% |
| Earthquake* | Hypothetical local crustal fault Mw-6.8 | 1 | 0.1% | 7 | 0 | 3,795,000 | 2.1% |

| Exposure Analysis Summary | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Exposed Buildings | Exposed Critical Facilities | Building Value ($) | Exposure Ratio |
| Landslide | High and Very High Susceptibility | 16 | 1.7% | 7 | 0 | 1,976,000 | 1.1% |
| Wildfire | High and Moderate Risk | 322 | 34.4% | 165 | 0 | 45,384,000 | 25.3% |

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with “First floor height” above the level of flooding (base flood elevation).

### Table A-26. City of Oakland critical facilities.

| | **Flood 1% Annual Chance** | **CSZ 9.0 Earthquake Moderate to Complete Damage** | **Hypothetical local crustal fault Mw-6.8 Moderate to Complete Damage** | **Landslide High and Very High Susceptibility** | **Wildfire High or Moderate Risk** |
|---|---|---|---|---|---|
| **Critical Facilities by Community** | **Exposed** | **>50% Prob.** | **>50% Prob.** | **Exposed** | **Exposed** |
| Lincoln Middle School | - | - | - | - | - |
| Oakland Elementary School | - | - | - | - | - |
| Oakland High School | - | - | - | - | - |
| Oakland Police Dept | - | - | - | - | - |
| Oakland RFD | - | - | - | - | - |

## A.14 City of Reedsport

### Table A-27. City of Reedsport hazard profile.

**Community Overview**

| Community Name | Population | Number of Buildings | Critical Facilities[1] | Total Building Value ($) |
|---|---|---|---|---|
| Reedsport | 4,252 | 2,626 | 8 | 667,084,000 |

**Hazus Analysis Summary**

| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Damaged Buildings | Damaged Critical Facilities | Loss Estimate ($) | Loss Ratio |
|---|---|---|---|---|---|---|---|
| Flood[2] | 1% Annual Chance | 1,064 | 25% | 713 | 2 | 36,691,000 | 5.5% |
| *Earthquake** | *CSZ M9.0 Deterministic* | 677 | 16% | 796 | 5 | 209,872,034 | 32% |
| Earthquake (within Tsunami Zone) | | 351 | 8.3% | 340 | 0 | 75,905,866 | 11% |
| Earthquake | Hypothetical local crustal fault Mw-6.8 | 1 | 0.0% | 3 | 0 | 2,295,000 | 0.3% |

**Exposure Analysis Summary**

| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Exposed Buildings | Exposed Critical Facilities | Building Value ($) | Exposure Ratio |
|---|---|---|---|---|---|---|---|
| *Tsunami* | *CSZ M8.9 – Medium* | 626 | 15% | 490 | 1 | 123,070,000 | 18% |
| Landslide | High and Very High Susceptibility | 396 | 9.3% | 204 | 0 | 43,946,000 | 6.6% |
| Wildfire | High Hazard | 40 | 0.9% | 20 | 0 | 3,830,000 | 0.6% |

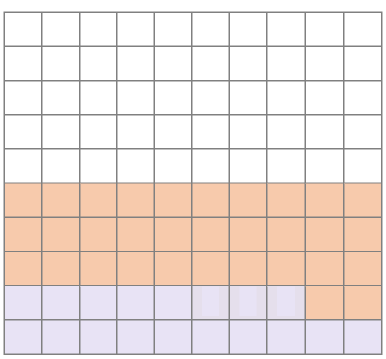
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-1.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

### Figure A-3. City of Reedsport loss ratio from CSZ event.



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. In order to avoid double counting to buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value.

= Estimated losses due to tsunami.

= Estimated losses due to earthquake (outside of tsunami zone).

## Table A-28. City of Reedsport critical facilities.

| Critical Facilities by Community | Flood 1% Annual Chance | CSZ 9.0 Earthquake Moderate to Complete Damage | CSZ Tsunami Medium-sized scenario | Hypothetical local crustal fault Mw-6.8 Moderate to Complete Damage | Landslide High and Very High Susceptibility | Wildfire High or Moderate Risk |
|---|---|---|---|---|---|---|
| | Exposed | >50% Prob. | Exposed | >50% Prob. | Exposed | Exposed |
| Highland Elementary School | - | X | - | - | - | - |
| Lower Umpqua Hospital | - | X | - | - | - | - |
| Lower Umpqua Hospital - Reedsport | - | X | - | - | - | - |
| Public Works - City Shop | - | X | - | - | - | - |
| Reedsport FD Station 2 | - | - | - | - | - | - |
| Reedsport Junior/High School | - | X | - | - | - | - |
| Reedsport Police Dept | X | X | - | - | - | - |
| Reedsport Public Works | X | - | - | - | - | - |

## A.15 City of Riddle

### Table A-29. City of Riddle hazard profile.

| Community Overview | | | | | | | |
|---|---|---|---|---|---|---|---|
| Community Name | | Population | Number of Buildings | Critical Facilities[1] | Total Building Value ($) | | |
| Riddle | | 1,226 | 569 | 3 | 174,784,000 | | |
| **Hazus-MH Analysis Summary** | | | | | | | |
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Damaged Buildings | Damaged Critical Facilities | Loss Estimate ($) | Loss Ratio |
| Flood[2] | 1% Annual Chance | 0 | 0.0% | 6 | 0 | 18,000 | 0.0% |
| Earthquake* | CSZ Mw-9.0 Deterministic | 88 | 7.1% | 176 | 0 | 25,993,770 | 14.9% |
| Earthquake* | Hypothetical local crustal fault Mw-6.8 | 89 | 7.3% | 187 | 3 | 35,268,000 | 20% |
| **Exposure Analysis Summary** | | | | | | | |
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Exposed Buildings | Exposed Critical Facilities | Building Value ($) | Exposure Ratio |
| Landslide | High and Very High Susceptibility | 0 | 0.0% | 2 | 0 | 551,000 | 0.3% |
| Wildfire | High and Moderate Risk | 63 | 5.1% | 30 | 0 | 7,295,000 | 4.2% |

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

### Table A-30. City of Riddle critical facilities.

| | Flood 1% Annual Chance | CSZ 9.0 Earthquake Moderate to Complete Damage | Hypothetical local crustal fault Mw-6.8 Moderate to Complete Damage | Landslide High and Very High Susceptibility | Wildfire High or Moderate Risk |
|---|---|---|---|---|---|
| **Critical Facilities by Community** | **Exposed** | **>50% Prob.** | **>50% Prob.** | **Exposed** | **Exposed** |
| Ardenwald Elementary School | - | - | X | - | - |
| Campbell Elementary School | - | - | X | - | - |
| Rowe Middle School | - | - | X | - | - |

## A.16 City of Roseburg

### Table A-31. City of Roseburg hazard profile.

| Community Overview | | | | | | |
|---|---|---|---|---|---|---|
| Community Name | Population | Number of Buildings | Critical Facilities[1] | Total Building Value ($) | | |
| Roseburg | 23,955 | 9,678 | 13 | 4,226,793,000 | | |

| Hazus-MH Analysis Summary | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Damaged Buildings | Damaged Critical Facilities | Loss Estimate ($) | Loss Ratio |
| Flood[2] | 1% Annual Chance | 1,569 | 6.5% | 398 | 2 | 15,891,000 | 0.4% |
| Earthquake* | CSZ Mw-9.0 Deterministic | 127 | 0.5% | 331 | 2 | 144,147,741 | 3.4% |
| Earthquake* | Hypothetical local crustal fault Mw-6.8 | 70 | 0.3% | 202 | 0 | 94,091,000 | 2.2% |

| Exposure Analysis Summary | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Exposed Buildings | Exposed Critical Facilities | Building Value ($) | Exposure Ratio |
| Landslide | High and Very High Susceptibility | 1,077 | 4.5% | 382 | 0 | 124,802,000 | 3.0% |
| Wildfire | High and Moderate Risk | 1,766 | 7.4% | 614 | 0 | 204,033,000 | 4.8% |

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with “First floor height” above the level of flooding (base flood elevation).

### Table A-32. City of Roseburg critical facilities.

| | Flood 1% Annual Chance | CSZ 9.0 Earthquake Moderate to Complete Damage | Hypothetical local crustal fault Mw-6.8 Moderate to Complete Damage | Landslide High and Very High Susceptibility | Wildfire High or Moderate Risk |
|---|---|---|---|---|---|
| **Critical Facilities by Community** | **Exposed** | **>50% Prob.** | **>50% Prob.** | **Exposed** | **Exposed** |
| Douglas County Sheriff's Office and ERC - 911 | - | X | - | - | - |
| Eastwood Elementary School | - | - | - | - | - |
| Fir Grove Elementary School | - | - | - | - | - |
| Fullerton IV Elementary School | - | - | - | - | - |
| Hucrest Elementary School | - | - | - | - | - |
| John C Fremont Middle School | X | - | - | - | - |
| Joseph Lane Middle School | - | - | - | - | - |
| Mercy Medical Center - Roseburg | - | - | - | - | - |
| OSP - Roseburg Patrol | - | - | - | - | - |
| Rose Elementary School | - | - | - | - | - |
| Roseburg FD | - | - | - | - | - |
| Roseburg High School | - | X | - | - | - |
| Roseburg Police Dept | X | - | - | - | - |

## A.17 City of Sutherlin

### Table A-33. City of Sutherlin hazard profile.

| Community Overview | | | | | |
|---|---|---|---|---|---|
| Community Name | Population | Number of Buildings | Critical Facilities[1] | Total Building Value ($) | |
| Sutherlin | 8,962 | 3,915 | 5 | 1,332,097,000 | |

| Hazus-MH Analysis Summary | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Damaged Buildings | Damaged Critical Facilities | Loss Estimate ($) | Loss Ratio |
| Flood[2] | 1% Annual Chance | 0 | 0.0% | 0 | 0 | 0 | 0.0% |
| Earthquake* | CSZ Mw-9.0 Deterministic | 13 | 0.1% | 107 | 0 | 31,823,286 | 2.4% |
| Earthquake* | Hypothetical local crustal fault Mw-6.8 | 13 | 0.1% | 61 | 0 | 21,836,000 | 1.6% |

| Exposure Analysis Summary | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Exposed Buildings | Exposed Critical Facilities | Building Value ($) | Exposure Ratio |
| Landslide | High and Very High Susceptibility | 239 | 2.7% | 93 | 0 | 30,251,000 | 2.3% |
| Wildfire | High and Moderate Risk | 1,816 | 20.3% | 732 | 0 | 242,350,000 | 18.2% |

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

### Table A-34. City of Sutherlin critical facilities.

| | Flood 1% Annual Chance | CSZ 9.0 Earthquake Moderate to Complete Damage | Hypothetical local crustal fault Mw-6.8 Moderate to Complete Damage | Landslide High and Very High Susceptibility | Wildfire High or Moderate Risk |
|---|---|---|---|---|---|
| **Critical Facilities by Community** | **Exposed** | **>50% Prob.** | **>50% Prob.** | **Exposed** | **Exposed** |
| East Sutherlin Primary School | - | - | - | - | - |
| Sutherlin High School | - | - | - | - | - |
| Sutherlin Middle School | - | - | - | - | - |
| Sutherlin Police Dept | - | - | - | - | - |
| West Sutherlin Intermediate | - | - | - | - | - |

## A.18 City of Winston

### Table A-35. City of Winston hazard profile.

| Community Overview | | | | | | | |
|---|---|---|---|---|---|---|---|
| Community Name | | Population | Number of Buildings | Critical Facilities[1] | Total Building Value ($) | | |
| Winston | | 5,682 | 2,406 | 6 | 749,929,000 | | |
| **Hazus-MH Analysis Summary** | | | | | | | |
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Damaged Buildings | Damaged Critical Facilities | Loss Estimate ($) | Loss Ratio |
| Flood[2] | 1% Annual Chance | 107 | 1.9% | 44 | 0 | 1,706,000 | 0.2% |
| Earthquake* | CSZ Mw-9.0 Deterministic | 108 | 1.9% | 247 | 3 | 55,748,051 | 7.4% |
| Earthquake* | Hypothetical local crustal fault Mw-6.8 | 40 | 0.7% | 95 | 0 | 20,264,000 | 2.7% |
| **Exposure Analysis Summary** | | | | | | | |
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Exposed Buildings | Exposed Critical Facilities | Building Value ($) | Exposure Ratio |
| Landslide | High and Very High Susceptibility | 2,760 | 48.6% | 1,153 | 3 | 357,217,000 | 47.6% |
| Wildfire | High and Moderate Risk | 985 | 17.3% | 396 | 2 | 123,983,000 | 16.5% |

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

### Table A-36. City of Winston critical facilities.

| | Flood 1% Annual Chance | CSZ 9.0 Earthquake Moderate to Complete Damage | Hypothetical local crustal fault Mw-6.8 Moderate to Complete Damage | Landslide High and Very High Susceptibility | Wildfire High or Moderate Risk |
|---|---|---|---|---|---|
| **Critical Facilities by Community** | **Exposed** | **>50% Prob.** | **>50% Prob.** | **Exposed** | **Exposed** |
| Brockway Elementary School | - | - | - | X | X |
| Douglas High School | - | X | - | X | X |
| McGovern Elementary School | - | X | - | - | - |
| Winston Dillard RFPD | - | - | - | - | - |
| Winston Middle School | - | X | - | X | - |
| Winston Police Department | - | - | - | - | - |

## A.19 City of Yoncalla

### Table A-37. City of Yoncalla hazard profile.

| Community Overview | | | | | | | |
|---|---|---|---|---|---|---|---|
| Community Name | | Population | Number of Buildings | | Critical Facilities[1] | | Total Building Value ($) |
| Yoncalla | | 1,032 | 635 | | 1 | | 184,859,000 |
| **Hazus-MH Analysis Summary** | | | | | | | |
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Damaged Buildings | Damaged Critical Facilities | Loss Estimate ($) | Loss Ratio |
| Flood[2] | 1% Annual Chance | 0 | 0.0% | 0 | 0 | 0 | 0.0% |
| Earthquake* | CSZ Mw-9.0 Deterministic | 13 | 1.3% | 59 | 0 | 11,078,979 | 6.0% |
| Earthquake* | Hypothetical local crustal fault Mw-6.8 | 14 | 1.4% | 44 | 0 | 8,402,000 | 4.5% |
| **Exposure Analysis Summary** | | | | | | | |
| Hazard | Scenario | Potentially Displaced Residents | % Potentially Displaced Residents | Exposed Buildings | Exposed Critical Facilities | Building Value ($) | Exposure Ratio |
| Landslide | High and Very High Susceptibility | 12 | 1.1% | 6 | 0 | 1,536,000 | 0.8% |
| Wildfire | High and Moderate Risk | 75 | 7.3% | 55 | 0 | 21,416,000 | 11.6% |

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

### Table A-38. City of Yoncalla critical facilities.

| | **Flood 1% Annual Chance** | **CSZ 9.0 Earthquake Moderate to Complete Damage** | **Hypothetical local crustal fault Mw-6.8 Moderate to Complete Damage** | **Landslide High and Very High Susceptibility** | **Wildfire High or Moderate Risk** |
|---|---|---|---|---|---|
| **Critical Facilities by Community** | **Exposed** | **>50% Prob.** | **>50% Prob.** | **Exposed** | **Exposed** |
| Yoncalla Elementary School | - | - | - | - | - |

# APPENDIX B. DETAILED RISK ASSESSMENT TABLES

## Table B-1. Douglas County building inventory.

*(all dollar amounts in thousands)*

| | Residential | | | Commercial and Industrial | | | Agricultural | | | Public and Non-Profit | | | All Buildings | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Community | Number of Buildings | Building Value ($) | Building Value per Community Total | Number of Buildings | Building Value ($) | Building Value per Community Total | Number of Buildings | Building Value ($) | Building Value per Community Total | Number of Buildings | Building Value ($) | Building Value per Community Total | Number of Buildings | Number of Buildings per Study Area Total | Building Value ($) | Value of Buildings per Study Area Total |
| Unincorp. Douglas Co (rural) | 20,826 | 7,080,934 | 58% | 2,390 | 1,388,077 | 11.5% | 16,366 | 3,345,786 | 28% | 368 | 302,450 | 2.5% | 39,950 | 54% | 12,117,248 | 51% |
| Glide | 843 | 249,250 | 62% | 82 | 49,869 | 12.3% | 291 | 47,530 | 12% | 37 | 57,880 | 14.3% | 1,253 | 1.7% | 404,529 | 1.7% |
| Green | 3,337 | 909,362 | 78% | 228 | 160,572 | 13.7% | 338 | 49,947 | 4.3% | 40 | 50,235 | 4.3% | 3,943 | 5.4% | 1,170,115 | 5.0% |
| Tri-City | 1,719 | 462,458 | 75% | 99 | 51,882 | 8.5% | 348 | 43,805 | 7.1% | 50 | 54,892 | 9.0% | 2,216 | 3.0% | 613,037 | 2.6% |
| Winchester | 1,298 | 356,018 | 92% | 24 | 12,178 | 3% | 80 | 9,054 | 2.3% | 5 | 10,280 | 2.7% | 1,407 | 1.9% | 387,530 | 1.6% |
| Winchester Bay | 275 | 37,204 | 51% | 85 | 20,058 | 27.7% | 62 | 7,072 | 9.8% | 22 | 8,171 | 11.3% | 444 | 1% | 72,506 | 0% |
| Total Unincorporated County | 28,298 | 9,095,227 | 62% | 2,908 | 1,682,634 | 11.4% | 17,485 | 3,503,194 | 23.7% | 522 | 483,908 | 3% | 49,213 | 67.0% | 14,764,964 | 62.6% |
| Canyonville | 569 | 156,793 | 57% | 208 | 75,462 | 27% | 93 | 8,420 | 3% | 28 | 34,001 | 12% | 898 | 1.2% | 274,677 | 1.2% |
| Cow Creek Umpqua Tribe | 6 | 2,805 | 11% | 19 | 17,104 | 69% | 16 | 4,008 | 16% | 3 | 738 | 3% | 44 | 0.1% | 24,655 | 0.1% |
| Drain | 465 | 133,240 | 59% | 51 | 52,179 | 23% | 46 | 4,482 | 2% | 27 | 36,499 | 16% | 589 | 0.8% | 226,400 | 1.0% |
| Elkton | 106 | 37,169 | 77% | 18 | 7,614 | 16% | 11 | 780 | 2% | 7 | 2,590 | 5.4% | 142 | 0.2% | 48,153 | 0.2% |
| Glendale | 344 | 90,538 | 71% | 20 | 15,348 | 12% | 52 | 5,211 | 4.1% | 7 | 16,528 | 13% | 423 | 1% | 127,625 | 1% |
| Myrtle Creek | 1,384 | 397,986 | 75% | 106 | 63,160 | 12% | 148 | 18,720 | 4% | 50 | 51,207 | 9.6% | 1,688 | 2% | 531,074 | 2% |
| Oakland | 417 | 119,197 | 67% | 25 | 17,279 | 10% | 55 | 6,047 | 3% | 15 | 36,700 | 20% | 512 | 1% | 179,224 | 1% |
| Reedsport | 1,903 | 351,169 | 53% | 242 | 126,767 | 19% | 397 | 60,281 | 9% | 84 | 128,867 | 19% | 2,626 | 4% | 667,084 | 3% |
| Riddle | 437 | 117,156 | 67% | 51 | 24,221 | 4% | 46 | 4,756 | 3% | 35 | 28,651 | 16% | 569 | 1% | 174,784 | 1% |
| Roseburg | 7,879 | 2,551,548 | 60% | 1,072 | 1,207,531 | 29% | 455 | 61,108 | 1% | 272 | 406,605 | 10% | 9,678 | 13% | 4,226,793 | 18% |
| Sutherlin | 3,257 | 931,774 | 70% | 290 | 269,947 | 20% | 294 | 49,189 | 4% | 74 | 81,188 | 6% | 3,915 | 5% | 1,332,097 | 6% |
| Winston | 1,980 | 561,137 | 75% | 122 | 69,215 | 9% | 245 | 36,793 | 5% | 59 | 82,784 | 11% | 2,406 | 3% | 749,929 | 3% |
| Yoncalla | 482 | 126,916 | 69% | 39 | 20,291 | 11% | 97 | 11,425 | 6% | 17 | 26,227 | 14% | 635 | 1% | 184,859 | 1% |
| Total County | 47,527 | 14,672,655 | 62% | 5,171 | 3,648,752 | 16% | 19,440 | 3,774,416 | 16% | 1,200 | 1,416,495 | 6% | 73,338 | 100% | 23,512,318 | 100% |

## Table B-2. CSZ Mw-9.0 Earthquake loss estimates.

*(all dollar amounts in thousands)*

| Community | Total Number of Buildings | Total Estimated Building Value ($) | Total Earthquake Damage*: Buildings Damaged: Sum of Economic Loss | Total Earthquake Damage*: Buildings Damaged: Loss Ratio | Earthquake Damage outside of Medium Tsunami Zone: Buildings Damaged: Yellow-Tagged Buildings | Earthquake Damage outside of Medium Tsunami Zone: Buildings Damaged: Red-Tagged Buildings | Earthquake Damage outside of Medium Tsunami Zone: Buildings Damaged: Sum of Economic Loss | Earthquake Damage outside of Medium Tsunami Zone: Buildings Damaged: Loss Ratio | All Buildings Changed to At Least Moderate Code: Yellow-Tagged Buildings | All Buildings Changed to At Least Moderate Code: Red-Tagged Buildings | All Buildings Changed to At Least Moderate Code: Sum of Economic Loss | All Buildings Changed to At Least Moderate Code: Loss Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unincorp. Douglas Co (rural) | 39,950 | 12,117,248 | 1137127 | 9.4% | 4821 | 1382 | 1107849 | 9.1% | 4004 | 973 | 910576 | 7.5% |
| Glide | 1,253 | 404,529 | 39695 | 9.8% | 181 | 39 | 39695 | 9.8% | 137 | 34 | 33199 | 8.2% |
| Green | 3,943 | 1,170,115 | 111047 | 9.5% | 607 | 158 | 111047 | 9.5% | 408 | 99 | 93787 | 8.0% |
| Tri-City | 2,216 | 613,037 | 55470 | 9.0% | 360 | 117 | 55470 | 9.0% | 240 | 60 | 45430 | 7.4% |
| Winchester | 1,407 | 387,530 | 13802 | 3.6% | 94 | 5 | 13802 | 3.6% | 19 | 3 | 8063 | 2.1% |
| Winchester Bay | 444 | 72,506 | 34231 | 47.2% | 60 | 95 | 20244 | 27.9% | 87 | 38 | 12485 | 17.2% |
| Total Unincorporated County | 49,213 | 14,764,964 | 1391372 | 9.4% | 6124 | 1796 | 1348107 | 9.1% | 4896 | 1207 | 1103541 | 7.5% |
| Canyonville | 898 | 274,677 | 26635 | 9.7% | 118 | 33 | 26635 | 9.7% | 84 | 21 | 19712 | 7.2% |
| Cow Creek Umpqua Tribe | 44 | 24,655 | 1826 | 7.4% | 6 | 1 | 1826 | 7.4% | 5 | 1 | 1605 | 6.5% |
| Drain | 589 | 226,400 | 26077 | 11.5% | 97 | 24 | 26077 | 11.5% | 84 | 21 | 22291 | 9.8% |
| Elkton | 142 | 48,153 | 2187 | 4.5% | 7 | 1 | 2187 | 4.5% | 4 | 1 | 1397 | 2.9% |
| Glendale | 423 | 127,625 | 19417 | 15.2% | 93 | 29 | 19417 | 15.2% | 84 | 21 | 16654 | 13.0% |
| Myrtle Creek | 1,688 | 531,074 | 67777 | 12.8% | 315 | 82 | 67777 | 12.8% | 283 | 71 | 60523 | 11.4% |
| Oakland | 512 | 179,224 | 4052 | 2.3% | 4 | 0 | 4052 | 2.3% | 1 | 0 | 1900 | 1.1% |
| Reedsport | 2,626 | 667,084 | 285778 | 42.8% | 325 | 471 | 209872 | 32% | 359 | 113 | 64383 | 9.7% |
| Riddle | 569 | 174,784 | 25994 | 14.9% | 133 | 44 | 25994 | 14.9% | 110 | 27 | 22196 | 12.7% |
| Roseburg | 9,678 | 4,226,793 | 144148 | 3.4% | 292 | 39 | 144148 | 3.4% | 159 | 37 | 81572 | 1.9% |
| Sutherlin | 3,915 | 1,332,097 | 31823 | 2.4% | 102 | 5 | 31823 | 2.4% | 24 | 4 | 18115 | 1.4% |
| Winston | 2,406 | 749,929 | 55748 | 7.4% | 202 | 45 | 55748 | 7.4% | 76 | 11 | 25247 | 3.4% |
| Yoncalla | 635 | 184,859 | 11079 | 6.0% | 50 | 8 | 11079 | 6.0% | 29 | 7 | 8332 | 4.5% |
| Total County | 73,338 | 23,512,318 | 2093912 | 8.9% | 7868 | 2579 | 1974742 | 8.4% | 6198 | 1542 | 1447469 | 6.2% |

*All losses calculated from earthquake inside or outside of Medium tsunami zone.

## Table B-3. Hypothetical local crustal fault Mw-6.8 Earthquake loss estimates.

| | | | *(all dollar amounts in thousands)* | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Total Earthquake Damage** | | | | | | | |
| | | | **Buildings Damaged** | | | | **All Buildings Changed to At Least Moderate Code** | | | |
| | **Total Number of Buildings** | **Total Estimated Building Value ($)** | **Yellow-Tagged Buildings** | **Red-Tagged Buildings** | **Sum of Economic Loss** | **Loss Ratio** | **Yellow-Tagged Buildings** | **Red-Tagged Buildings** | **Sum of Economic Loss** | **Loss Ratio** |
| Unincorp. Douglas Co (rural) | 39,950 | 12,117,248 | 3,996 | 1,381 | 1,056,653 | 8.7% | 3,548 | 957 | 887,201 | 7.3% |
| Glide | 1,253 | 404,529 | 237 | 118 | 80,622 | 20% | 222 | 65 | 57,439 | 14% |
| Green | 3,943 | 1,170,115 | 546 | 227 | 135,001 | 12% | 483 | 119 | 108,164 | 9.2% |
| Tri-City | 2,216 | 613,037 | 457 | 223 | 104,039 | 17% | 424 | 119 | 80,241 | 13% |
| Winchester | 1,407 | 387,530 | 46 | 5 | 8,453 | 2.2% | 23 | 2 | 5,251 | 1.4% |
| Winchester Bay | 444 | 72,506 | 0 | 0 | 150 | 0.2% | 0 | 0 | 64 | 0.1% |
| Total Unincorporated County | 49,213 | 14,764,964 | 5,283 | 1,953 | 1,384,918 | 9.4% | 4,699 | 1,261 | 1,138,361 | 7.7% |
| Canyonville | 898 | 274,677 | 114 | 51 | 34,791 | 13% | 95 | 24 | 22,801 | 8.3% |
| Cow Creek Umpqua Tribe | 44 | 24,655 | 8 | 4 | 3,104 | 13% | 6 | 2 | 2,283 | 9.3% |
| Drain | 589 | 226,400 | 80 | 20 | 22,157 | 9.8% | 74 | 18 | 20,120 | 8.9% |
| Elkton | 142 | 48,153 | 0 | 0 | 167 | 0.3% | 0 | 0 | 78 | 0.2% |
| Glendale | 423 | 127,625 | 57 | 14 | 12,151 | 9.5% | 53 | 13 | 10,896 | 8.5% |
| Myrtle Creek | 1,688 | 531,074 | 408 | 158 | 119,525 | 23% | 360 | 100 | 87,131 | 16% |
| Oakland | 512 | 179,224 | 6 | 1 | 3,795 | 2.1% | 2 | 0 | 2,062 | 1.2% |
| Reedsport | 2,626 | 667,084 | 3 | 0 | 2,295 | 0.3% | 1 | 0 | 758 | 0.1% |
| Riddle | 569 | 174,784 | 142 | 45 | 35,268 | 20% | 123 | 30 | 26,266 | 15% |
| Roseburg | 9,678 | 4,226,793 | 177 | 25 | 94,091 | 2.2% | 87 | 15 | 52,012 | 1.2% |
| Sutherlin | 3,915 | 1,332,097 | 56 | 5 | 21,836 | 1.6% | 30 | 3 | 14,562 | 1.1% |
| Winston | 2,406 | 749,929 | 77 | 18 | 20,264 | 2.7% | 37 | 7 | 10,891 | 1.5% |
| Yoncalla | 635 | 184,859 | 36 | 8 | 8,402 | 4.5% | 30 | 7 | 7,176 | 3.9% |
| Total County | 73,338 | 23,512,318 | 6,446 | 2,303 | 1,762,766 | 7.5% | 5,596 | 1,481 | 1,395,395 | 6.0% |

## Table B-4. Tsunami exposure.

*(all dollar amounts in thousands)*

| | | | Small (Low Severity) | | | Medium (Moderate Severity) | | | Large (High Severity) | | | X Large (Very High-Severity) | | | XX Large (Extreme Severity) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Community | Total Number of Buildings | Total Estimated Building Value ($) | Number of Buildings | Building Value ($) | Ratio of Exposure Value | Number of Buildings | Building Value ($) | Ratio of Exposure Value | Number of Buildings | Building Value ($) | Ratio of Exposure Value | Number of Buildings | Building Value ($) | Ratio of Exposure Value | Number of Buildings | Building Value ($) | Ratio of Exposure Value |
| Unincorp. Douglas Co. | 39,950 | 12,117,248 | 62 | 24,582 | 0.2% | 152 | 47,433 | 0.4% | 227 | 70,466 | 0.6% | 367 | 106,319 | 1% | 397 | 110,514 | 0.9% |
| Glide | 1,253 | 404,529 | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0% | 0 | 0 | 0.0% |
| Green | 3,943 | 1,170,115 | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0% | 0 | 0 | 0.0% |
| Tri-City | 2,216 | 613,037 | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% |
| Winchester | 1,407 | 387,530 | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0% | 0 | 0 | 0.00% |
| Winchester Bay | 444 | 72,506 | 160 | 24,112 | 33.3% | 219 | 33,940 | 47% | 370 | 58,904 | 81% | 383 | 60,528 | 83% | 384 | 60,563 | 84% |
| Total Unincorp. | 49,213 | 14,764,964 | 222 | 48,695 | 0.3% | 371 | 81,373 | 0.5% | 597 | 129,370 | 0.9% | 750 | 166,847 | 1% | 781 | 171,077 | 1.2% |
| Canyonville | 898 | 274,677 | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% |
| Cow Creek Umpqua Tribe | 44 | 24,655 | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% |
| Drain | 589 | 226,400 | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% |
| Elkton | 142 | 48,153 | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% |
| Glendale | 423 | 127,625 | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% |
| Myrtle Creek | 1,688 | 531,074 | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% |
| Oakland | 512 | 179,224 | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% |
| Reedsport | 2,626 | 667,084 | 150 | 23,906 | 3.6% | 490 | 123,070 | 18% | 785 | 194,590 | 29% | 908 | 216,786 | 33% | 918 | 221,087 | 33% |
| Riddle | 569 | 174,784 | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% |
| Roseburg | 9,678 | 4,226,793 | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% |
| Sutherlin | 3,915 | 1,332,097 | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% |
| Winston | 2,406 | 749,929 | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% |
| Yoncalla | 635 | 184,859 | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% |
| Total County | 73,338 | 23,512,318 | 372 | 72,600 | 0.3% | 861 | 204,443 | 0.9% | 1,382 | 323,960 | 1.4% | 1,658 | 383,633 | 1.6% | 1,699 | 392,164 | 1.7% |

## Table B-5. Flood loss estimates.

| Community | Total Number of Buildings | Total Estimated Building Value ($) | 10% (10-yr) Number of Buildings | 10% (10-yr) Loss Estimate | 10% (10-yr) Loss Ratio | 2% (50-yr) Number of Buildings | 2% (50-yr) Loss Estimate | 2% (50-yr) Loss Ratio | 1% (100-yr) Number of Buildings | 1% (100-yr) Loss Estimate | 1% (100-yr) Loss Ratio | 0.2% (500-yr) Number of Buildings | 0.2% (500-yr) Loss Estimate | 0.2% (500-yr) Loss Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *(all dollar amounts in thousands)* | | | | | | | | | | | |
| Unincorp. Douglas Co (rural) | 39,950 | 12,117,248 | 575 | 15,263 | 0.1% | 1,723 | 87,132 | 0.7% | 2,249 | 137,976 | 1.1% | 3,088 | 296,911 | 2.5% |
| Glide | 1,253 | 404,529 | 1 | 78 | 0.02% | 7 | 303 | 0.1% | 15 | 749 | 0.2% | 43 | 3,056 | 0.8% |
| Green | 3,943 | 1,170,115 | 8 | 118 | 0.01% | 120 | 1,588 | 0.1% | 187 | 3,440 | 0.3% | 312 | 8,498 | 0.7% |
| Tri-City | 2,216 | 613,037 | 19 | 185 | 0.0% | 95 | 3,655 | 0.6% | 102 | 6,123 | 1.0% | 110 | 11,257 | 1.8% |
| Winchester | 1,407 | 387,530 | 0 | 0 | 0.0% | 22 | 343 | 0.1% | 45 | 1,918 | 0.5% | 71 | 8,610 | 2.2% |
| Winchester Bay | 444 | 72,506 | 6 | 179 | 0.2% | 17 | 414 | 0.6% | 23 | 535 | 0.7% | 26 | 764 | 1.1% |
| Total Unincorporated County | 49,213 | 14,764,964 | 609 | 15,824 | 0.1% | 1,984 | 93,436 | 0.6% | 2,621 | 150,741 | 1.0% | 3,650 | 329,096 | 2.2% |
| Canyonville | 898 | 274,677 | 4 | 14 | 0.0% | 10 | 51 | 0.0% | 14 | 177 | 0.1% | 19 | 321 | 0.1% |
| Cow Creek Umpqua Tribe | 44 | 24,655 | 1 | 11 | 0.0% | 3 | 123 | 0.5% | 5 | 226 | 0.9% | 8 | 792 | 3.2% |
| Drain | 589 | 226,400 | 19 | 237 | 0.1% | 112 | 2,274 | 1.0% | 170 | 4,362 | 1.9% | 240 | 10,988 | 4.9% |
| Elkton | 142 | 48,153 | 4 | 110 | 0.2% | 16 | 657 | 1.4% | 20 | 1,369 | 2.8% | 24 | 3,798 | 7.9% |
| Glendale | 423 | 127,625 | 0 | 0 | 0.0% | 1 | 3 | 0.0% | 1 | 7 | 0.0% | 6 | 35 | 0.0% |
| Myrtle Creek | 1,688 | 531,074 | 30 | 1,010 | 0.2% | 91 | 4,431 | 0.8% | 109 | 6,980 | 1.3% | 153 | 12,919 | 2.4% |
| Oakland | 512 | 179,224 | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% |
| Reedsport | 2,626 | 667,084 | 469 | 10,136 | 1.5% | 683 | 27,813 | 4.2% | 713 | 36,691 | 5.5% | 772 | 51,223 | 7.7% |
| Riddle | 569 | 174,784 | 6 | 18 | 0.0% | 6 | 18 | 0.0% | 6 | 18 | 0.0% | 6 | 18 | 0.0% |
| Roseburg | 9,678 | 4,226,793 | 21 | 467 | 0.0% | 199 | 7,614 | 0.2% | 398 | 15,891 | 0.4% | 989 | 55,142 | 1.3% |
| Sutherlin | 3,915 | 1,332,097 | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% |
| Winston | 2,406 | 749,929 | 15 | 444 | 0.1% | 38 | 1,331 | 0.2% | 44 | 1,706 | 0.2% | 79 | 2,656 | 0.4% |
| Yoncalla | 635 | 184,859 | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% | 0 | 0 | 0.0% |
| Total County | 73,338 | 23,512,318 | 1,178 | 28,270 | 0.1% | 3,143 | 137,750 | 0.6% | 4,101 | 218,169 | 0.9% | 5,946 | 466,987 | 2.0% |

## Table B-6. Flood exposure.

| | | | 1% (100-yr) | | | | |
|---|---|---|---|---|---|---|---|
| Community | Total Number of Buildings | Total Population | Potentially Displaced Residents from Flood Exposure | % Potentially Displaced Residents from flood Exposure | Number of Flood Exposed Buildings | % of Flood Exposed Buildings | Number of Flood Exposed Buildings Without Damage |
| Unincorp. Douglas Co (rural) | 39,950 | 44,535 | 3,116 | 7.0% | 2,500 | 6.3% | 251 |
| Glide | 1,253 | 1,625 | 33 | 2.0% | 24 | 1.9% | 9 |
| Green | 3,943 | 6,201 | 408 | 6.6% | 272 | 6.9% | 85 |
| Tri-City | 2,216 | 3,012 | 147 | 4.9% | 102 | 4.6% | 0 |
| Winchester | 1,407 | 2,555 | 107 | 4.2% | 52 | 3.7% | 7 |
| Winchester Bay | 444 | 276 | 9 | 3.1% | 33 | 7.4% | 10 |
| Total Unincorporated County | 49,213 | 58,203 | 3,819 | 6.6% | 2,983 | 6.1% | 362 |
| Canyonville | 898 | 1,663 | 24 | 1.4% | 20 | 2.2% | 6 |
| Cow Creek Umpqua Tribe | 44 | 9 | 5 | 53.2% | 6 | 13.6% | 1 |
| Drain | 589 | 1,174 | 441 | 37.6% | 231 | 39.2% | 61 |
| Elkton | 142 | 189 | 33 | 17.5% | 20 | 14.1% | 0 |
| Glendale | 423 | 857 | 12 | 1.4% | 4 | 0.9% | 3 |
| Myrtle Creek | 1,688 | 3,507 | 177 | 5.0% | 120 | 7.1% | 11 |
| Oakland | 512 | 937 | 0 | 0.0% | 0 | 0.0% | 0 |
| Reedsport | 2,626 | 4,252 | 1,064 | 25.0% | 760 | 28.9% | 47 |
| Riddle | 569 | 1,226 | 0 | 0.0% | 6 | 1.1% | 0 |
| Roseburg | 9,678 | 23,955 | 1,569 | 6.5% | 617 | 6.4% | 219 |
| Sutherlin | 3,915 | 8,962 | 0 | 0.0% | 0 | 0.0% | 0 |
| Winston | 2,406 | 5,682 | 107 | 1.9% | 66 | 2.7% | 22 |
| Yoncalla | 635 | 1,032 | 0 | 0.0% | 0 | 0.0% | 0 |
| Total County | 73,338 | 111,649 | 7,251 | 6.5% | 4,833 | 6.6% | 732 |

## Table B-7. Landslide exposure.

*(all dollar amounts in thousands)*

| Community | Total Number of Buildings | Total Estimated Building Value ($) | Very High Susceptibility | | | High Susceptibility | | | Moderate Susceptibility | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Number of Buildings | Building Value ($) | Percent of Building Value Exposed | Number of Buildings | Building Value ($) | Percent of Building Value Exposed | Number of Buildings | Building Value ($) | Percent of Building Value Exposed |
| Unincorp. Douglas Co (rural) | 39,950 | 12,117,248 | 1,210 | 288,171 | 2.4% | 4,270 | 1,053,098 | 8.7% | 15,999 | 4,446,262 | 37% |
| Glide | 1,253 | 404,529 | 111 | 29,181 | 7.2% | 78 | 20,972 | 5.2% | 600 | 148,409 | 37% |
| Green | 3,943 | 1,170,115 | 0 | 0 | 0% | 542 | 158,649 | 14% | 590 | 155,036 | 13% |
| Tri-City | 2,216 | 613,037 | 745 | 208,340 | 34% | 24 | 6,477 | 1.1% | 367 | 87,579 | 14% |
| Winchester | 1,407 | 387,530 | 0 | 0 | 0% | 24 | 8,824 | 2.3% | 510 | 154,791 | 40% |
| Winchester Bay | 444 | 72,506 | 0 | 0 | 0% | 54 | 6,187 | 8.5% | 99 | 14,552 | 20% |
| Total Unincorporated County | 49,213 | 14,764,964 | 2,066 | 525,692 | 3.6% | 4,992 | 1,254,207 | 8.5% | 18,165 | 5,006,629 | 34% |
| Canyonville | 898 | 274,677 | 0 | 0 | 0% | 40 | 10,753 | 3.9% | 220 | 60,751 | 22% |
| Cow Creek Umpqua Tribe | 44 | 24,655 | 0 | 0 | 0.0% | 4 | 1,061 | 4.3% | 4 | 711 | 3% |
| Drain | 589 | 226,400 | 0 | 0 | 0% | 24 | 6,237 | 2.8% | 184 | 62,076 | 27% |
| Elkton | 142 | 48,153 | 0 | 0 | 0% | 3 | 769 | 1.6% | 139 | 47,384 | 98% |
| Glendale | 423 | 127,625 | 0 | 0 | 0% | 21 | 4,945 | 3.9% | 147 | 34,594 | 27% |
| Myrtle Creek | 1,688 | 531,074 | 0 | 0 | 0% | 27 | 8,666 | 1.6% | 675 | 186,044 | 35% |
| Oakland | 512 | 179,224 | 0 | 0 | 0% | 7 | 1,976 | 1.1% | 201 | 69,843 | 39% |
| Reedsport | 2,626 | 667,084 | 89 | 22,685 | 3.4% | 115 | 21,261 | 3.2% | 744 | 168,575 | 25% |
| Riddle | 569 | 174,784 | 0 | 0 | 0% | 2 | 551 | 0.3% | 123 | 35,460 | 20% |
| Roseburg | 9,678 | 4,226,793 | 209 | 57,076 | 1.4% | 173 | 67,726 | 1.6% | 2,211 | 842,133 | 20% |
| Sutherlin | 3,915 | 1,332,097 | 0 | 0 | 0% | 93 | 30,251 | 2.3% | 983 | 344,264 | 26% |
| Winston | 2,406 | 749,929 | 0 | 0 | 0% | 1,153 | 357,217 | 48% | 170 | 46,018 | 6.1% |
| Yoncalla | 635 | 184,859 | 0 | 0 | 0% | 6 | 1,536 | 0.8% | 50 | 15,301 | 8.3% |
| Total County | 73,338 | 23,512,318 | 2,364 | 605,452 | 2.6% | 6,660 | 1,767,155 | 7.5% | 24,016 | 6,919,784 | 29% |

## Table B-8. Wildfire exposure.

*(all dollar amounts in thousands)*

| | | | High Hazard | | | Moderate Hazard | | | Low Hazard | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Community** | **Total Number of Buildings** | **Total Estimated Building Value ($)** | **Number of Buildings** | **Building Value ($)** | **Percent of Building Value Exposed** | **Number of Buildings** | **Building Value ($)** | **Percent of Building Value Exposed** | **Number of Buildings** | **Building Value ($)** | **Percent of Building Value Exposed** |
| Unincorp. Douglas Co (rural) | 39,950 | 12,117,248 | 18,347 | 4,654,318 | 38% | 13,878 | 4,081,857 | 34% | 523 | 144,176 | 1% |
| Glide | 1,253 | 404,529 | 528 | 136,548 | 34% | 365 | 122,995 | 30.4% | 4 | 3,171 | 1% |
| Green | 3,943 | 1,170,115 | 48 | 14,410 | 1% | 357 | 112,068 | 10% | 41 | 8,116 | 1% |
| Tri-City | 2,216 | 613,037 | 662 | 165,997 | 27% | 46 | 9,482 | 2% | 3 | 1,144 | 0% |
| Winchester | 1,407 | 387,530 | 46 | 19,122 | 4.9% | 147 | 51,957 | 13% | 15 | 4,156 | 1% |
| Winchester Bay | 444 | 72,506 | 0 | 0 | 0% | 0 | 0 | 0% | 30 | 4,335 | 6% |
| Total Unincorporated County | 49,213 | 14,764,964 | 19,631 | 4,990,395 | 33.8% | 14,793 | 4,378,359 | 30% | 616 | 165,099 | 1% |
| Canyonville | 898 | 274,677 | 211 | 57,681 | 21% | 1 | 308 | 0% | 7 | 1,076 | 0% |
| Cow Creek Umpqua Tribe | 44 | 24,655 | 18 | 7,625 | 31% | 1 | 230 | 0.9% | 0 | 0 | 0% |
| Drain | 589 | 226,400 | 14 | 4,385 | 2% | 48 | 12,799 | 6% | 3 | 1,620 | 1% |
| Elkton | 142 | 48,153 | 0 | 0 | 0% | 30 | 8,347 | 17% | 4 | 677 | 1% |
| Glendale | 423 | 127,625 | 116 | 26,241 | 20.6% | 0 | 0 | 0% | 0 | 0 | 0% |
| Myrtle Creek | 1,688 | 531,074 | 371 | 101,228 | 19% | 25 | 10,394 | 2% | 0 | 0 | 0% |
| Oakland | 512 | 179,224 | 0 | 0 | 0% | 165 | 45,384 | 25.3% | 11 | 2,395 | 1% |
| Reedsport | 2,626 | 667,084 | 0 | 0 | 0% | 20 | 3,830 | 0.6% | 64 | 17,491 | 3% |
| Riddle | 569 | 174,784 | 30 | 7,295 | 4.2% | 0 | 0 | 0% | 0 | 0 | 0% |
| Roseburg | 9,678 | 4,226,793 | 66 | 23,558 | 0.6% | 548 | 180,475 | 4.3% | 175 | 56,385 | 1% |
| Sutherlin | 3,915 | 1,332,097 | 73 | 20,103 | 1.5% | 659 | 222,247 | 16.7% | 43 | 11,172 | 1% |
| Winston | 2,406 | 749,929 | 323 | 102,718 | 13.7% | 73 | 21,266 | 2.8% | 1 | 315 | 0% |
| Yoncalla | 635 | 184,859 | 0 | 0 | 0% | 55 | 21,416 | 11.6% | 59 | 12,691 | 7% |
| Total County | 73,338 | 23,512,318 | 20,853 | 5,341,229 | 22.7% | 16,418 | 4,905,055 | 20.9% | 983 | 268,920 | 1% |

# APPENDIX C. VULNERABILITY ASSESSMENT OF LIFELINES

## Table C-1. Inventory of Douglas County high hazard potential dams.

| Dam name | NID ID | Hazard Potential | Owner/Operator | Storage (Acre Feet) | State Regulated | Purpose |
|---|---|---|---|---|---|---|
| Bear Creek 3 | OR00614 | High | Local Government | 500 | Yes | Water Supply |
| Berry Creek | OR00640 | High | Local Government | 15,000 | Yes | Water Supply |
| Canyonville Reservoir | OR00683 | Significant | Local Government | 300 | Yes | Water Supply |
| Clearwater No 1 Forebay | OR00542 | Low | Private | 182 | No | Hydroelectric |
| Clearwater No 2 Forebay | OR00563 | High | Private | 76 | No | Hydroelectric |
| Cooper Creek (Sutherlin) | OR00463 | High | Local Government | 5,200 | Yes | Recreation |
| Corder Log Pond | OR00215 | Low | Private | 56 | Yes | Other |
| Creekside Development Dam No. 1 | OR03902 | High | Federal | 0 | Yes | |
| Creekside Development Dam No. 3 | OR03903 | High | Federal | 0 | No | |
| Denley Brothers Dam | OR00334 | Low | Private | 120 | Yes | Irrigation |
| Dillard Lumber CO Dike | OR00155 | Significant | Private | 285 | Yes | Other |
| Dixonville Log Pond | OR00409 | Significant | Private | 1,163 | Yes | Other |
| Dollar Mill Pond | OR00296 | Significant | Private | 150 | Yes | Other |
| Drain Plywood Log Pond | OR00299 | Significant | Private | 176 | Yes | Other |
| Drain Sewage Lagoon | OR01573 | Significant | Local Government | 40 | Yes | Water Supply |
| Fish Creek Diversion Dam | OR00562 | Significant | Public Utility | 71 | Yes | Hydroelectric |
| Fish Creek Forebay | OR03707 | High | Private | 110.3 | No | Hydroelectric |
| Galesville | OR00748 | High | Local Government | 117,000 | No | Irrigation |
| Gardiner | OR03727 | Significant | Private | 90 | Yes | Fish and Wildlife Pond |
| Georgia Pacific Log Pond | OR00165 | Low | Private | 237 | Yes | Other |
| Hayhurst Road | OR01892 | High | Local Government | 70 | Yes | Water Supply |
| Hemlock Meadows Dam | OR00370 | Low | State | 1,150 | Yes | Other |
| Iverson Reservoir (Douglas) | OR00526 | Low | Private | 51 | Yes | Recreation |
| Kinnan, Frank Reservoir | OR00441 | Significant | Private | 395 | Yes | Recreation |
| Lemolo No 1 | OR00556 | High | Private | 19,000 | No | Hydroelectric |
| Lemolo No 2 Forebay | OR00564 | Low | Private | 265 | No | Hydroelectric |
| Little River Log Pond | OR00203 | Low | Private | 253 | Yes | Other |
| Paris | OR00320 | High | Private | 130 | Yes | Hydroelectric |
| Plat I | OR00443 | High | Local Government | 2,760 | Yes | Flood Risk Reduction |
| Rock Creek Hatchery | OR03979 | Low | Private | 1,500 | Yes | Irrigation |
| Skookum Pond Dam | OR03876 | Low | Federal | 80 | No | Fire Protection, Stock, Or Small Fish Pond |
| Slide Creek | OR00561 | Low | Private | 43 | No | Hydroelectric |
| Soda Springs | OR00555 | High | Private | 512 | No | Hydroelectric |
| Stump Lake Dam | OR00565 | Low | Public Utility | 152 | Yes | Hydroelectric |
| Sun Studs Log Pond | OR00197 | Significant | Private | 80 | Yes | Other |
| Sutherlin Log Pond | OR00333 | Significant | Private | 170 | Yes | Other |
| Sutherlin Mill (Fords Pond) | OR00274 | Low | Private | 1,040 | Yes | Other |
| Tahkenitch Lake | OR00359 | Low | Private | 16,580 | Yes | Other |
| Toketee | OR00554 | High | Private | 880 | No | Hydroelectric |
| Updegrave | OR00491 | High | Private | 172 | Yes | Irrigation |
| Wageman | OR00496 | High | Private | 70 | Yes | Irrigation |
| Weaver Reservoir | OR00447 | Low | Private | 55 | Yes | Irrigation |
| Whistlers Bend | OR00365 | Low | Private | 500 | Yes | Other |
| Winchester | OR00263 | High | Public Utility | 700 | Yes | Recreation |
| Yoncalla Reservoir | OR00682 | Low | Local Government | 112 | Yes | Water Supply |

## Table C-2. Inventory of Douglas County Bridges

| | | Scour Risk from Flooding | Liquefaction High and Very High Susceptibility | CSZ Tsunami Medium-sized scenario | Landslide High and Very High Susceptibility | Wildfire High or Moderate Risk |
|---|---|---|---|---|---|---|
| **Bridge Name** | **Stream Name** | **Exposed** | **Exposed** | **Exposed** | **Exposed** | **Exposed** |
| North Umpqua River, Hwy 234 (Old Winchester) | NORTH UMPQUA RIVER | - | - | - | - | - |
| Umpqua River, Hwy 231 (Smith) | UMPQUA RIVER | X | - | - | - | - |
| Umpqua River, Hwy 45 (Scottsburg) | UMPQUA RIVER@ SCOTTSBURG | X | - | - | - | - |
| Umpqua River & McIntosh Slough, Hwy 9 | UMPQUA R & MCINTOSH SL | - | X | X | - | - |
| South Umpqua River, Hwy 35 EB (Winston) | EB S UMPQUA RV (WINSTON) | - | - | - | - | - |
| South Umpqua River, Hwy 35 WB (Winston) | WB S.UMPQUA RV (WINSTON) | X | - | - | - | - |
| North Umpqua River, Hwy 138 at MP 17.95 (Lone Rock | N UMPQUA RV (LONE ROCK) | X | X | - | - | X |
| Elk Creek Tunnel, Hwy 45 | ELK CREEK TUNNEL | - | - | - | X | X |
| Umpqua River, Hwy 231 (Kellogg) | UMPQUA RIVER (KELLOG BR) | - | X | - | - | - |
| South Umpqua River, Hwy 138 Conn (Oak Ave) | SOUTH UMPQUA RIVER | - | - | - | - | - |
| South Umpqua River, Hwy 1 SB (Vets) | S UMPQUA R (VETS BR) | X | - | - | - | - |
| South Umpqua River, Hwy 1 NB (Vets) | S UMPQUA R (VETS BR) | X | - | - | - | - |
| N Umpqua R & CORP & Co Rd, Hwy 1 SB (Winchester) | N UMPQUA,CORP,CR,& CORP | - | - | - | - | - |
| N Umpqua R & CORP & Co Rd, Hwy 1 NB (Winchester) | N UMPQUA,CORP,CR,& CORP | - | - | - | - | - |
| S Umpqua R & CORP & Cnty Rd, Hwy1 SB (Booth Ranch) | S UMPQUA R CORP, CO RD | - | - | - | - | - |
| South Umpqua River, Hwy 138 Conn (Washington Ave) | SOUTH UMPQUA RIVER | - | - | - | - | - |
| South Umpqua River, County Rd 387 | SOUTH UMPQUA RIVER | - | X | - | - | X |
| Smith River, Hwy 9 | SMITH RIVER | - | X | X | - | - |
| S Umpqua R & CORP & Round Prairie Rd, Hwy 1 NB | S UMPQUA R CORP, CO RD | - | - | - | - | - |
| South Umpqua River, Hwy 1 NB (Fords) | S UMPQUA RIVER(FORDS BR) | - | X | - | - | - |
| South Umpqua River, Hwy 1 SB (Fords) | S UMPQUA RIVER(FORDS BR) | - | X | - | - | - |
| South Umpqua River & CORP, Hwy 1 NB (Shady) | S UMPQUA R & CORP | - | X | - | - | - |
| South Umpqua River & CORP, Hwy 1 SB (Shady) | S UMPQUA R & CORP | - | X | - | - | - |
| Pedestrian over South Umpqua River (Shady) | S UMPQUA R | - | X | - | - | - |
| Umpqua River, Hubbard Creek Rd | UMPQUA RIVER | - | X | - | - | - |
| Umpqua River, Bulllock Rd | UMPQUA RIVER | - | X | - | - | - |
| Umpqua River, Nehl Creek Rd #11 (Elkton) | UMPQUA RIVER @ ELKTON | - | - | - | - | - |
| South Umpqua River, Dole Rd #14 | S.UMPQUA RIVER | - | X | - | - | - |
| South Umpqua River, County Rd 47 | SOUTH UMPQUA RIVER | - | X | - | - | - |
| Smith River, Smith River Rd (Gardiner) | SMITH RIVER @ GARDINER | - | X | X | - | - |
| South Umpqua River, County Rd 167 | S UMPQUA RIVER/CONN FORD | - | X | - | - | - |
| Smith River, Southside Rd | SMITH RIVER | X | X | X | - | - |
| South Umpqua River, County Rd 386 | SOUTH UMPQUA RIVER | - | - | - | - | - |
| South Umpqua River, County Rd 387 | SOUTH UMPQUA RIVER | - | X | - | - | - |

| | | Scour Risk from Flooding | Liquefaction High and Very High Susceptibility | CSZ Tsunami Medium-sized scenario | Landslide High and Very High Susceptibility | Wildfire High or Moderate Risk |
|---|---|---|---|---|---|---|
| **Bridge Name** | **Stream Name** | **Exposed** | **Exposed** | **Exposed** | **Exposed** | **Exposed** |
| South Umpqua River, County Rd 20 | SOUTH UMPQUA RIVER | - | X | - | - | - |
| South Umpqua River, Hwy 1 NB (Missouri Bottom) | S UMPQUA R(MISSOURI BTM) | - | X | - | - | - |
| South Umpqua River, Hwy 1 SB (Missouri Bottom) | S UMPQUA R(MISSOURI BTM) | - | X | - | - | - |
| North Umpqua River, County Rd 6 (Brown) | N UMPQUA RIVER | - | X | - | - | - |
| South Umpqua River, Weaver Road MP 3.70 | South Umpqua River | - | X | - | - | - |
| South Umpqua River, Stewart Pkwy | SOUTH UMPQUA RIVER | - | - | - | - | - |

## Table C-3. Lifeline Risk by Douglas County Community

| Lifeline by Community | UDF ID | Flood 1% Annual Chance<br>Exposed | CSZ 9.0 Earthquake Moderate to Complete Damage<br>>50% Prob. | CSZ Tsunami Medium-sized scenario<br>Exposed | Hypothetical local crustal fault Mw-6.8 Moderate to Complete Damage<br>>50% Prob. | Landslide High and Very High Susceptibility<br>Exposed | Wildfire High or Moderate Risk<br>Exposed |
|---|---|---|---|---|---|---|---|
| **CANYONVILLE** | | | | | | | |
| High-occupancy building | 160965 | - | - | - | - | - | - |
| Fuel supply | 189072 | - | X | - | - | - | - |
| Fuel supply | 189111 | - | - | - | - | - | - |
| Fuel supply | 190005 | - | - | - | - | - | - |
| Food distribution | 190412 | - | X | - | X | - | - |
| **DRAIN** | | | | | | | |
| Food distribution | 174701 | X | X | - | X | - | - |
| Financial Institution | 174991 | X | X | - | X | - | - |
| Financial Institution | 175119 | - | X | - | - | - | - |
| Food distribution | 175351 | - | - | - | - | - | - |
| Fuel supply | 175431 | - | X | - | X | - | - |
| High-occupancy building | 179027 | X | - | - | - | - | - |
| Power grid | 185849 | - | - | - | - | - | - |
| **ELKTON** | | | | | | | |
| Food distribution | 173230 | - | X | - | - | - | - |
| Communication | 173301 | - | - | - | - | - | - |
| High-occupancy building | 173610 | - | - | - | - | - | - |
| Fuel supply | 174170 | - | X | - | - | - | - |
| **UNINCORP. DOUGLAS COUNTY** | | | | | | | |
| High-occupancy building | 171000 | - | - | - | X | - | X |
| High-occupancy building | 171556 | - | X | - | - | - | - |
| High-occupancy building | 182543 | - | - | - | - | - | X |
| High-occupancy building | 191037 | - | - | - | - | - | - |
| High-occupancy building | 201312 | - | - | - | - | - | X |
| High-occupancy building | 201318 | - | - | - | - | - | X |
| High-occupancy building | 201320 | - | - | - | - | - | X |
| High-occupancy building | 211155 | - | - | - | - | - | X |
| High-occupancy building | 217203 | - | X | - | - | - | - |
| Fuel supply | 218801 | - | X | - | X | - | - |
| High-occupancy building | 235937 | - | X | - | - | - | - |
| **GLENDALE** | | | | | | | |
| Fuel supply | 197417 | - | - | - | - | - | - |
| Food distribution | 197461 | - | - | - | - | - | - |
| Food distribution | 197531 | - | - | - | - | - | - |
| **GREEN** | | | | | | | |
| High-occupancy building | 191958 | - | - | - | - | - | - |
| Financial Institution | 203385 | - | - | - | - | - | - |
| **MYRTLE CREEK** | | | | | | | |
| Fuel supply | 159646 | - | - | - | X | - | - |

| Lifeline by Community | UDF ID | Flood 1% Annual Chance<br>Exposed | CSZ 9.0 Earthquake Moderate to Complete Damage<br>>50% Prob. | CSZ Tsunami Medium-sized scenario<br>Exposed | Hypothetical local crustal fault Mw-6.8 Moderate to Complete Damage<br>>50% Prob. | Landslide High and Very High Susceptibility<br>Exposed | Wildfire High or Moderate Risk<br>Exposed |
|---|---|---|---|---|---|---|---|
| Fuel supply | 170273 | - | X | - | X | - | - |
| Food distribution | 170281 | - | - | - | X | - | - |
| Financial Institution | 170584 | - | X | - | X | - | - |
| High-occupancy building | 170657 | - | X | - | X | - | - |
| Food distribution | 216021 | - | - | - | X | - | - |
| High-occupancy building | 217264 | X | - | - | X | - | - |
| High-occupancy building | 217265 | X | - | - | X | - | X |
| Food distribution | 217527 | - | - | - | X | - | - |
| **REEDSPORT** | | | | | | | |
| Financial Institution | 233243 | X | X | - | - | - | - |
| Financial Institution | 233700 | - | X | - | - | - | - |
| Financial Institution | 235542 | X | X | X | - | - | - |
| **RIDDLE** | | | | | | | |
| High-occupancy building | 180042 | | | | | | |
| **ROSEBURG** | | | | | | | |
| Financial Institution | 159591 | - | X | - | - | - | - |
| Financial Institution | 159598 | - | - | - | - | - | - |
| Financial Institution | 159609 | - | - | - | - | - | - |
| Financial Institution | 160260 | - | - | - | - | - | - |
| Fuel supply | 161621 | - | - | - | - | - | - |
| Financial Institution | 161967 | - | X | - | - | - | - |
| Financial Institution | 168003 | - | - | - | - | - | - |
| Financial Institution | 178435 | - | X | - | - | - | - |
| Financial Institution | 199105 | - | - | - | - | - | - |
| Financial Institution | 200215 | - | - | - | - | - | - |
| Financial Institution | 201354 | - | - | - | - | - | - |
| Financial Institution | 206751 | - | - | - | - | - | - |
| High-occupancy building | 223333 | X | - | - | - | - | - |
| Financial Institution | 224184 | - | - | - | - | - | - |
| Financial Institution | 224696 | - | X | - | - | - | - |
| Financial Institution | 224803 | - | - | - | - | - | - |
| **SUTHERLIN** | | | | | | | |
| Financial Institution | 161379 | - | - | - | - | - | - |
| Financial Institution | 196928 | - | - | - | - | - | - |
| Financial Institution | 205142 | - | - | - | - | - | - |
| Financial Institution | 210965 | - | - | - | - | - | - |
| Financial Institution | 211409 | - | - | - | - | - | - |
| **WINSTON** | | | | | | | |
| High-occupancy building | 196461 | - | - | - | - | X | - |
| Financial Institution | 206464 | - | X | - | - | - | - |

# APPENDIX D. HAZUS-MH METHODOLOGY

## D.1 Software

We performed all loss estimations using Hazus®-MH 4.2 and ArcGIS® Desktop® 10.2.2.

## D.2 User-Defined Facilities (UDF) Database

A UDF database was compiled for all buildings in Douglas County for use in both the flood and earthquake modules of Hazus-MH. The Douglas County assessor database (acquired in 2018) was used to determine which taxlots had improvements (i.e., buildings) and how many building points should be included in the UDF database.

### D.2.1 Locating buildings points

The Oregon Department of Geology and Mineral Industries (DOGAMI) used the SBFO-1 (Williams, 2021) dataset to help precisely locate the centroid of each building. Extra effort was spent to locate building points along the 1% and 0.2% annual chance inundation fringe. When buildings were partially within the inundation zone, the building point was moved to the centroid of the portion of the building within the inundation zone. An iterative approach was used to further refine locations of building points for the flood module by generating results, reviewing the highest value buildings, and moving the building point over a representative elevation on the lidar digital elevation model to ensure an accurate first floor height.

### D.2.2 Attributing building points

Populating the required attributes for Hazus-MH was achieved through a variety of approaches. The Douglas County assessor database was used whenever possible, but in many cases that database did not provide the necessary information. The following is list of attributes and their sources:

- **Longitude** and **Latitude** – Location information that provides Hazus-MH the x and y-position of the UDF point. This allows for an overlay to occur between the UDF point and the flood or earthquake input data layers. The hazard model uses this spatial overlay to determine the correct hazard risk level that will be applied to the UDF point. The format of the attribute must be in decimal degrees. A simple geometric calculation using GIS software is done on the point to derive this value.
- **Occupancy class** – An alphanumeric attribute that indicates the use of the UDF (e.g. 'RES1' is a single family dwelling). The alphanumeric code is composed of seven broad occupancy types (RES = residential, COM = commercial, IND = industrial, AGR = agricultural, GOV = public, REL = non-profit/religious, EDU = education) and various suffixes that indicate more specific types. This code determines the damage function to be used for flood analysis. It is also used to attribute the Building Type field, discussed below, for the earthquake analysis. The code was interpreted from "Stat Class" or "Description" data found in the Douglas County assessor database. When data was not available, the default value of RES1 was applied throughout.
- **Cost** – The replacement cost of an individual UDF. Loss ratio is derived from this value. Replacement cost is based on a method called RSMeans valuation (Charest, 2017) and is calculated by multiplying the building square footage by a standard cost per square foot. These standard rates per square foot are in tables within the default Hazus database.

- **Year built** – The year of construction that is used to attribute the Building Design Level field for the earthquake analysis (see "Building Design" below). The year a UDF was built is obtained from Douglas County assessor database. When not available, the year of "1900" was applied.
- **Square feet** – The size of the UDF is used to pro-rate the total improvement value for taxlots with multiple UDFs. The value distribution method will ensure that UDFs with the highest square footage will be the most expensive on a given taxlot. This value is also used to pro-rate the **Number of People** field for Residential UDFs. The value was obtained from DOGAMI's building footprints; where (RES) footprints were not available, we used the Douglas County assessor database.
- **Number of stories** – The number of stories for an individual UDF, along with Occupancy Class, determines the applied damage function for flood analysis. The value was obtained from the Douglas County assessor database when available. For UDFs without assessor information for number of stories that are within the flood zone, closer inspection using Google Street View™ or available oblique imagery was used for attribution.
- **Foundation type** – The UDF foundation type correlates with First Floor Height values in feet (see Table 3.11 in the Hazus-MH Technical Manual for the Flood Model [FEMA, 2012a]). It also functions within the flood model by indicating if a basement exists or not. UDFs with a basement have a different damage function from UDFs that do not have one. The value was obtained from the Douglas County assessor database when available. For UDFs without assessor information for basements that are within the flood zone, closer inspection using Google Street View™ or available oblique imagery was used to ascertain if one exists or not.
- **First floor height** – The height in feet above grade for the lowest habitable floor. The height is factored during the depth of flooding analysis. The value is used directly by Hazus-MH, where Hazus-MH overlays a UDF location on a depth grid and using the **first floor height** determines the level of flooding occurring to a building. It is derived from the Foundation Type attribute or observation via oblique imagery or Google Street View™ mapping service.
- **Building type** – This attribute determines the construction material and structural integrity of an individual UDF. It is used by Hazus-MH for estimating earthquake losses by determining which damage function will be applied. This information was unavailable from the Douglas County assessor data, so instead it was derived from a statistical distribution based on **Occupancy class**.
- **Building design level** – This attribute determines the seismic building code for an individual UDF. It is used by Hazus-MH for estimating earthquake losses by determining which damage function will be applied. This information is derived from the **Year Built** attribute (Douglas County Assessor) and state/regional Seismic Building Code benchmark years.
- **Number of people** – The estimated number of permanent residents living within an individual residential structure. It is used in the post-analysis phase to determine the amount of people affected by a given hazard. This attribute is derived from PSU Population Research Center estimates for Douglas County and incorporated communities, where number of people are distributed based on square footage.
- **Community** – The community that a UDF is within. These areas are used in the post-analysis for reporting results. The communities were based on incorporated area boundaries; unincorporated community areas were based on building density.

### D.2.3 Seismic building codes

Oregon initially adopted seismic building codes in the mid-1970s (Judson, 2012). The established benchmark years of code enforcement are used in determining a "design level" for individual buildings. The design level attributes (pre code, low code, moderate code, and high code) are used in the Hazus-MH earthquake model to determine what damage functions are applied to a given building (FEMA, 2012b). The year built or the year of the most recent seismic retrofit are the main considerations for an individual design level attribute. Seismic retrofitting information for structures would be ideal for this analysis but was not available for Douglas County. **Table D-1** outlines the benchmark years that apply to buildings within Douglas County.

**Table D-1. Douglas County seismic design level benchmark years.**

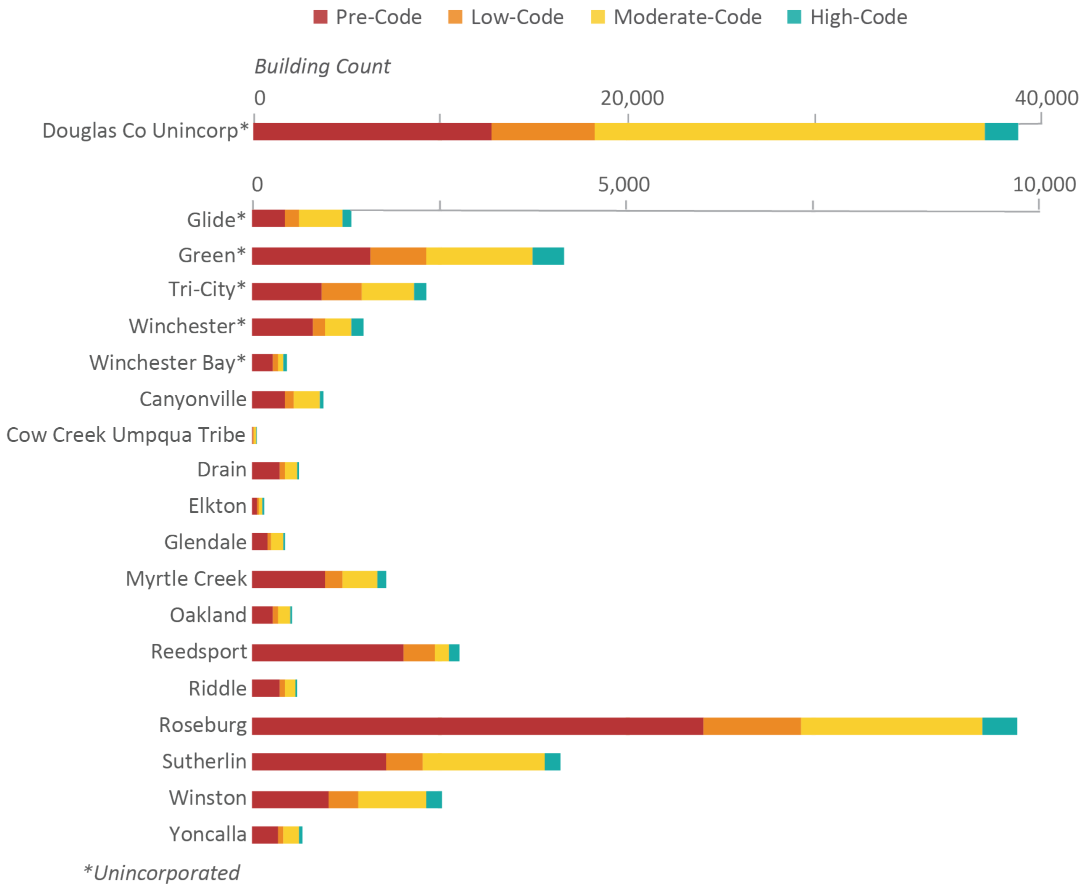
| Building Type | Year Built | Design Level | Basis |
|---|---|---|---|
| Single-Family Dwelling (includes Duplexes) | prior to 1976 | Pre Code | Interpretation of Judson (Judson, 2012) |
| | 1976–1991 | Low Code | |
| | 1992–2003 | Moderate Code | |
| | 2004–2016 | High Code | |
| Manufactured Housing | prior to 2003 | Pre Code | Interpretation of OR BCD 2002 Manufactured Dwelling Special Codes (Oregon Building Codes Division, 2002) |
| | 2003–2010 | Low Code | |
| | 2011–2016 | Moderate Code | Interpretation of OR BCD 2010 Manufactured Dwelling Special Codes Update (Oregon Building Codes Division, 2010) |
| All other buildings | prior to 1976 | Pre Code | Business Oregon 2022 Oregon Benefit-Cost Analysis Tool, p. 24 (Business Oregon, 2022) |
| | 1976–1990 | Low Code | |
| | 1991–2016 | Moderate Code | |

**Table D-2** and corresponding **Figure D-1** illustrate the current state of seismic building codes for the county.

## Table D-2. Seismic design level in Douglas County.

| Community | Total Number of Buildings | Pre Code: Number of Buildings | Pre Code: Percentage of Buildings | Low Code: Number of Buildings | Low Code: Percentage of Buildings | Moderate Code: Number of Buildings | Moderate Code: Percentage of Buildings | High Code: Number of Buildings | High Code: Percentage of Buildings |
|---|---|---|---|---|---|---|---|---|---|
| Unincorp. Douglas Co (rural) | 39,950 | 12,442 | 31% | 5,396 | 14% | 20,355 | 51% | 1,757 | 4.4% |
| Glide | 1,253 | 427 | 34% | 167 | 13% | 562 | 45% | 97 | 7.7% |
| Green | 3,943 | 1,489 | 38% | 708 | 18% | 1,355 | 34% | 391 | 9.9% |
| Tri-City | 2,216 | 885 | 40% | 494 | 22% | 680 | 31% | 157 | 7.1% |
| Winchester | 1,407 | 763 | 54% | 159 | 11% | 345 | 25% | 140 | 10.0% |
| Winchester Bay | 444 | 261 | 59% | 58 | 13% | 66 | 15% | 59 | 13.3% |
| Total Unincorp. County | 49,213 | 16,267 | 33% | 6,982 | 14% | 23,363 | 47% | 2,601 | 5.3% |
| Canyonville | 898 | 425 | 47% | 102 | 11% | 336 | 37% | 35 | 3.9% |
| Cow Creek Umpqua Tribe | 44 | 9 | 20% | 13 | 30% | 22 | 50% | 0 | 0% |
| Drain | 589 | 350 | 59% | 67 | 11% | 146 | 25% | 26 | 4.4% |
| Elkton | 142 | 67 | 47% | 17 | 12% | 36 | 25% | 22 | 15.5% |
| Glendale | 423 | 194 | 46% | 42 | 9.9% | 151 | 36% | 36 | 8.5% |
| Myrtle Creek | 1,688 | 920 | 55% | 221 | 13% | 436 | 26% | 111 | 6.6% |
| Oakland | 512 | 261 | 51% | 71 | 14% | 150 | 29% | 30 | 5.9% |
| Reedsport | 2,626 | 1,915 | 73% | 401 | 15% | 166 | 6% | 144 | 5.5% |
| Riddle | 569 | 348 | 61% | 79 | 14% | 120 | 21% | 22 | 3.9% |
| Roseburg | 9,678 | 5,723 | 59% | 1,235 | 13% | 2,288 | 24% | 432 | 4.5% |
| Sutherlin | 3,915 | 1,690 | 43% | 480 | 12% | 1,527 | 39% | 218 | 5.6% |
| Winston | 2,406 | 977 | 41% | 376 | 16% | 846 | 35% | 207 | 8.6% |
| Yoncalla | 635 | 329 | 52% | 70 | 11% | 196 | 31% | 40 | 6.3% |
| Total County | 73,338 | 29,475 | 40% | 10,156 | 14% | 29,783 | 41% | 3,924 | 5.4% |

**Figure D-1. Seismic design level by Douglas County community.**




## D.3 Flood Hazard Data

DOGAMI developed depth grids from detailed stream model information within the study area. These depth grids were used in this risk assessment to determine the level to which buildings are impacted by flooding.

A study area-wide, 2-meter, lidar-based depth grid was developed for each of the 10-, 50-, 100-, and 500-year annual chance flood events. The depth grids were imported into Hazus-MH for determining the depth of flooding for areas within the FEMA flood zones.

Once the UDF database was developed into a Hazus-compliant format, the Hazus-MH methodology was applied using a Python (programming language) script developed by DOGAMI (Bauer, 2018). The analysis was then run for a given flood event, and the script cross-referenced a UDF location with the depth grid to find the depth of flooding. The script then applied a specific damage function, based on a UDF's Occupancy Class [OccCls], which was used to determine the loss ratio for a given amount of flood depth, relative to the UDF's first-floor height.

## D.4 Earthquake Hazard Data

The following hazard layers used for our loss estimation are derived from work conducted by Madin and others (2021): National Earthquake Hazard Reduction Program (NEHRP) soil classification, liquefaction susceptibility and wet landslide susceptibility. The liquefaction and landslide susceptibility layers together with NEHRP were used by the Hazus-MH tool to calculate ground motion layers and permanent ground deformation and associated probability. The default value of 5 feet was used for the water table depth value.

During the Hazus-MH earthquake analysis, each UDF was analyzed given its site-specific parameters (ground deformation) and evaluated for loss, expressed as a probability of a damage state. Specific damage functions based on Building type and Building design level were used to calculate the damage states given the site-specific parameters for each UDF. The output provided probabilities of the five damage states (None, Slight, Moderate, Extensive, Complete) from which losses in dollar amounts were derived.

## D.5 Post-Analysis Quality Control

Ensuring the quality of the results from Hazus-MH flood and earthquake modules is an essential part of the process. A primary characteristic of the process is that it is iterative. A UDF database without errors is highly unlikely, so this part of the process is intended to limit and reduce the influence these errors have on the final outcome. Before applying the Hazus-MH methodology, closely examining the top 10 largest area UDFs and the top 10 most expensive UDFs is advisable. Special consideration can also be given to critical facilities due to their importance to communities.

Identifying, verifying, and correcting (if needed) the outliers in the results is the most efficient way to improve the UDF database. This can be done by sorting the results based on the loss estimates and closely scrutinizing the top 10 to 15 records. If corrections are made, then subsequent iterations are necessary. We continued checking the “loss leaders” until no more corrections were needed.

Finding anomalies and investigating possible sources of error are crucial in making corrections to the data. A wide range of corrections might be required to produce a better outcome. For example, floating homes may need to have a first-floor height adjustment or a UDF point position might need to be moved due to issues with the depth grid. Incorrect basement or occupancy type attribution could be the cause of a problem. Commonly, inconsistencies between assessor data and taxlot geometry can be the source of an error. These are just a few of the many types of problems addressed in the quality control process.

# APPENDIX E. ACRONYMS AND DEFINITIONS

## E.1 Acronyms

| | |
|---|---|
| CRS | Community Rating System |
| CSZ | Cascadia subduction zone |
| DLCD | Oregon Department of Land Conservation and Development |
| DOGAMI | Department of Geology and Mineral Industries (State of Oregon) |
| FEMA | Federal Emergency Management Agency |
| FIRM | Flood Insurance Rate Map |
| FIS | Flood Insurance Study |
| FRI | Fire Risk Index |
| GIS | Geographic Information System |
| NFIP | National Flood Insurance Program |
| NHMP | Natural hazard mitigation plan |
| NOAA | National Oceanic and Atmospheric Administration |
| ODF | Oregon Department of Forestry |
| OEM | Oregon Emergency Management |
| OFR | Open-File Report |
| OPDR | Oregon Partnership for Disaster Resilience |
| PGA | Peak ground acceleration |
| PGD | Permanent ground deformation |
| PGV | Peak ground velocity |
| Risk MAP | Risk Mapping, Assessment, and Planning |
| SHMO | State Hazard Mitigation Officer |
| SLIDO | State Landslide Information Layer for Oregon |
| UDF | User-defined facilities |
| USACE | U.S. Army Corps of Engineers |
| USGS | U.S. Geological Survey |
| WUI | Wildland-urban interface |
| WWA | West Wide Wildfire Risk Assessment |

## E.2 Definitions

**1% annual chance flood** – The flood elevation that has a 1-percent chance of being equaled or exceeded each year. Sometimes referred to as the 100-year flood.

**0.2% annual chance flood** – The flood elevation that has a 0.2-percent chance of being equaled or exceeded each year. Sometimes referred to as the 500-year flood.

**Base flood elevation (BFE)** – Elevation of the 1-percent-annual-chance flood. This elevation is the basis of the insurance and floodplain management requirements of the NFIP.

**Critical facilities** – Facilities that, if damaged, would present an immediate threat to life, public health, and safety. As categorized in HAZUS-MH, critical facilities include hospitals, emergency operations centers, police stations, fire stations and schools.

**Exposure** – Determination of whether a building is within or outside of a hazard zone. No loss estimation is modeled.

**Flood Insurance Rate Map (FIRM)** – An official map of a community, on which FEMA has delineated both the SFHAs and the risk premium zones applicable to the community.

**Flood Insurance Study (FIS)** – Contains an examination, evaluation, and determination of the flood hazards of a community and, if appropriate, the corresponding water-surface elevations.

**Hazus-MH** – A GIS-based risk assessment methodology and software application created by FEMA and the National Institute of Building Sciences for analyzing potential losses from floods, hurricane winds, and earthquakes.

**Lidar** – A remote sensing technology that measures distance by illuminating a target with a laser and analyzing the reflected light. Lidar is popularly used as a technology to make high-resolution maps.

**Liquefaction** – Describes a phenomenon whereby a saturated soil substantially loses strength and stiffness in response to an applied stress, usually an earthquake, causing it to behave like liquid.

**Loss Ratio** – The expression of loss as a fraction of the value of the local inventory (total value/loss).

**Magnitude** – A scale used by seismologists to measure the size of earthquakes in terms of energy released.

**Risk** – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of a natural hazard. Sometimes referred to as vulnerability.

**Risk MAP** – The vision of this FEMA strategy is to work collaboratively with State, local, and tribal entities to deliver quality flood data that increases public awareness and leads to action that reduces risk to life and property.

**Riverine** – Of or produced by a river. Riverine floodplains have readily identifiable channels.

**Susceptibility** – Degree of proneness to natural hazards that is determined based on physical characteristics that are present.

**Vulnerability** – Characteristics that make people or assets more susceptible to a natural hazard.

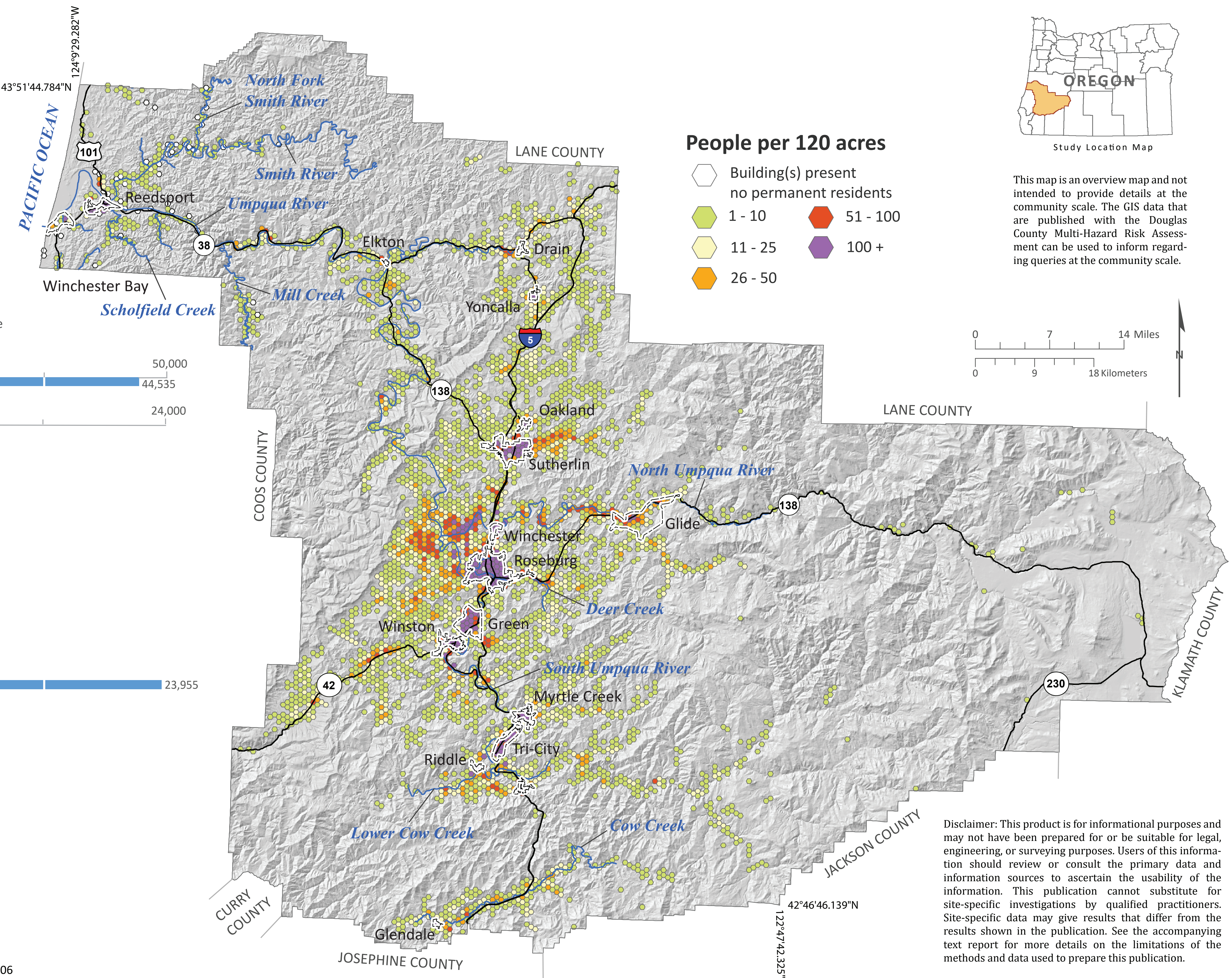
# APPENDIX F. MAP PLATES

*See appendix folder for individual map PDFs.*

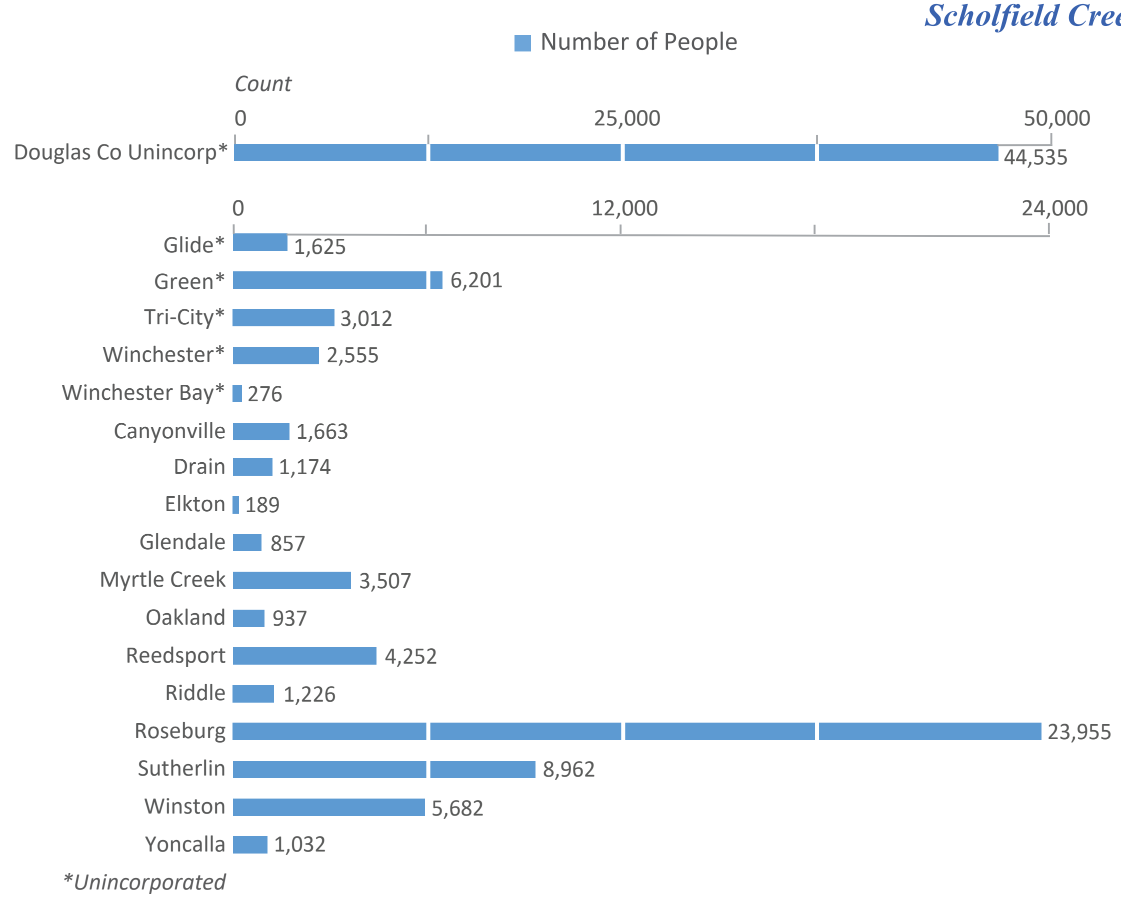
PLATE 1

STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
RUARRI J. DAY-STIRRAT, STATE GEOLOGIST
https://www.oregon.gov/dogami

# Population Density Map of Douglas County, Oregon




This map is an overview map and not intended to provide details at the community scale. The GIS data that are published with the Douglas County Multi-Hazard Risk Assessment can be used to inform regarding queries at the community scale.




**Data Sources:**
Population data: PSU Population Research Center (2021)
Roads: Oregon Department of Transportation Signed Routes (2013)
Place names: U.S. Geological Survey Geographic Names Information System (2015)
City limits: Oregon Department of Transportation (2014)
Basemap: Oregon Lidar Consortium (2014)
Hydrography: U.S. Geological Survey National Hydrography Dataset (2017)

Projection: NAD 1983 UTM Zone 10N
Software: Esri® ArcMap 10, Adobe® Illustrator CC

Cartography by:Matt C. Williams, 2023

Disclaimer: This product is for informational purposes and may not have been prepared for or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information. This publication cannot substitute for site-specific investigations by qualified practitioners. Site-specific data may give results that differ from the results shown in the publication. See the accompanying text report for more details on the limitations of the methods and data used to prepare this publication.

# CSZ Mw-9.0 Earthquake Shaking Map of Douglas County, Oregon

PLATE 2

STATE OF OREGON
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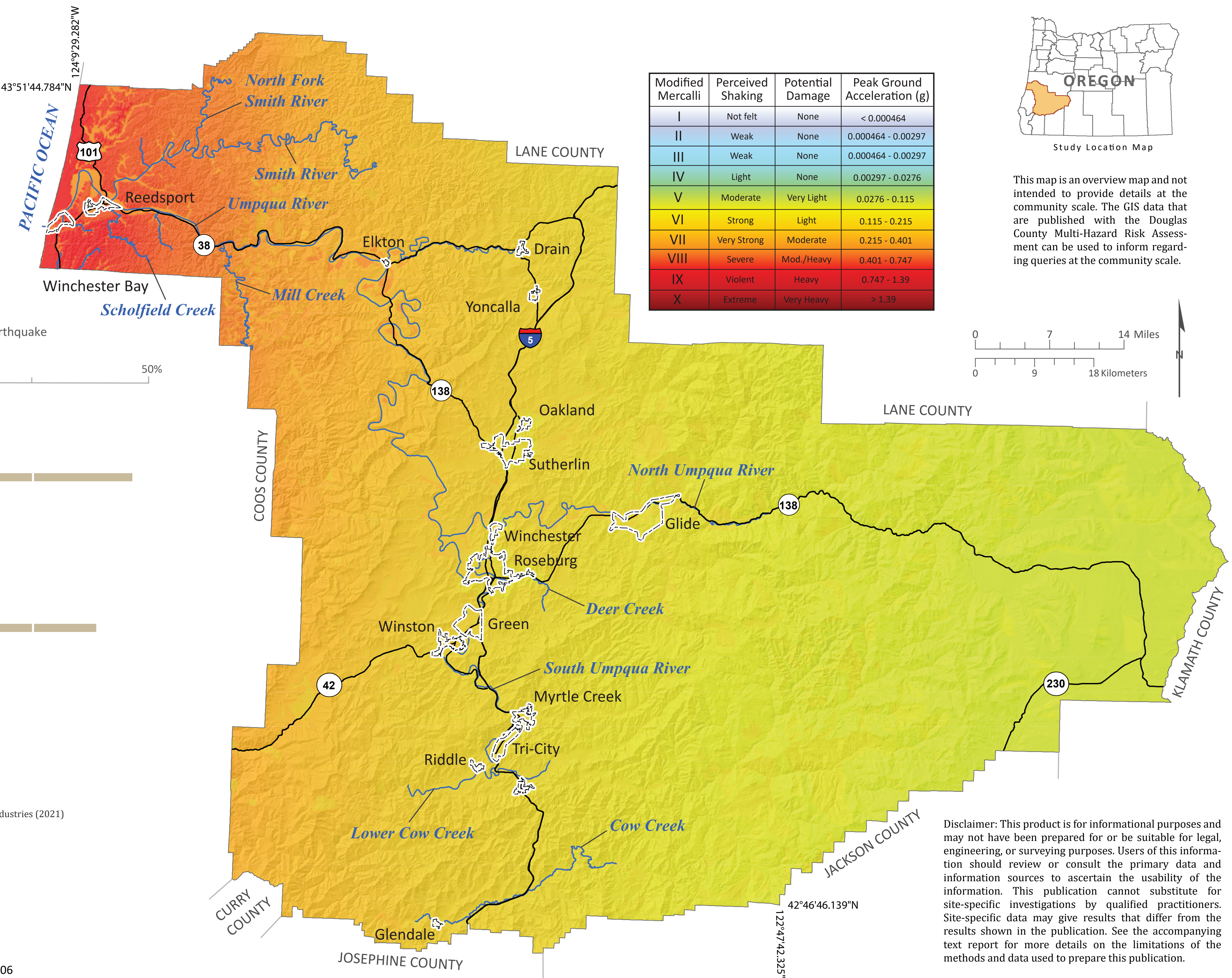
RUARRI J. DAY-STIRRAT, STATE GEOLOGIST
https://www.oregon.gov/dogami

Peak Ground Acceleration (PGA) is the maximum acceleration in a given location or rather how hard the ground is shaking during an earthquake. It is one measurement of ground motion, which is closely associated with the level of damage that occurs from an earthquake.




| Modified Mercalli | Perceived Shaking | Potential Damage | Peak Ground Acceleration (g) |
|---|---|---|---|
| I | Not felt | None | < 0.000464 |
| II | Weak | None | 0.000464 - 0.00297 |
| III | Weak | None | 0.000464 - 0.00297 |
| IV | Light | None | 0.00297 - 0.0276 |
| V | Moderate | Very Light | 0.0276 - 0.115 |
| VI | Strong | Light | 0.115 - 0.215 |
| VII | Very Strong | Moderate | 0.215 - 0.401 |
| VIII | Severe | Mod./Heavy | 0.401 - 0.747 |
| IX | Violent | Heavy | 0.747 - 1.39 |
| X | Extreme | Very Heavy | > 1.39 |

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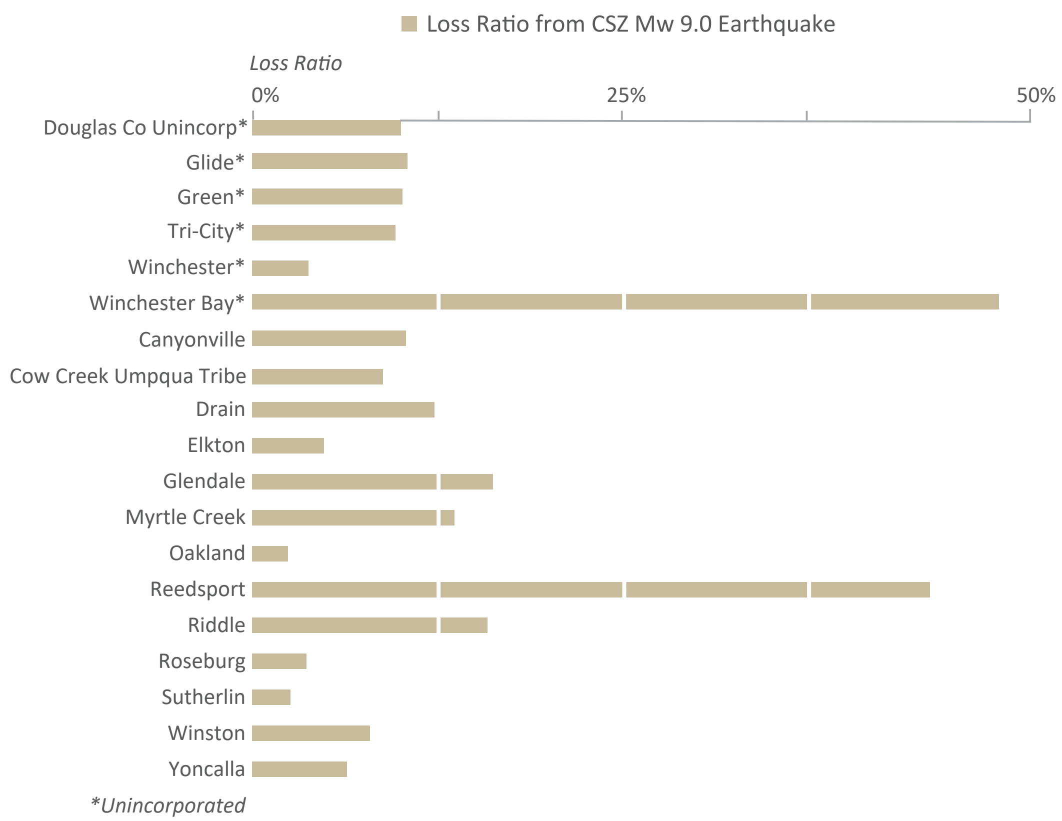


**Data Sources:**
Earthquake peak ground acceleration: Oregon Department of Geology and Mineral Industries (2021)
Roads: Oregon Department of Transportation Signed Routes (2013)
Place names: U.S. Geological Survey Geographic Names Information System (2015)
City limits: Oregon Department of Transportation (2014)
Basemap: Oregon Lidar Consortium (2014)
Hydrography: U.S. Geological Survey National Hydrography Dataset (2017)

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Cartography by:Matt C. Williams, 2023

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PLATE 3

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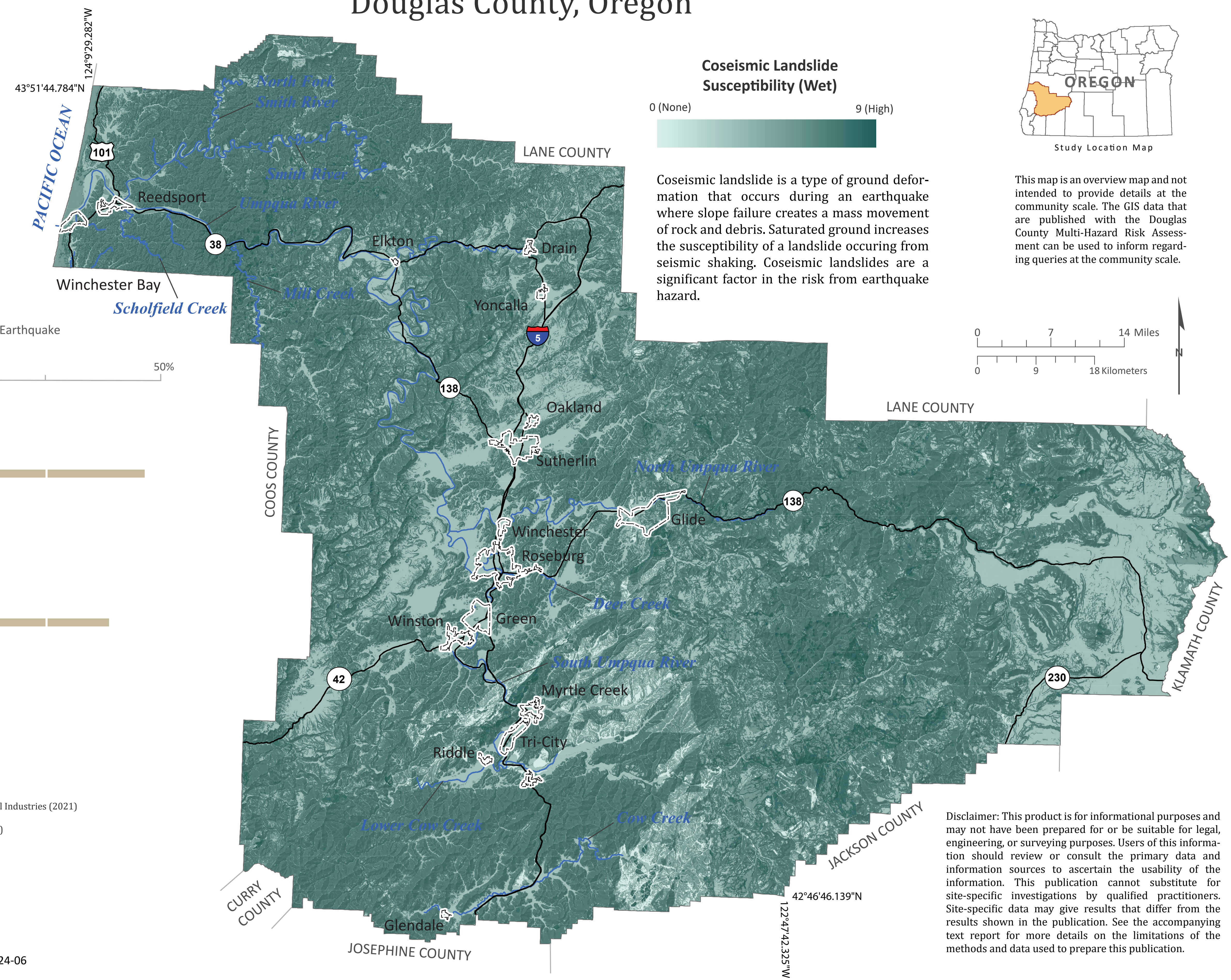
# Coseismic Landslide Susceptibility (Wet) Map of Douglas County, Oregon

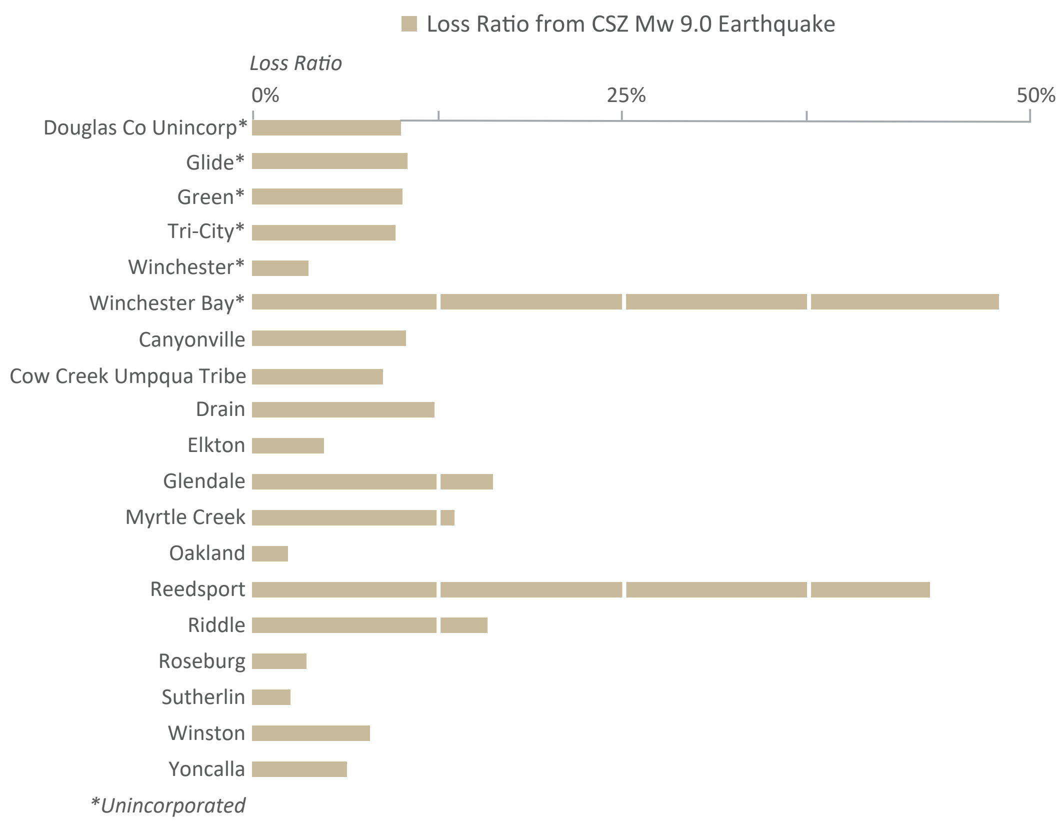



## Coseismic Landslide Susceptibility (Wet)

0 (None) — 9 (High)

Coseismic landslide is a type of ground deformation that occurs during an earthquake where slope failure creates a mass movement of rock and debris. Saturated ground increases the susceptibility of a landslide occuring from seismic shaking. Coseismic landslides are a significant factor in the risk from earthquake hazard.

This map is an overview map and not intended to provide details at the community scale. The GIS data that are published with the Douglas County Multi-Hazard Risk Assessment can be used to inform regarding queries at the community scale.




**Data Sources:**
Earthquake peak ground acceleration: Oregon Department of Geology and Mineral Industries (2021)
Roads: Oregon Department of Transportation Signed Routes (2013)
Place names: U.S. Geological Survey Geographic Names Information System (2015)
City limits: Oregon Department of Transportation (2014)
Basemap: Oregon Lidar Consortium (2014)
Hydrography: U.S. Geological Survey National Hydrography Dataset (2017)

Projection: NAD 1983 UTM Zone 10N
Software: Esri® ArcMap 10, Adobe® Illustrator CC

Cartography by:Matt C. Williams, 2023

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PLATE 4

STATE OF OREGON
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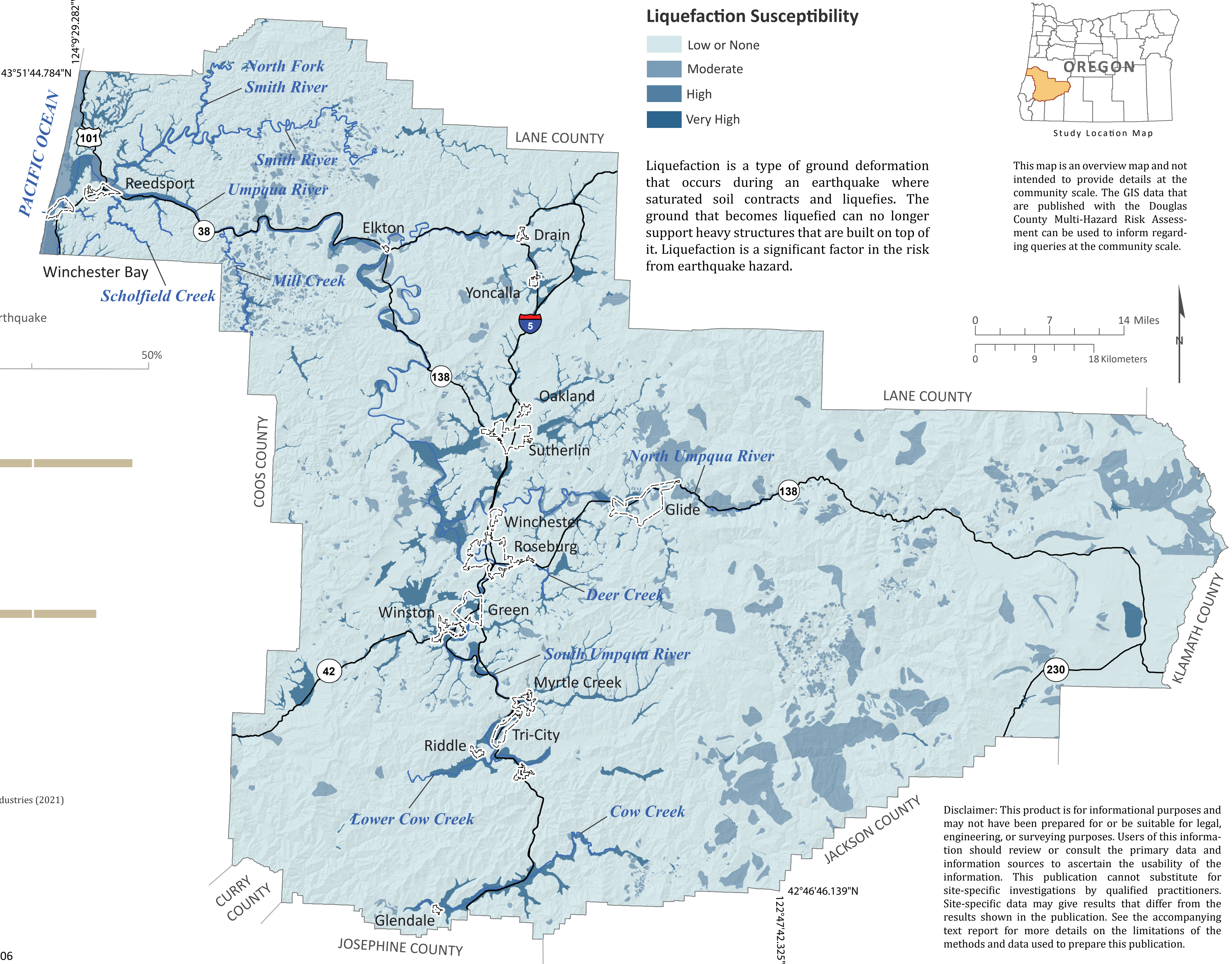
# Liquefaction Susceptibility Map of Douglas County, Oregon




## Liquefaction Susceptibility

- Low or None
- Moderate
- High
- Very High

OREGON
Study Location Map

Liquefaction is a type of ground deformation that occurs during an earthquake where saturated soil contracts and liquefies. The ground that becomes liquefied can no longer support heavy structures that are built on top of it. Liquefaction is a significant factor in the risk from earthquake hazard.

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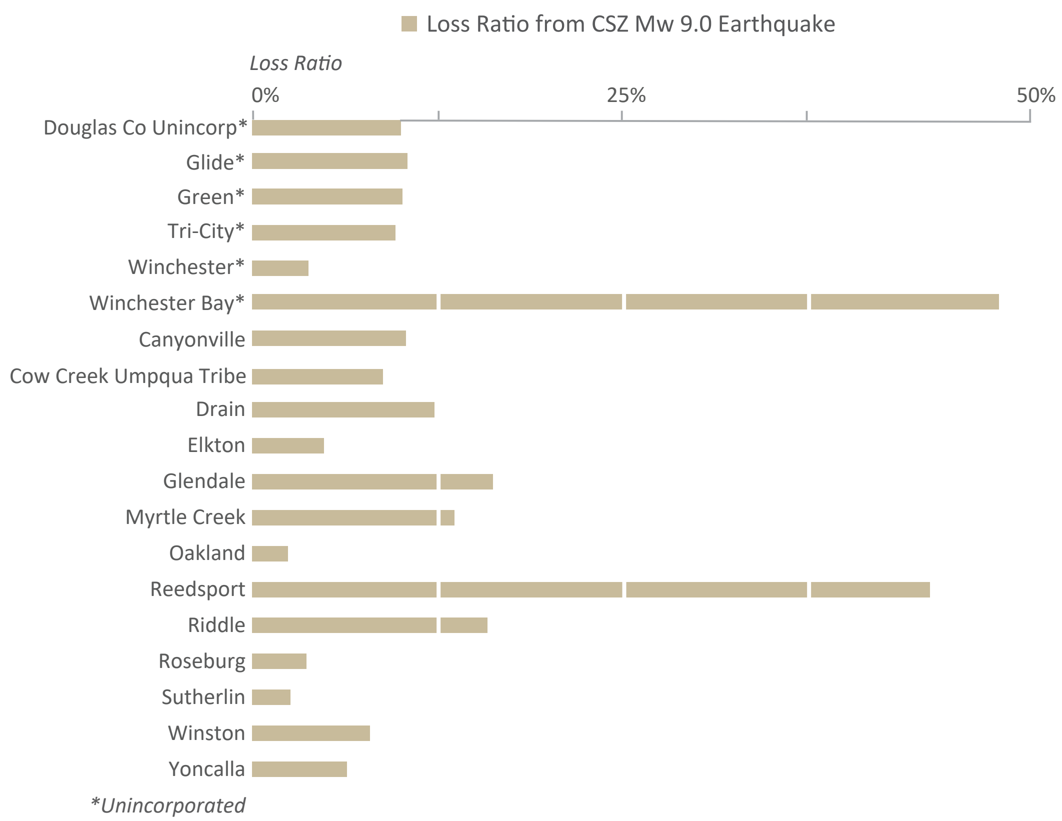



**Data Sources:**
Earthquake peak ground acceleration: Oregon Department of Geology and Mineral Industries (2021)
Roads: Oregon Department of Transportation Signed Routes (2013)
Place names: U.S. Geological Survey Geographic Names Information System (2015)
City limits: Oregon Department of Transportation (2014)
Basemap: Oregon Lidar Consortium (2014)
Hydrography: U.S. Geological Survey National Hydrography Dataset (2017)

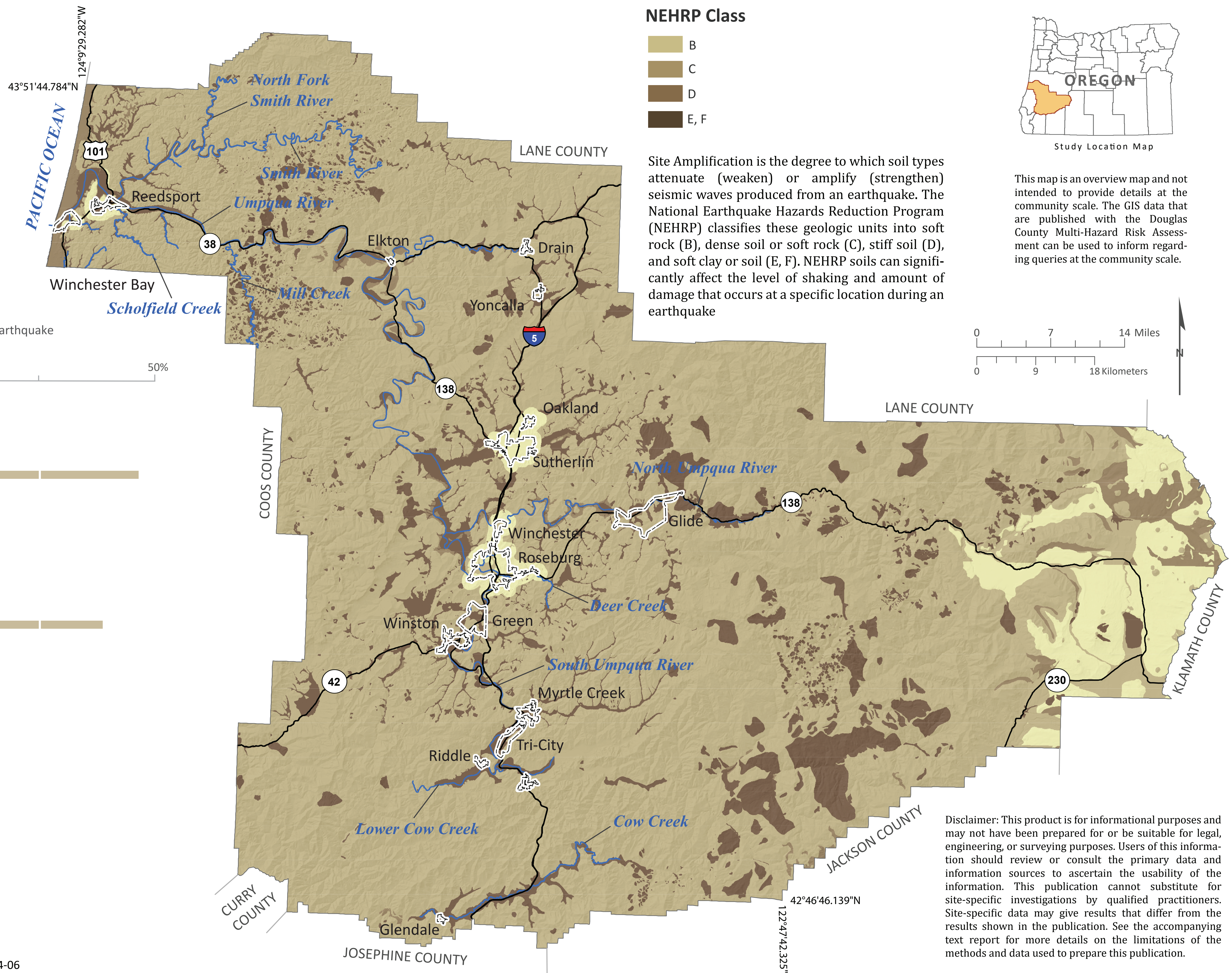
Projection: NAD 1983 UTM Zone 10N
Software: Esri® ArcMap 10, Adobe® Illustrator CC

Cartography by:Matt C. Williams, 2023

PLATE 5

STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
RUARRI J. DAY-STIRRAT, STATE GEOLOGIST
https://www.oregon.gov/dogami

# Site Amplification Class Map of Douglas County, Oregon




## NEHRP Class

- B
- C
- D
- E, F

Site Amplification is the degree to which soil types attenuate (weaken) or amplify (strengthen) seismic waves produced from an earthquake. The National Earthquake Hazards Reduction Program (NEHRP) classifies these geologic units into soft rock (B), dense soil or soft rock (C), stiff soil (D), and soft clay or soil (E, F). NEHRP soils can significantly affect the level of shaking and amount of damage that occurs at a specific location during an earthquake

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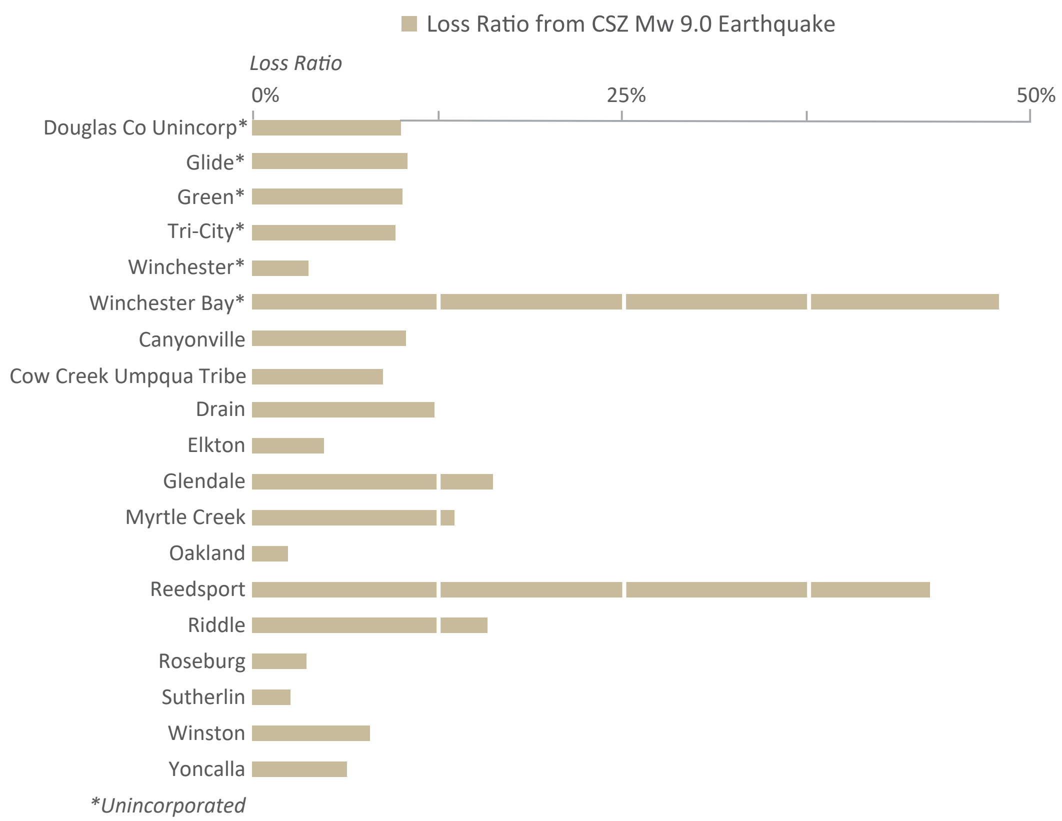


**Data Sources:**
Soil amplification: Oregon Department of Geology and Mineral Industries (2021)
Roads: Oregon Department of Transportation Signed Routes (2013)
Place names: U.S. Geological Survey Geographic Names Information System (2015)
City limits: Oregon Department of Transportation (2014)
Basemap: Oregon Lidar Consortium (2014)
Hydrography: U.S. Geological Survey National Hydrography Dataset (2017)

Projection: NAD 1983 UTM Zone 10N
Software: Esri® ArcMap 10, Adobe® Illustrator CC

Cartography by:Matt C. Williams, 2023

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STATE OF OREGON
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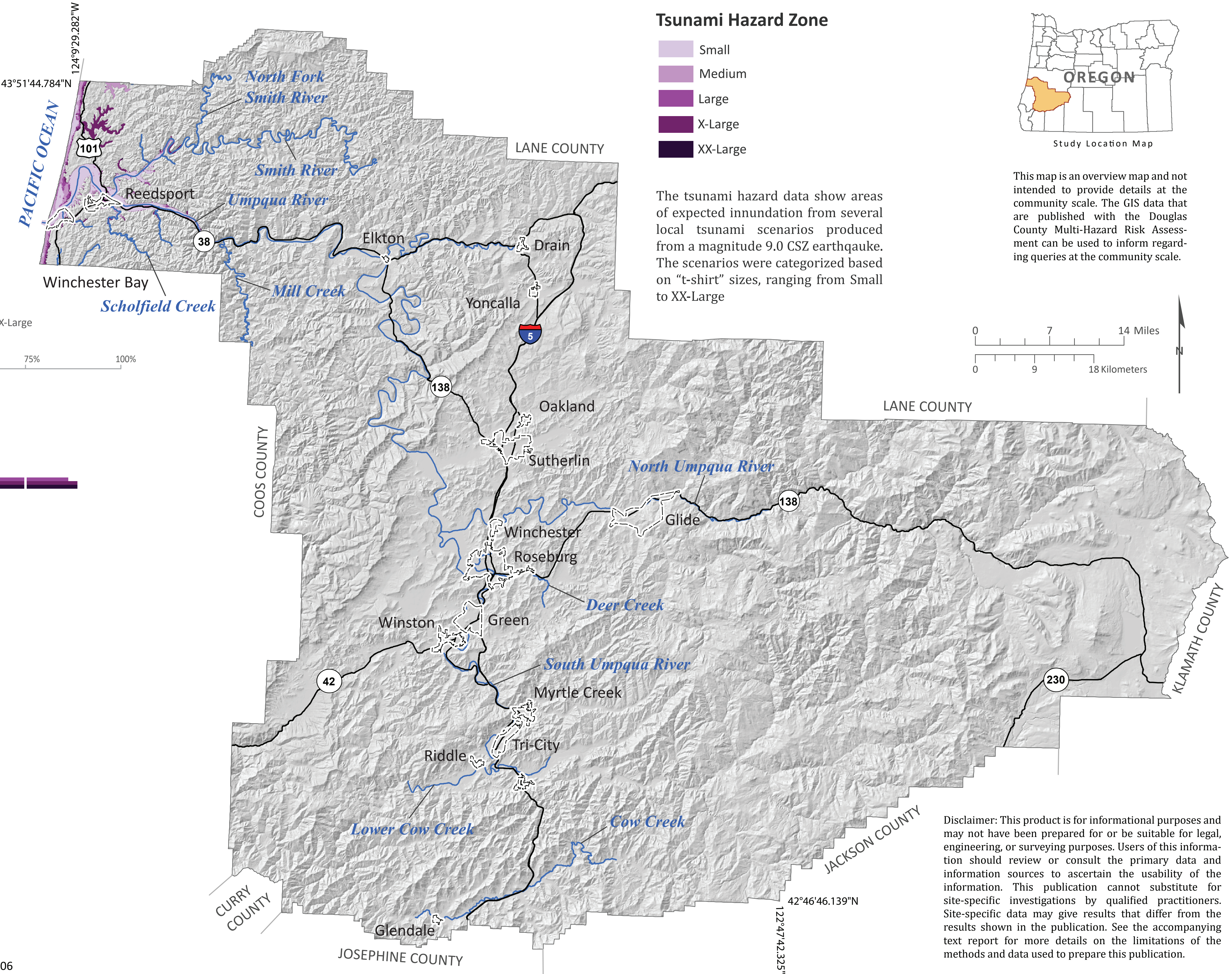
# Tsunami Inundation Map of Douglas County, Oregon

PLATE 6



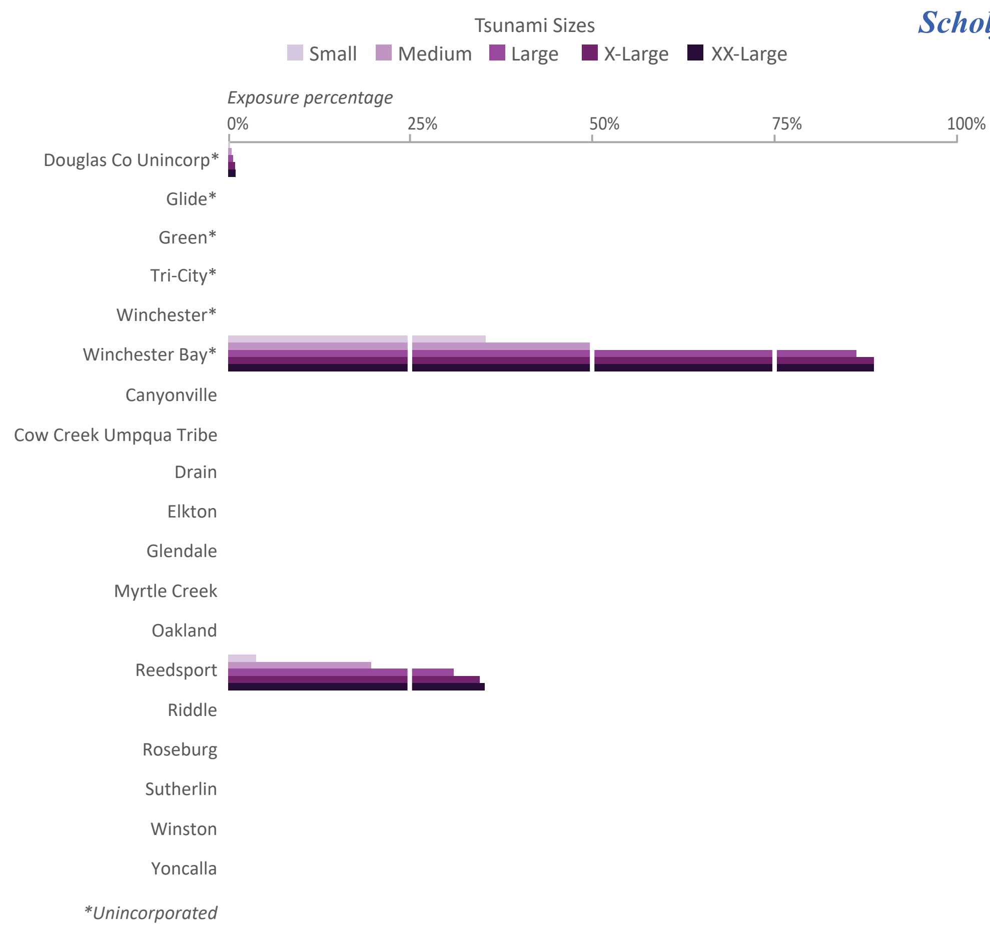

## Tsunami Hazard Zone

- Small
- Medium
- Large
- X-Large
- XX-Large

The tsunami hazard data show areas of expected innundation from several local tsunami scenarios produced from a magnitude 9.0 CSZ earthqauke. The scenarios were categorized based on "t-shirt" sizes, ranging from Small to XX-Large

This map is an overview map and not intended to provide details at the community scale. The GIS data that are published with the Douglas County Multi-Hazard Risk Assessment can be used to inform regarding queries at the community scale.

0 7 14 Miles
0 9 18 Kilometers
N




**Data Sources:**
Tsunami hazard zones: Oregon Department of Geology, Priest and others (2013)
Roads: Oregon Department of Transportation (2014)
Place names: U.S. Geological Survey Geograpic Names Information System (2015)
City limits: Oregon Department of Transportation (2014)
Basemap: U.S. Geological Survey and Oregon Lidar Consortium (2012)
Hydrography: U.S. Geological Survey National Hydrography Dataset (2017)

Projection: NAD 1983 UTM Zone 10N
Software: Esri® ArcMap 10, Adobe® Illustrator CC

Cartography by:Matt C. Williams, 2022

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STATE OF OREGON
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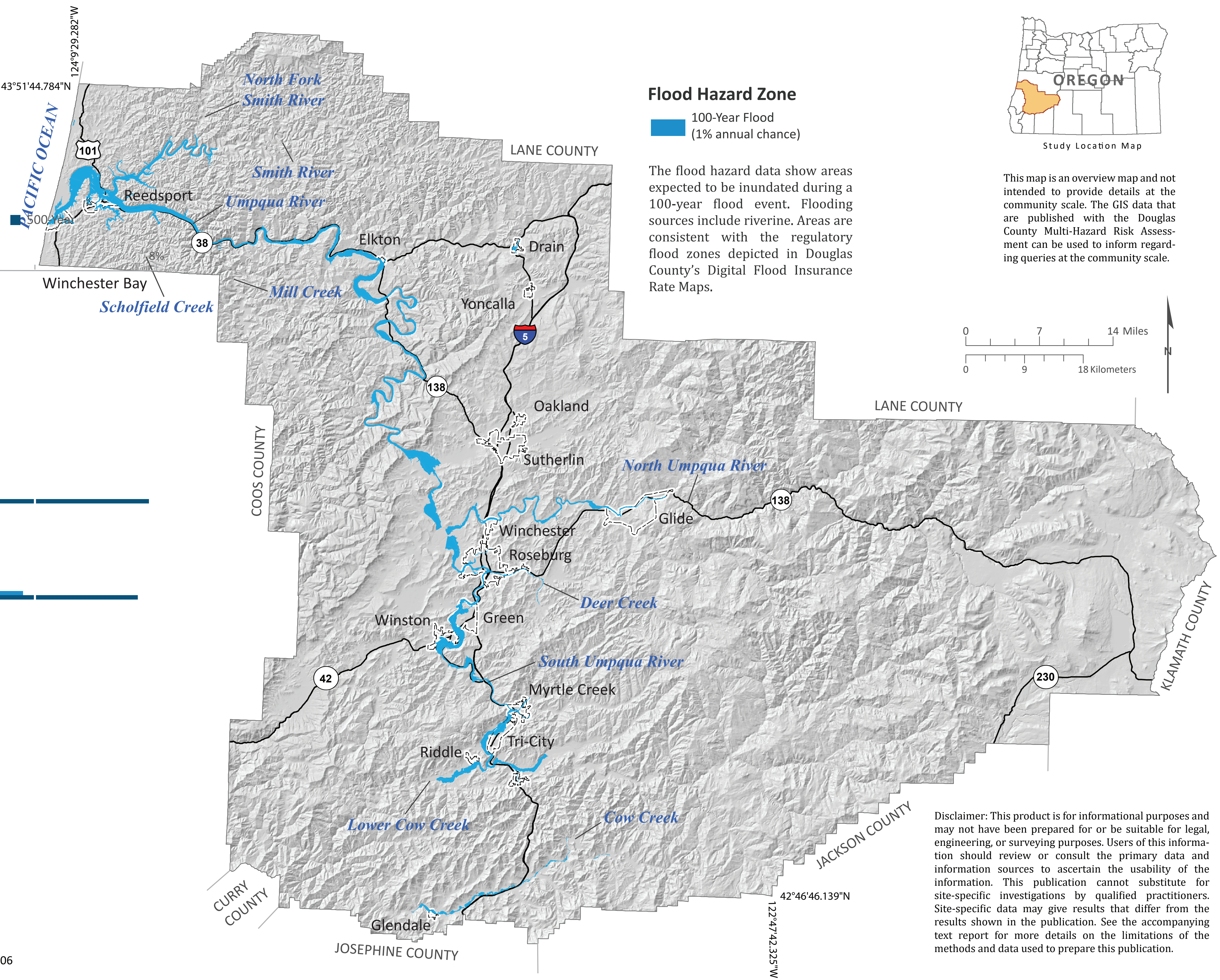
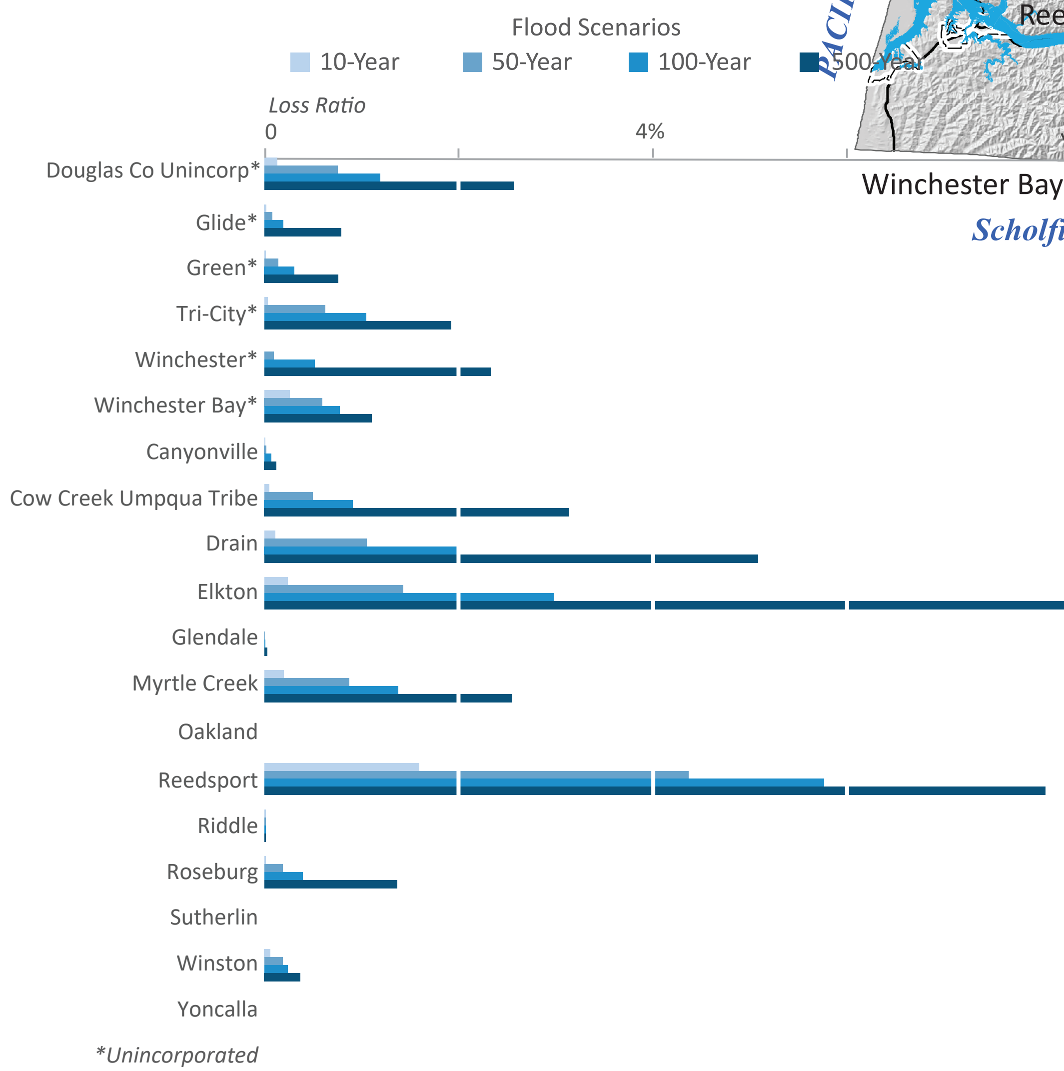
# Flood Hazard Map of Douglas County, Oregon




OREGON
Study Location Map

The flood hazard data show areas expected to be inundated during a 100-year flood event. Flooding sources include riverine. Areas are consistent with the regulatory flood zones depicted in Douglas County's Digital Flood Insurance Rate Maps.

This map is an overview map and not intended to provide details at the community scale. The GIS data that are published with the Douglas County Multi-Hazard Risk Assessment can be used to inform regarding queries at the community scale.

**Data Sources:**
Flood hazard zone (100-year): Douglas County Flood Insurance Rate Map (2021)
Roads: Oregon Department of Transportation Signed Routes (2013)
Place names: U.S. Geological Survey Geographic Names Information System (2015)
City limits: Oregon Department of Transportation (2014)
Basemap: Oregon Lidar Consortium (2014)
Hydrography: U.S. Geological Survey National Hydrography Dataset (2017)

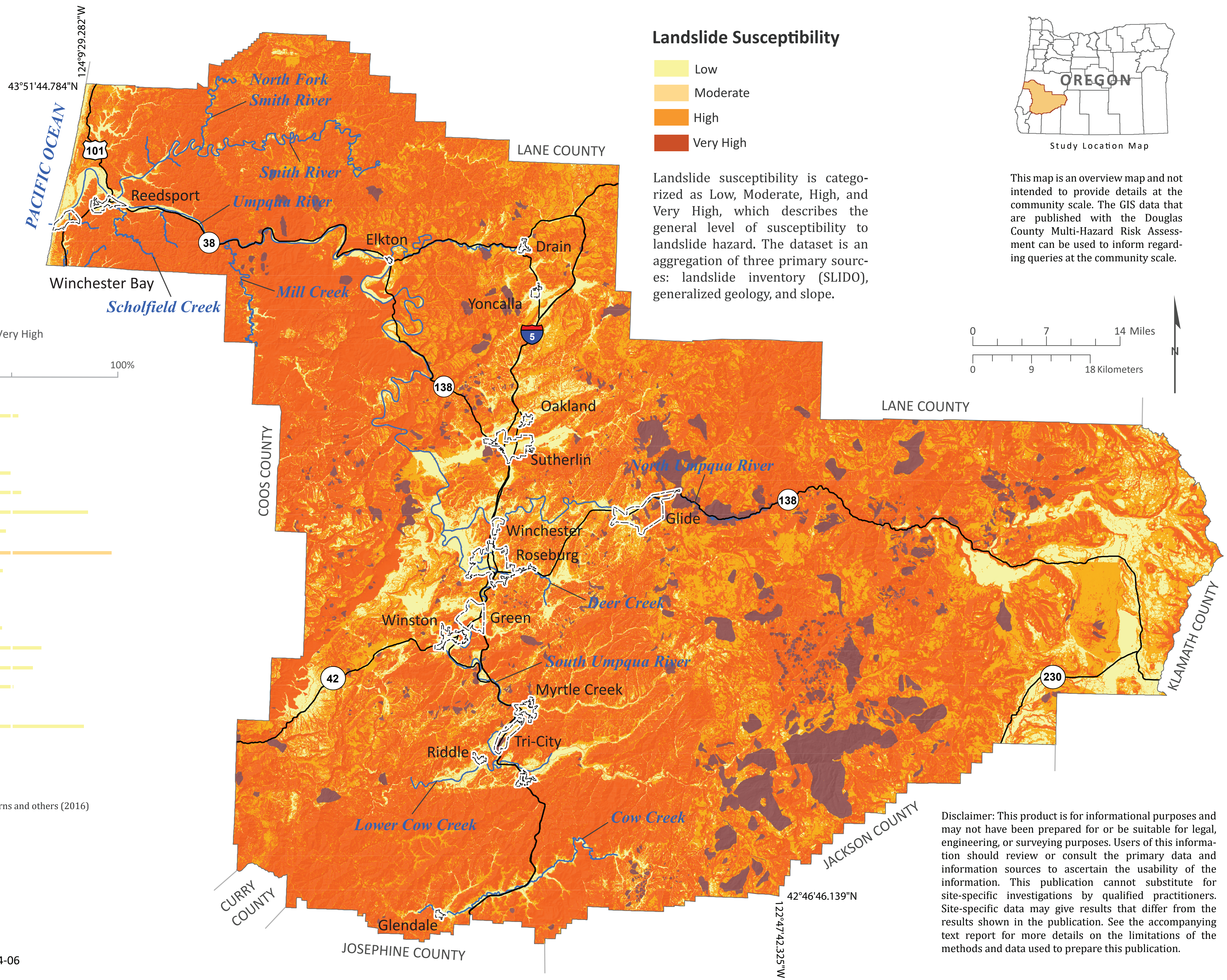
Projection: NAD 1983 UTM Zone 10N
Software: Esri® ArcMap 10, Adobe® Illustrator CC

Cartography by:Matt C. Williams, 2023

PLATE 8

# Landslide Susceptibility Map of Douglas County, Oregon

STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
RUARRI J. DAY-STIRRAT, STATE GEOLOGIST
https://www.oregon.gov/dogami

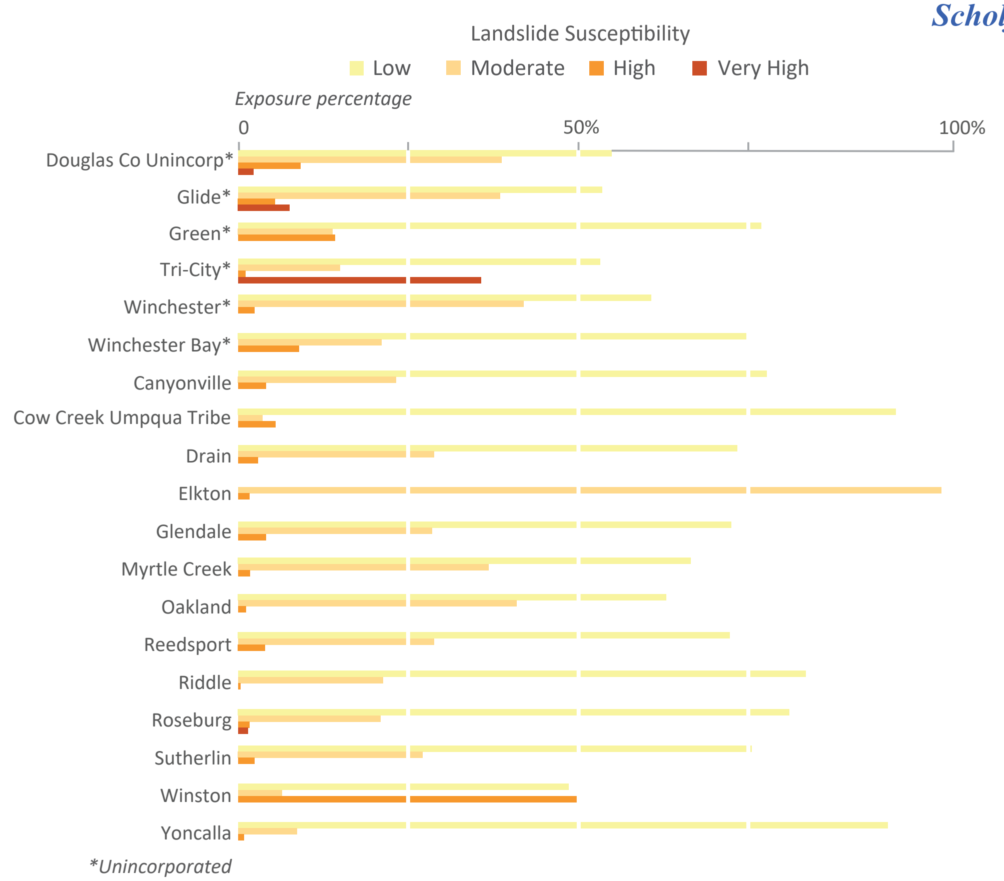



## Landslide Susceptibility

- Low
- Moderate
- High
- Very High

Landslide susceptibility is categorized as Low, Moderate, High, and Very High, which describes the general level of susceptibility to landslide hazard. The dataset is an aggregation of three primary sources: landslide inventory (SLIDO), generalized geology, and slope.

This map is an overview map and not intended to provide details at the community scale. The GIS data that are published with the Douglas County Multi-Hazard Risk Assessment can be used to inform regarding queries at the community scale.




**Data Sources:**
Landslide susceptibility: Oregon Department of Geology and Mineral Industries, Burns and others (2016)
Roads: Oregon Department of Transportation Signed Routes (2013)
Place names: U.S. Geological Survey Geographic Names Information System (2015)
City limits: Oregon Department of Transportation (2014)
Basemap: Oregon Lidar Consortium (2014)
Hydrography: U.S. Geological Survey National Hydrography Dataset (2017)

Projection: NAD 1983 UTM Zone 10N
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PLATE 9

STATE OF OREGON
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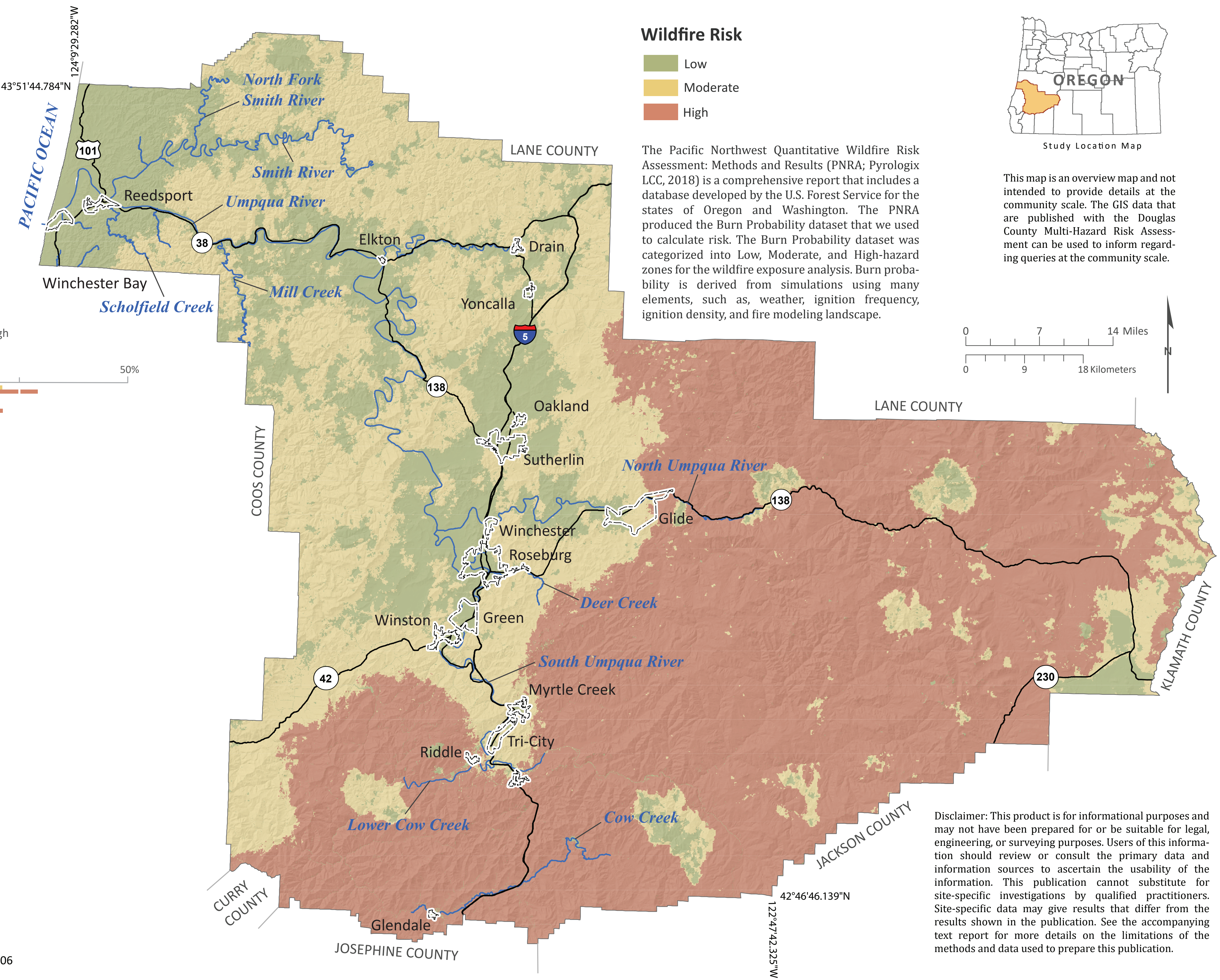
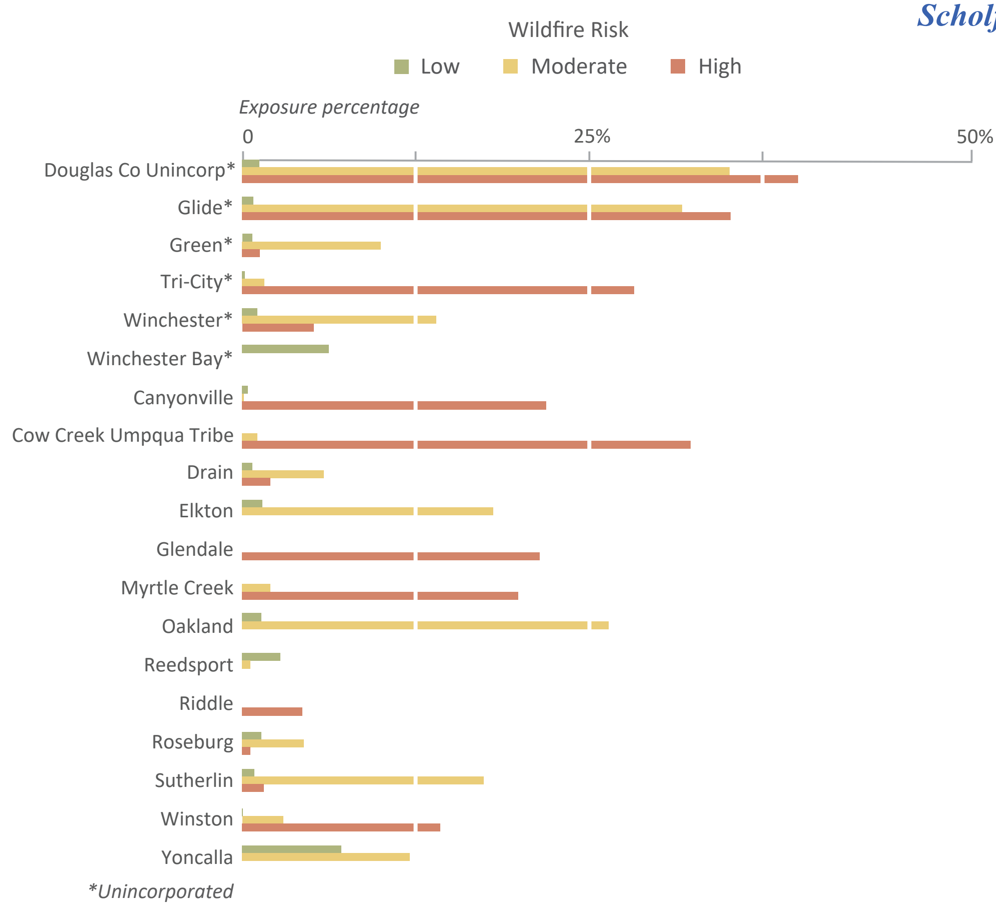
# Wildfire Risk Map of Douglas County, Oregon




The Pacific Northwest Quantitative Wildfire Risk Assessment: Methods and Results (PNRA; Pyrologix LCC, 2018) is a comprehensive report that includes a database developed by the U.S. Forest Service for the states of Oregon and Washington. The PNRA produced the Burn Probability dataset that we used to calculate risk. The Burn Probability dataset was categorized into Low, Moderate, and High-hazard zones for the wildfire exposure analysis. Burn probability is derived from simulations using many elements, such as, weather, ignition frequency, ignition density, and fire modeling landscape.

This map is an overview map and not intended to provide details at the community scale. The GIS data that are published with the Douglas County Multi-Hazard Risk Assessment can be used to inform regarding queries at the community scale.




**Data Sources:**
Wildfire risk data: Oregon Department of Forestry, Pyrologix, LCC. (2018)
Roads: Oregon Department of Transportation Signed Routes (2013)
Place names: U.S. Geological Survey Geographic Names Information System (2015)
City limits: Oregon Department of Transportation (2014)
Basemap: Oregon Lidar Consortium (2014)
Hydrography: U.S. Geological Survey National Hydrography Dataset (2017)

Projection: NAD 1983 UTM Zone 10N
Software: Esri® ArcMap 10, Adobe® Illustrator CC

Cartography by:Matt C. Williams, 2023

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