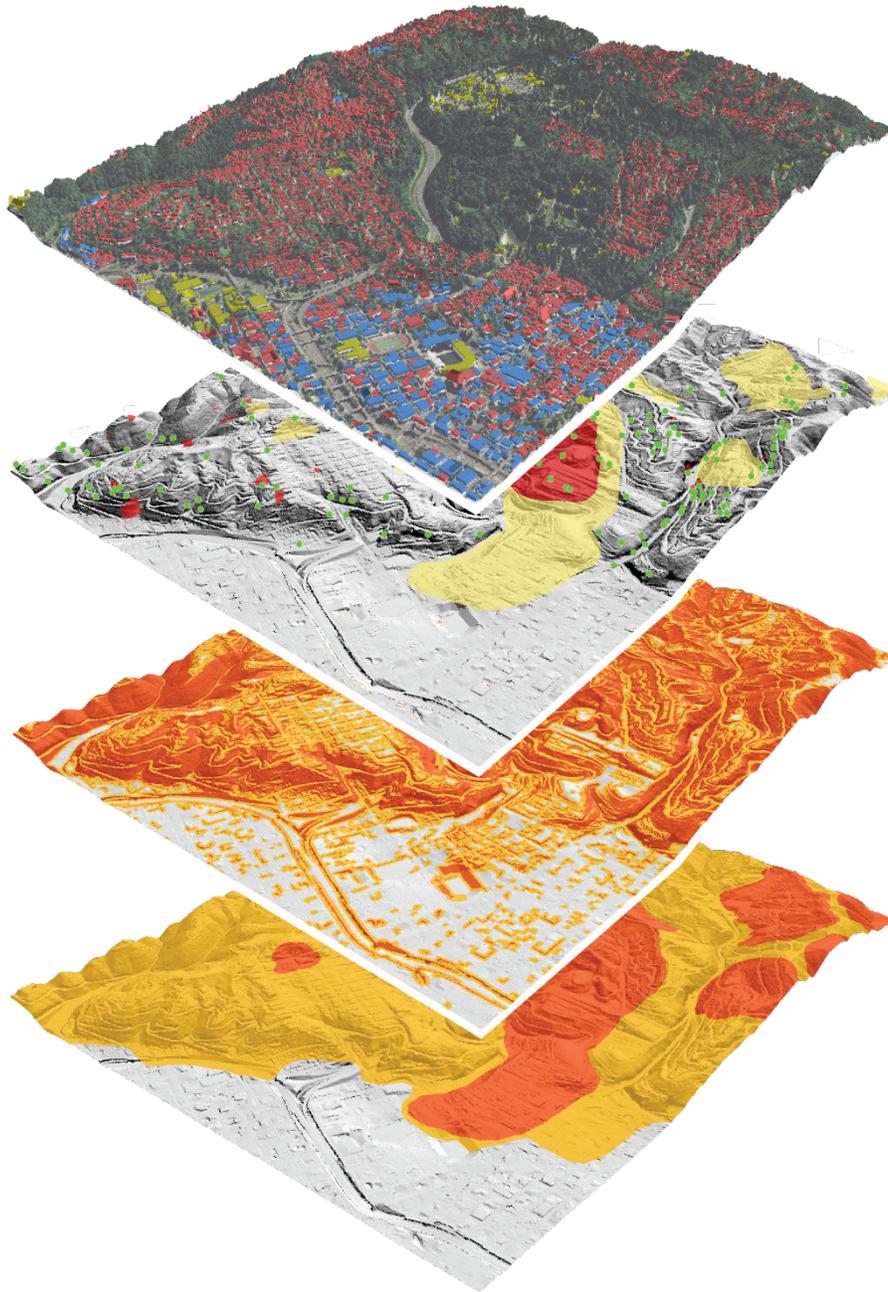# Landslide Hazard and Risk Study

Central and Western Multnomah County, Oregon

Interpretive Map 57
Oregon Department of Geology and Mineral Industries

Cover page: Landslide risk and hazards for a portion of the study area. Layers from top to bottom: Assets (buildings and transportation routes), landslide inventory, shallow landslide susceptibility, and deep landslide susceptibility.

State of Oregon
Oregon Department of Geology and Mineral Industries
Brad Avy, State Geologist

INTERPRETIVE MAP 57

LANDSLIDE HAZARD AND RISK STUDY OF CENTRAL AND WESTERN MULTNOMAH COUNTY, OREGON

by William J. Burns[1], Nancy C. Calhoun[1], Jon J. Franczyk[1], Kassandra O. Lindsey[2], and Lina Ma[1]

2018

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Oregon Department of Geology and Mineral Industries Interpretive Map 57
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LIST OF FIGURES

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LIST OF PLATES

APPENDICES

GEOGRAPHIC INFORMATION SYSTEM (GIS) DATA

See the digital publication folder for files.
Geodatabase is Esri® version 10.1 format. Metadata is embedded in the geodatabase
and is also provided as separate .xml format files.

Multnomah_Landslide_Inventory.gdb:

feature classes:

Deep_LS_Susceptibility (polygons)

Deposits (polygons)

Historic_LS_Points (points)

Scarps (polylines)

Scarps_Flanks (polygons)

Shallow_LS_Susceptiblity (raster)

Metadata in .xml file format:

Deep_LS_Susceptibility.xlsm

Deposits.xlsm

Historic_LS_Points.xlsm

Scarps.xlsm

Scarps_Flanks.xlsm

Shallow_LS_Susceptibility.xlsm

1.0 REPORT SUMMARY

At least 1,700 landslides have occurred within the City of Portland during the last 90 years (1928–2016). Of these landslides, approximately 830 occurred during the severe storms in 1996. From these historical data, we estimate an average of 20 landslides per year in the City of Portland. We estimate annual loss from landslides in the City of Portland ranges from $1.5M (million) to $3M. In years with extreme winter storms, this estimate can increase to approximately $64M to $81M. These historical data are a clear indication of a significant landslide risk and thus the need for continued landslide risk reduction.

In 2014, the Oregon Department of Geology and Mineral Industries (DOGAMI) submitted a grant application to Federal Emergency Management Agency (FEMA) and was granted funding to perform this study. The majority of the work on this project took place during 2015-2016. The purpose of the project was to assist the communities in the study area to better understand the landslide hazard and risk and to continue landslide risk reduction. Deliverables of the study include:

- This report text, appendices, and map plates
- Geographic Information System (GIS) datasets including:
    - landslide inventory—map of locations of landslides that have occurred at some time in the past
    - shallow landslide susceptibility—map of areas prone (low, moderate, high) to future shallow landslides
    - deep landslide susceptibility—map of areas prone (low, moderate, high) to future deep landslides
    - Landside risk analysis

The study area includes the Cities of Portland, Gresham, Fairview, Wood Village, Troutdale, and portions of Multnomah County and covers approximately 300 square miles. The city of Portland is divided into risk reporting areas roughly defined by the nine neighborhood coalitions. Nearly one quarter of the people living in Oregon (~4 million people), live in the study area (~724,000 people). These people live and work in approximately 230,000 buildings worth approximately $75B with an additional $45B in land value.

First, we compiled existing detailed, lidar-based landslide inventories. These data were created and published during 2010–2012 by following the protocol of Burns and Madin (2009). Then, we updated the historical landslide inventory inside the City of Portland with data provided by the City. We created new, generalized bedrock and surficial engineering geology datasets as part of this study as the foundation of new susceptibility maps. The new shallow and deep landslide susceptibility maps are appropriate for use in landslide risk reduction activates such as updates to building codes and evaluation of storm water systems.

We performed two types of risk analysis: 1) hazard and asset exposure, and 2) Hazus® earthquake-triggered landslide risk analysis. We found that approximately $1.65B (billion) in land and buildings and almost 6,700 people are located on existing landslides. Also, 29,000 people live in the high-susceptibility hazard zone for shallow landslides, and nearly 8,000 people live in the high-susceptibility hazard zone for deep landslides in the study area. The second type of risk analysis, with Hazus, a risk modeling software package developed by FEMA, can be used to model a variety of earthquake, flood, and wind probabilistic hazards and/or hazard event scenarios. Because there is no Hazus landslide module, we used the earthquake module with and without earthquake-induced landslide hazards. Then we subtracted the earthquake-without-landslides model from the earthquake-with-landslides model so that the earthquake-

induced landslide damage and losses could be examined separately. We found in some communities up to 25% of the modeled damage is from landslides triggered by earthquakes.

Although we cannot predict when the next landslide events will occur or how big they will be, we were able to provide a detailed understanding of landslide events in the past, the estimated scale of a potential disaster, the areas susceptible to future landslides, and an estimate of what the damage and losses might be. All of these data confirm that landslide risk exists in the study area and thus that there is a strong need for continued landslide risk reduction. Landslide risk reduction can be performed in various ways. We provide recommendations and conclusions based on our findings. These recommendations are not comprehensive, but they should provide an adequate foundation for many of the risk management phases. The primary actions are related to awareness, regulations, and planning.

2.0   INTRODUCTION

Portions of central and western Multnomah County, Oregon, have significant landslide hazards (Burns and others, 1998). This region of the state also contains the most developed land in Oregon. The high landslide hazard combined with dense development results in high risk. The assessment of this risk is the primary reason for this study.

2.1   The Study Area

The study area is defined by the Multnomah County boundary with the exception of the eastern one third of the county (**Figure 2-1**).

Figure 2-1. Map of the study area.
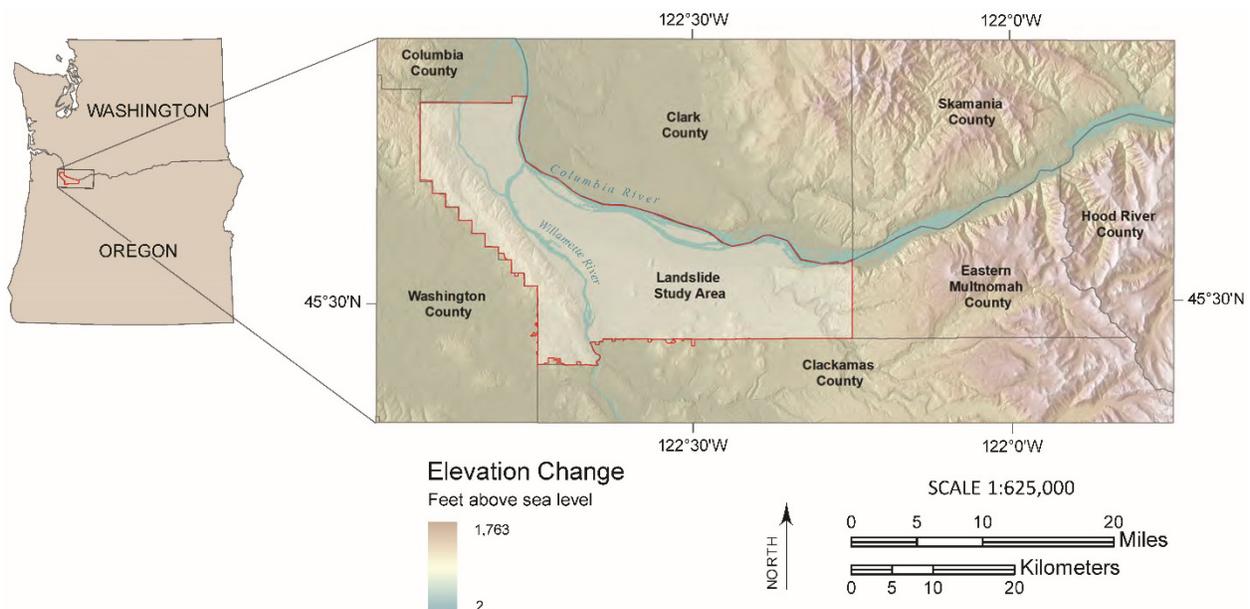
The study area includes the Cities of Portland, Gresham, Fairview, Wood Village, and Troutdale and covers 300.64 mi² (**Figure 2-2**). The City of Portland is divided into risk reporting areas roughly defined by nine neighborhood coalitions as listed in Portland's mitigation action plan (Tetra Tech, 2016); 723,895 people live in the study area (U.S. Census, 2010, https://www.census.gov/2010census/data/).

The Columbia River bounds the study area to the north; the Sandy River approximates the eastern boundary. The Willamette River runs through the study area. The topography is relatively flat except for the Tualatin Mountains (also known as the Portland Hills), locally steep slope-banks along the rivers, the Boring volcanoes (such as Rocky Butte, Powell Butte, and Kelly Butte, Mount Tabor, and Mount Scott), and in the eastern portion of the study area the Columbia River Gorge and the foothills of the Cascade Mountains (Plate 1).

Figure 2-2. Map of risk reporting areas/communities in the study area. NHMP is Natural Hazard Mitigation Plan.
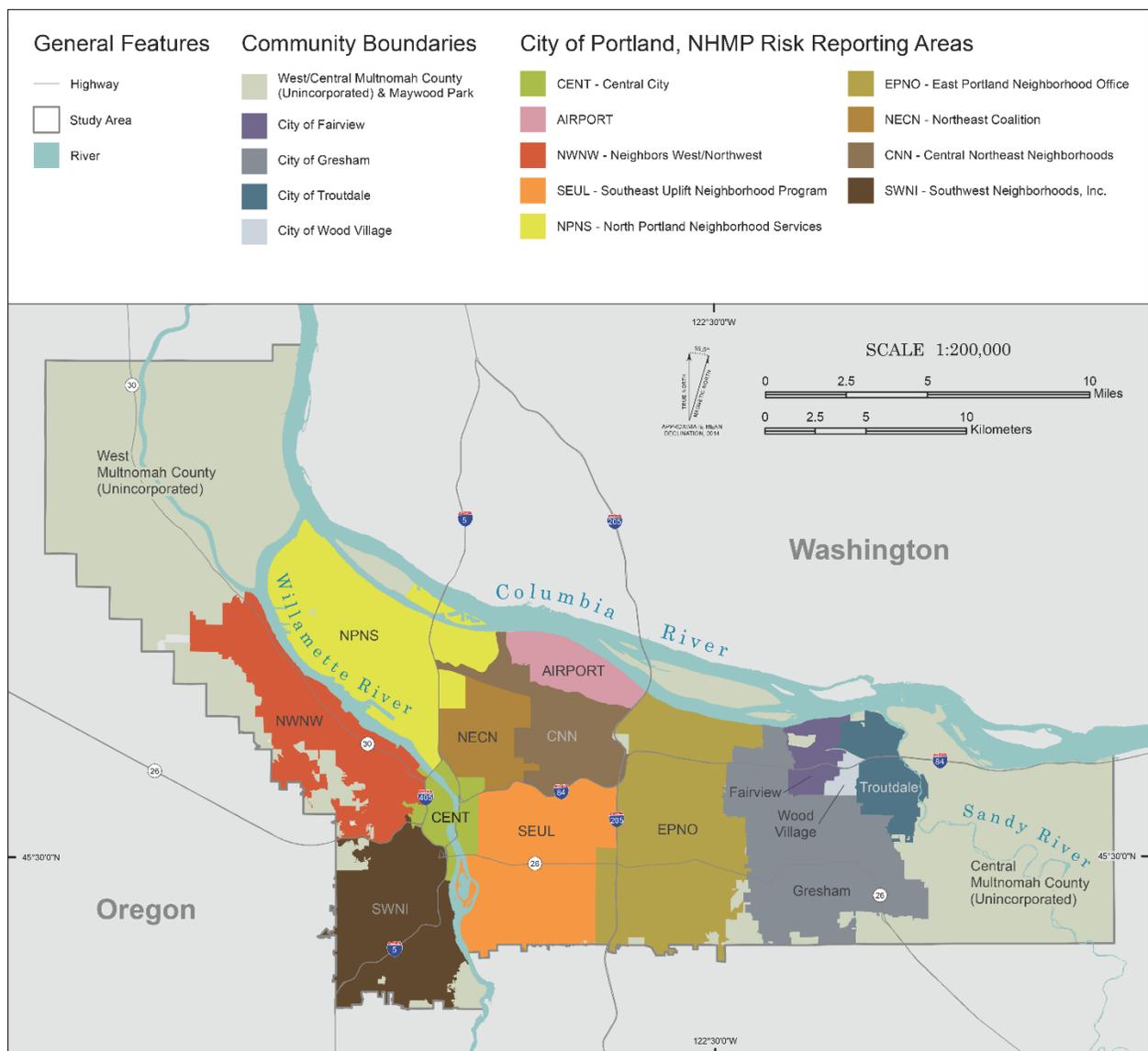
The study area has a West Coast marine climate: cool, wet winters and warm, dry summers. The precipitation is driven by a strong orographic effect associated with warmer moist air coming inland from the Pacific Ocean. As this moist air is driven up the Cascade Range, prolonged periods of precipitation result. The average annual precipitation ranges between 40 and 60 in/yr (Spatial Climate Analysis Service, 2000). The region is subjected to small to large magnitude earthquakes from three primary sources: 1) the Cascadia Subduction Zone, 2) intraplate, and 3) crustal.

2.2 Purpose

The purpose of this project is to help communities in this region become more aware of and resilient to landslide hazards by providing the communities with accurate, detailed, and up-to-date information about these hazards and community assets at risk.

The main objectives of this study are to:
- compile existing data including previous geologic hazard reports and natural hazard mitigation plans
- create new geodatabases of landslide hazards including landslide inventory and susceptibility
- compile or create a database of critical facilities and primary infrastructure, generalized land occupancy (land use/zoning), buildings, and population distribution data
- perform exposure and Hazus–based risk analyses

The body of this report describes the methods and results for these objectives. Throughout this report we use the engineering geology terms *hazard*, *susceptibility,* and *risk*. The term hazard is defined here as a possible source of danger, and in this report we are specifically referring to landslides as a hazard. The term susceptibility is defined here as capable of being affected by a specified action or process, and in this report the process is mass wasting by means of slope failure or landsliding. The term risk is defined here as the possibility of loss or injury. In this report risk is the overlap of the hazard with assets (such as infrastructure) and their vulnerability to the hazard (Burns and others, 2015).

2.3   Adjacent Landslide Hazard and Risk Projects

Recent landslide hazard projects and, in some cases, risk analysis projects have been completed adjacent to the study area (**Figure 2-3**). This study follows the same methods used for those projects.

Figure 2-3. Recently completed landslide hazard and risk analysis projects (pink areas) near the study area.
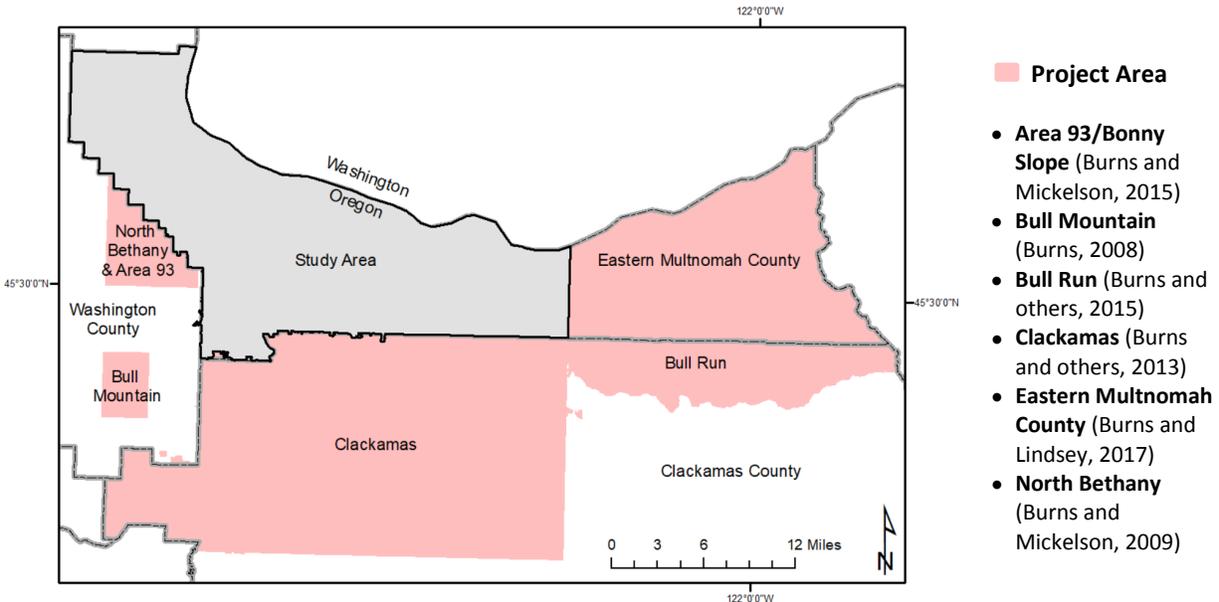
2.4   Engineering Geology

We created bedrock and surficial engineering geologic maps of the study area as input datasets for the deep and shallow landslide susceptibility models described later in this report. Engineering geology maps are commonly based on geotechnical properties and engineering behavior derived from a standard lithostratigraphical geologic map (Dobbs and others, 2012). Such maps are commonly divided into bedrock engineering geology and surficial engineering geology (Keaton and Degraff, 1996).

In general, we followed the methods of Burns and others (2012) and Burns and Mickelson (2016) to create the surficial and bedrock engineering geology maps. A brief geologic history of the study area is described below. For additional information on the bedrock and surficial geology, see Ma and others (2009, 2012).

The oldest rocks belong to the basalt of Waverly Heights and consist of a sequence of subaerial basaltic lava flows deposited during the Eocene (~40 Ma; Ma and others, 2012; Beeson and others, 1989). Subsequently, sediments of the Scappoose Formation were deposited. The Scappoose Formation consists of marine sandstone, siltstone, and claystone deposited during the Miocene. Next, lava of the Columbia River Basalt Group erupted from vents in eastern Oregon, Washington, and western Idaho, and some lavas of the Wanapum Basalt as well as the Grande Ronde Basalt flowed into the Portland Basin.

On top of the Columbia River Basalt Group is a series of sedimentary deposits including the Springwater Formation and Troutdale/Sandy River Mudstone Formations. Sediments that make up these formations were deposited at the end of the Miocene into the Pleistocene and consist of a range of sedimentary types from volcaniclastic to conglomerate to mudstone (Ma and others, 2012). The rocks are

slightly consolidated and generally lack cementation. During approximately the same time period, the Boring Volcanic Field was active in the Portland region (Ma and others, 2012). The lava from the Boring volcanoes is primarily basaltic lava flows but can include scoria and tephra. Many of the Boring deposits are highly weathered, especially near the surface. The weathered material consists of red clay rich soil with relict texture and gravel as well as boulder size weathered basalt corestone pieces.

During the Pleistocene, silt, sand, and gravel were deposited throughout the Portland region by cataclysmic floods (Allen and others, 2009). The Cordilleran ice sheet formed an ice dam along the Clark Fork River, which resulted in the formation of Glacial Lake Missoula. When the ice dam broke, huge floods traveled across eastern Washington, eroding the sediment and carrying it down the Columbia River channel to the Willamette River Valley. This process was repeated at least 40 times, resulting in deposits typically over 200 feet thick. After the floods, eolian silt (loess) was blown onto the Tualatin Mountains and Boring volcanoes. At the same time, large and small rivers in the area were eroding and depositing alluvium.

We simplified the geologic units in the study area into 15 bedrock engineering geologic units on the basis of similar geologic and geotechnical properties (**Figure 2-4**):

Generally Quaternary alluvial rocks:
Coarse-Grained Alluvial Deposits (recent alluvium)
Coarse-Grained Alluvial Deposits (Missoula coarse)
Fine-Grained Older Alluvial Deposits (Missoula fine)
Soft Loess (loess)

Generally Pliocene to Quaternary volcanic and sedimentary rocks:
Weak Severely Weathered Basalt (Boring Lavas)
Weak Coarse-Grained Sedimentary Rock (Troutdale/Springwater)
Weak Fine-Grained Sedimentary Rock (Troutdale/Sandy River Mudstone)
Weak Sandstone (Troutdale, includes Scappoose)

Generally Eocene to Middle Miocene volcanic rocks (CRBG–Columbia River Basalt Group):
Medium Weathered Basalt (CRBG – Wanapum-Priest Rapids Member)
Medium Weathered Basalt (CRBG – Wanapum-Frenchman Springs Member)
Medium Weathered Basalt (CRBG – Grande Ronde-Sentinel Bluffs Member)
Medium Weathered Basalt (CRBG – Grande Ronde-Winter Water Member)
Medium Weathered Basalt (CRBG – Grande Ronde-Ortley Member)
Medium Weathered Basalt (CRBG – Grande Ronde-Wapshilla Ridge Member)
Medium Weathered Waverly Basalt (Basalt of Waverly Heights)

Figure 2-4. Map of generalized bedrock engineering geology in the study area.

Generally Quaternary alluvial rocks:

- Coarse-Grained Alluvial Deposits (recent alluvium)
- Coarse-Grained Alluvial Deposits (Missoula coarse)
- Fine-Grained Older Alluvial Deposits (Missoula fine)
- Soft Loess (loess)

Generally Pliocene to Quaternary volcanic and sedimentary rocks:

- Weak Severely Weathered Basalt (Boring Lavas)
- Weak Coarse-Grained Sedimentary Rock (Troutdale/Springwater)
- Weak Fine-Grained Sedimentary Rock (Troutdale/Sandy River Mudstone)
- Weak Sandstone (Troutdale, includes Scappoose)

Generally Eocene to Middle Miocene volcanic rocks (CRBG-Columbia River Basalt Group):

- Medium Weathered Basalt (CRBG - Wanapum-Priest Rapids Member)
- Medium Weathered Basalt (CRBG - Wanapum-Frenchman Springs Member)
- Medium Weathered Basalt (CRBG - Grande Ronde-Sentinel Bluffs Member)
- Medium Weathered Basalt (CRBG - Grande Ronde-Winter Water Member)
- Medium Weathered Basalt (CRBG - Grande Ronde-Ortley Member)
- Medium Weathered Basalt (CRBG - Grande Ronde-Wapshilla Ridge Member)
- Medium Weathered Waverly Basalt (Basalt of Waverly Heights)

Explanation of Symbols

- Study Area
- River
- Not in Study Area

We simplified the surficial geologic units in the study area into 15 surficial engineering geologic units on the basis of similar geologic and geotechnical properties (**Figure 2-5**). The units are listed below in generally increasing strength (weaker to stronger):

- Man-Made Mixed-Grained Fill
- Landslide (Deep) Deposits
- Talus Deposits
- Fine-Grained Older Alluvial Deposits and Colluvium
- Basalt Fragments and Loess Colluvium
- Loess and Loess-Basalt Colluvium
- Loess
- Fine-Grained Alluvial Deposits
- Coarse-Grained Alluvial Deposits
- Fine-Grained Older Alluvial Deposits
- Coarse-Grained Older Alluvial Deposits
- Residual Soil on Coarse-Grained Sedimentary Rock
- Residual Soil on Fine-Grained Sedimentary Rock
- Residual Soil on Quaternary-Tertiary Basalt
- Residual Soil on Miocene Basalt

Figure 2-5. Map of generalized surficial engineering geology in the study area.

Quaternary Deposits

- Man-Made Mixed-Grained Fill
- Landslide (Deep) Deposits
- Talus Deposits
- Fine-Grained Older Alluvial Deposits and Colluvium
- Basalt Fragments and Loess Colluvium
- Loess and Loess-Basalt Colluvium

Quaternary / Tertiary

- Loess
- Fine-Grained Alluvial Deposits
- Coarse-Grained Alluvial Deposits
- Fine-Grained Older Alluvial Deposits
- Coarse-Grained Older Alluvial Deposits
- Residual Soil on Coarse-Grained Sedimentary Rock
- Residual Soil on Fine-Grained Sedimentary Rock
- Residual Soil on Quaternary-Tertiary Basalt
- Residual Soil on Miocene Basalt

Explanation of Symbols

- Study Area
- River
- Not in Study Area
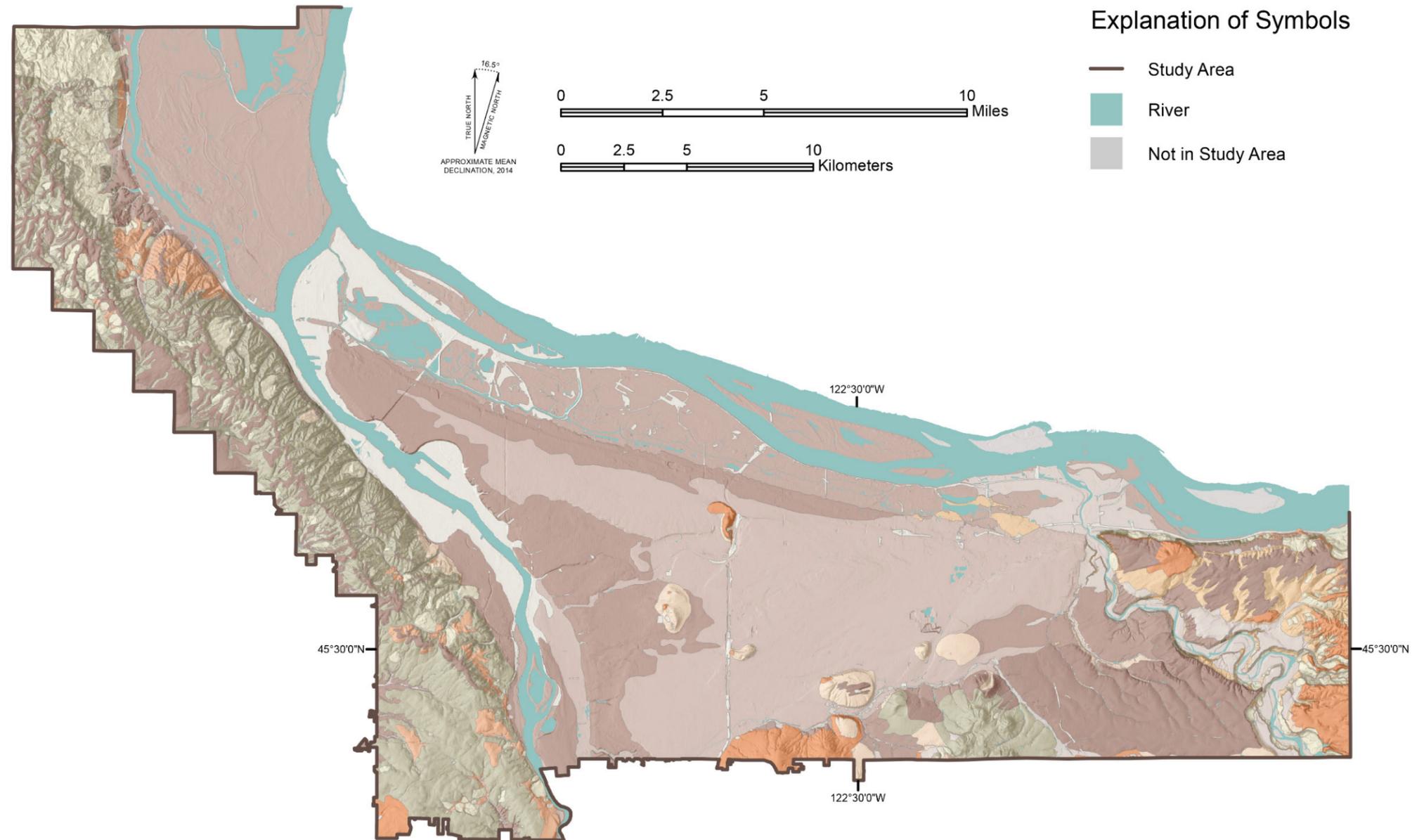
2.5 Landslides

The Federal Emergency Management Agency (FEMA) issued 32 major disaster declarations for Oregon during the period 1953–2016 (https://www.fema.gov/disasters/grid/state-tribal-government/88?field _disaster_type_term_tid_1=All). Most of these disasters were related to storm events that caused flooding and frequently included landslides. During this time, at least seven Presidential Disaster Declarations for Multnomah County noted landslides as part of the reason for the declaration (FEMA Disaster Declarations Summary [Excel spreadsheet], accessed via https://www.fema.gov/media-library/assets/docu-ments/28318):

- 1964 – FEMA DR-184, Oregon Heavy Rains and Flooding
- 1996 – FEMA DR-1099, Oregon Severe Storms/Flooding
- 2004 – FEMA DR-1510, Oregon Severe Winter Storms
- 2006 – FEMA DR-1632, Oregon Severe Storms, Flooding, Landslides, and Mudslides
- 2009 – FEMA DR-1824, Oregon Severe Winter Storm, Record and Near Record Snow, Land-slides, and Mudslides
- 2011 – FEMA DR-1956, Oregon Severe Winter Storm, Flooding, Mudslides, Landslides, and Debris Flows
- 2016 – FEMA DR-4258, Oregon Severe Winter Storms, Straight-line Winds, Flooding, Land-slides, and Mudslides

The increase in declared disasters in recent decades is likely due to a combination of 1) improved re-porting, recording, and communications because of the onset of digital technology during this time period and 2) development into areas with relatively higher landslide hazards.

There are many historic (<150 years ago) and prehistoric (>150 years ago) landslides in the study area, which increase the current landslide risk. In 2012, DOGAMI finished mapping the existing landslides following the method outlined by Burns and Madin (2009). There are 1,996 landslides, which cover 8% of the study area (Plate 1). There are 820 shallow and 781 deep landslides. These landslides were one of the primary inputs into the models used for the current project to create the shallow and deep landslide susceptibility maps.

There are several well-known large deep landslides in the City of Portland including the Zoo Landslide (also known as the Ancient Highlands Landslide) and the Washington Park Landslide. The Oregon Zoo and the residential neighborhood to the west are located on the Zoo Landslide (Hammond and Vessely, 1998). Portions of this extensive prehistoric landslide have been reactivated during construction on High-way 26 in the 1950s and 1960s. In 1998, TriMet (the Oregon Tri-County Metropolitan mass transit oper-ator) installed an elevator shaft through the Zoo Landslide to the light rail tunnel below (https:// trimet.org/pdfs/history/railfactsheet-westside.pdf). A complex dewatering system was installed to re-duce the likelihood of the Zoo Landslide from moving in the future and damaging the transportation sys-tem. The Washington Park Landslide (sometimes referred to as the Phenomenal Landslide) is located adjacent and west of the northwestern portion of downtown Portland (Clark, 1904). In the 1890s, the City of Portland constructed two drinking water reservoirs in Washington Park, which caused a portion of an existing landslide to reactivate (Cornforth, 2005). The landslide is described in detail by Clark (1904). The new lidar-based mapping revealed the extent of the original pre-historic landslide, which encompasses the historic Washington Park Landslide (Plate 1). In 1993, the M5.6 Scotts Mills Earthquake shook the region. This shaking caused the Washington Park Landslide to make a jump in the rate of movement

(Cornforth, 2005). Both landslides are examples of historic reactivation of a deep landslide within an older prehistoric landslide complex.

There are several well-known large deep landslides outside of the City of Portland but within the study area. These include the Wildwood and the Dutch Canyon Landslide Complexes in the northwestern portion of Multnomah County (Plate 1; Madin and Niewendorp, 2008). In the eastern portion of the study area, there are numerous large deep landslides along the Sandy River, especially where the weak sedimentary rocks of the Troutdale Formation crop out on the surface.

Several recent events have caused widespread landsliding in the study area. The most notable is the February 1996 storm event, a 100-year event (Burns and others, 1998). Burns and others mapped 705 landslides that occurred during this event and concluded that these landslides were concentrated in certain geological provinces, including the Tualatin Mountains (Portland Hills), steep bluffs along the rivers, the fine-grained Troutdale Formation area, and the valley bottoms. The landslide inventory and hazard regions map by Burns and others (1998) has been used by the City of Portland and others for two decades.

The combination of FEMA declared disasters, hundreds of prehistoric landslides, and hundreds of historic landslides provide good evidence of a significant level of landslide hazard and risk in the study area. Therefore, these data attest to the need to continue landslide risk reduction in this area.

3.0   METHODS

To evaluate the landslide hazard and risk for the study area, we performed three primary tasks: 1) compiled and created landslide hazard data including landslide inventory and susceptibility, 2) compiled and created asset data including critical facilities, roads, generalized land occupancy (land use/zoning), buildings, and population distribution data, and 3) performed risk analysis including exposure and Hazus-based risk analysis. **Figure 3-1** summarizes the hazard and asset datasets needed for the risk analyses and where the results of the analyses can be found.

Figure 3-1. Input datasets and results. SP-42 is Special Paper 42 (Burns and Madin, 2009). LS is landslide. SLIDO 3.2 is Statewide Landslide Information Database for Oregon, release 3.2 (Burns, 2014). Hazus-MH is Hazus-MH, version 2.1, loss estimation data (FEMA, 2011).
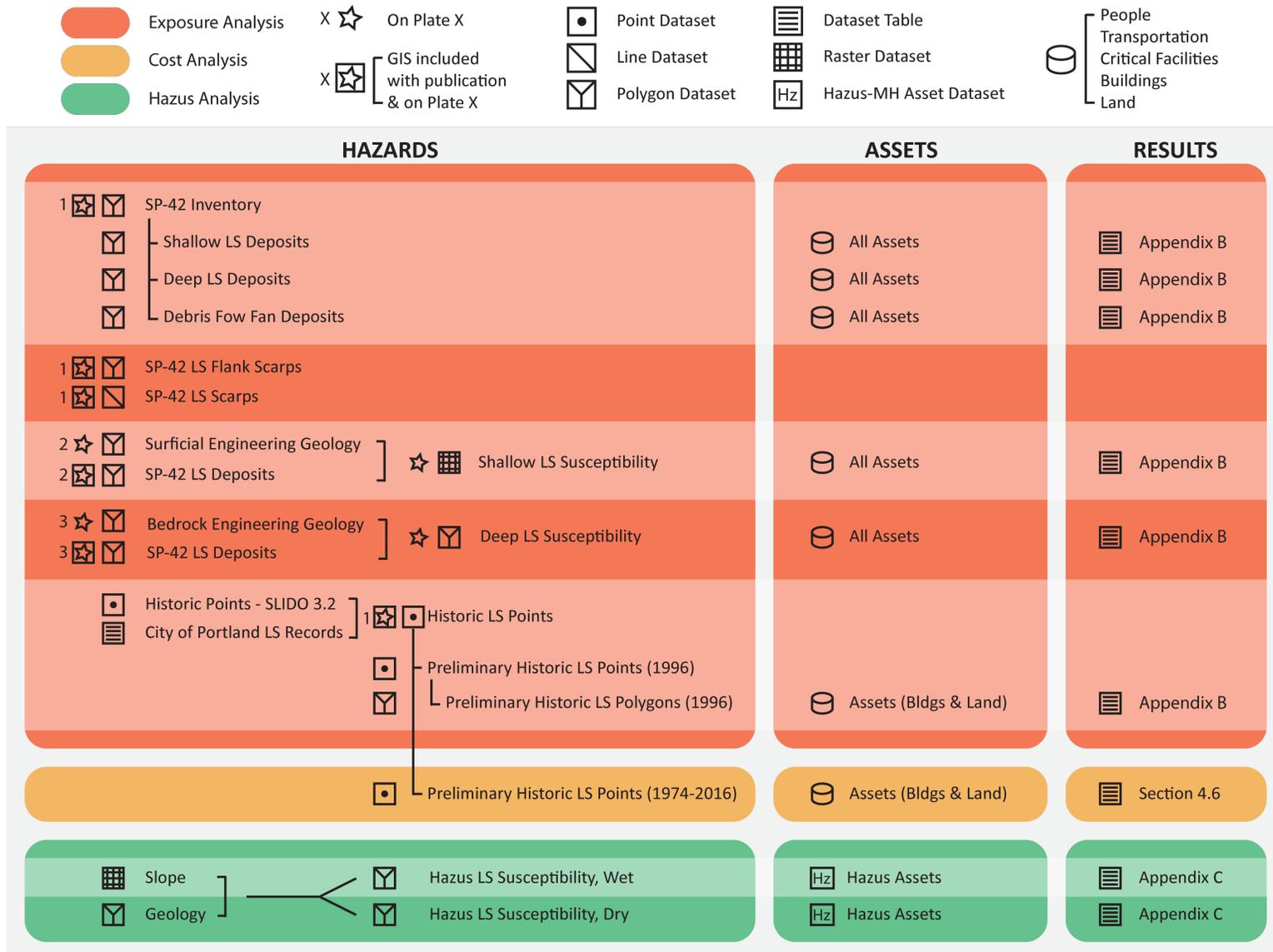
3.1   Landslide Hazard Evaluation Methods

First, we compiled the detailed lidar-based landslide inventory. Lidar data are from laser imaging of the ground surface from an airplane. Lidar data provide high-accuracy elevation imagery of the ground surface without vegetation and buildings, which makes mapping landslide scarps and morphology much easier (Burns, 2007). Then, we updated the historic landslide inventory inside the City of Portland boundary. Because both these datasets are landslide inventories but are different types of landslide inventories, we will refer to the lidar-based polygon inventory as the *SP-42 inventory* (**Figure 3-1,** DOGAMI Special Paper 42; Burns and Madin, 2009) and the historic point inventory as the *historic landslide points inventory* throughout this paper. Next, we used models to create shallow and deep landslide susceptibility. The methods we used to perform analysis with and create these datasets are described in detail in the following sections of this report and are the same methods DOGAMI uses for landslide hazard mapping projects throughout Oregon.

3.1.1   Landslide inventories

The SP-42 inventory was compiled from existing publications following the methodology of Burns and Madin (2009) to create the landslide inventory at a recommended use scale of 1:8,000. The data were extracted from the Statewide Landslide Information Database for Oregon (SLIDO), release 3.2 (Burns, 2014).

A subset of the final combined *historic landslide points* inventory that occurred during 1996 has length and width attributes. These were used to create a dataset of rectangular polygons used to perform exposure analysis (section 3.3.1.1).

The historic landslide point dataset was created by compiling two existing datasets: 1) SLIDO-3.2 and 2) City of Portland historic landslide records. We began the compilation by extracting historic landslide points from SLIDO-3.2. The City of Portland historic landslide records were provided by Ericka Koss (written communication, 2016). The City of Portland landslide dataset consists of 1,481 records with dates ranging from 1928 to 2013 with a wide range of attributes including a street address, landslide dimensions, landslide type, and date. Additional data from 2014–2016 was also provided by the City of Portland. However, there was no spatial component (GIS) to these datasets, so a process combining GIS (tax lots, streets, lidar hillshade, aerial photos) and Google Earth® (street addresses, imagery) was followed to convert the City of Portland dataset into a GIS dataset (Appendix A). Also, it was discovered that many of the landslides in the SLIDO-3.2 dataset had duplicates in the City of Portland dataset, so a process combining GIS and address and other matching attributes was followed to remove duplicates (see Appendix A). The final version of this dataset is included with this publication and is referred to as *historic landslide points (*Figure 3-1)**.

A subset of the final combined *historic landslide points* inventory that occurred during 1996 has length and width attributes. These were used to create a dataset of rectangular polygons used to perform exposure analysis (section 3.3.1.1).

A preliminary version of the *historic landslide points* (*preliminary historic landslide points*) was used in this study to estimate losses from landslides (Burns and others, 2017). This previous study used the *preliminary historic landslide points* (**Figure 3-1)** dataset, which contains 1,806 landslide records from 1928 through the first half of 2016 located inside the City of Portland. Some of these 1,806 records were later deemed duplicates or non-landslide events and removed from the *historic landslide points* dataset included with this publication (Erika Koss, written communication, 2017).

3.1.2 Shallow landslide susceptibility

We created the shallow landslide susceptibility map by following the shallow-landslide susceptibility (**Figure 3-1**) mapping methodology of Burns and others (2012). The main components of the method include:

1) using a landslide inventory,
2) calculating regional slope stability factor of safety (FOS),
3) removing isolated small elevation changes (to reduce overprediction),
4) creating buffers to add susceptible areas missed in a grid-type analysis (to reduce underprediction), and
5) combining the four components into final susceptibility hazard zones.

The first component was taken directly from the landslide inventory created as part of this project. The calculation of the FOS requires several input datasets. One is a map of the surficial geology with geotechnical material properties. As discussed in section 2.3, we created a new surficial engineering geology map during this project. Instead of using existing generalized statewide values (Burns and others, 2012, Table 2), we created a new table of material properties (**Table 3-1**) for each of the primary surficial engineering geologic units in this specific study area. To calculate the FOS (component 2), we estimated new material properties from adjacent past studies including Clackamas, Bull Run, and North Bethany/Area 93 (**Figure 2-3**).

After we acquired the material property values either directly from past studies or through correlations for each surficial geologic unit, we averaged each set of values by geologic unit. DOGAMI staff and Portland Water Bureau geotechnical engineers then reviewed these ranges of values and the averaged values in order to decide the final material properties to be used for this study. These properties are listed in **Table 3-1** and were used to calculate the two slope thresholds that separate the three FOS ranges. The three FOS ranges are 1) values greater than 1.5 (generally considered stable), 2) values between 1.25 and 1.5 (generally considered potentially unstable), and 3) values below 1.25 (generally considered potentially unstable and unstable below 1.0).

Table 3-1. Summary of geotechnical material properties for primary surficial geologic engineering units in the study area.

Primary Surficial Geologic Engineering Unit	Angle of Internal Friction (degrees)	Cohesion (lb/ft²)	Unit Weight (Saturated lb/ft³)	Slope Threshold For Stable (FOS > 1.5) (degrees)	Slope Threshold For Potentially Unstable (FOS > 1.25) (degrees)
Landslide (Deep) Deposits	28	0	115	9.0	10.5
Man-Made Mixed-Grained Fill	28	0	115	9.0	10.5
Basalt Fragments and Loess Colluvium	28	0	115	9.0	10.5
Loess and Loess-Basalt Colluvium	28	0	115	9.0	10.5
Talus Deposits	30	150	115	13.0	15.5
Fine-Grained Older Alluvial Deposits and Colluvium	28	0	115	9.0	10.5
Coarse-Grained Alluvial Deposits	32	0	115	10.5	12.5
Coarse-Grained Older Alluvial Deposits	34	0	115	11.0	13.5
Fine-Grained Alluvial Deposits	30	0	115	9.5	11.5
Fine-Grained Older Alluvial Deposits	30	150	115	13.0	15.5
Loess	30	150	115	13.0	15.5
Residual Soil on Coarse-Grained Sedimentary Rock	40	0	115	14.0	16.5
Residual Soil on Fine-Grained Sedimentary Rock	30	200	115	14.5	16.5
Residual Soil on Miocene Basalt	28	500	115	20.0	24.0
Residual Soil on Quaternary-Tertiary Basalt	28	500	115	20.0	24.0

To remove isolated small elevation changes (to reduce overprediction—component 3) and to add susceptible areas missed in a grid-type analysis (to reduce underprediction—component 4), we created buffers as described in detail by Burns and others (2012. When the FOS class map is prepared using a slope map with such high resolution, many areas with shallow landslide susceptibility are falsely classified as having moderate or high susceptibility (overprediction). This occurs because many fine-scale topographic features are represented in the lidar DEM that do not have sufficient vertical or lateral extent to pose a significant shallow landslide hazard. This could include features like road ditches. One disadvantage of a slope stability analysis using a raster or grid-type infinite slope equation is that the analysis looks at each raster cell independently. The FOS is calculated in the same way regardless of where the cell falls on a slope or where it sits in relation to important topographic features or changes. Because the location of a cell can have an important impact on the landslide susceptibility, DOGAMI developed these two buffers to help reduce underprediction.

3.1.3 Deep landslide susceptibility

We created the deep landslide susceptibility map by generally following the methodology of Burns and Mickelson (2016; SP-48; **Figure 3-1**). Deep landslides were defined by Burns and Madin (2009) as having a failure surface greater than 15 feet deep. The main components of the method include:

1) using a landslide inventory
2) creating buffers (hazard zone expansion areas)
3) combining the following four factors to determine the moderate susceptibility zone:
   a. susceptible geologic units
   b. susceptible geologic contacts
   c. susceptible slope angles for each engineering geology unit polygon
   d. susceptible direction of movement for each engineering geology unit polygon
4) combining components 1–3 into final susceptibility hazard zones

For each component and factor we made separate GIS data layers. The first component is taken directly from the landslide inventory created as part of this project. Because many deep landslides move repeatedly over hundreds or thousands of years, and commonly the continued movement is through retrogressive failure or upslope failure of the head scarp, we applied a buffer (expanded the hazard zone) to all mapped deep landslide deposits.

Next, we used four factors to determine the moderate zone. The first factor, geologic units, has a relatively widespread correlation with surficial processes. For example, it is very common that certain rock formations or soil types are more, or less, prone to landslides. This is generally due to the properties of the rock or soil, such as the material strength or bedding planes.

The second factor is geologic contacts. We have observed in Oregon, especially since we began mapping landslide inventories using lidar (Burns and Mickelson, 2016) that many landslides occur along a contact, especially when sedimentary or volcaniclastic rock is covered by hard volcanic rock. For example, large, deep landslides are located next to each other along the contact between the overlying basalt of the Weak Severely-Weather Basalt (Boring Lavas) and the underlying Weak Fine-Grained Sedimentary Rocks (Troutdale/Sandy River Mudstone) along the Sandy River in the eastern portion of the study area. Most of the failure surfaces of these landslides are almost completely within the Rhododendron Formation, so they are not failing or sliding along the "geologic contact" in the sense that the failure plane follows the contact below ground. It is more of a spatial relationship between the landslides and the contact surface trace in map view; this relationship is most likely caused by erosion or downcutting at the surface, which leads to exposure of the underlying weaker unit.

The third factor, slope angles, is very commonly correlated with landslide susceptibility. Most landslide susceptibility maps use slope as the primary factor or as at least one of the factors to predict future landslide locations. It is very common to see more shallow landslides associated with steeper slopes. Deep landslides appear to have a less direct correlation with slope steepness, which is one reason to include the other three factors (geologic units, geologic contacts, and direction of movement).

Finally, the fourth factor is the direction of movement, which is recorded for every landslide in our landslide inventory. A standard factor to examine during site-specific evaluations is the local bedding dip and dip direction, because deep landslides tend to fail along those bedding planes and in the direction of the dip, especially where slope and dip are in the same direction. Unfortunately, we do not have extensive dip and dip direction measurements. Therefore we used the recorded direction of movement from the landslide inventory database as a proxy for dip direction or preferred direction of movement.

We then added together the four GIS data layers made from the factors to delineate the line between the moderate and low hazard zones (Plate 3). Then we combined the four component GIS layers to create the deep landslide susceptibility map with low, moderate, and high hazard zones.

3.1.4 Landslide susceptibility for Hazus

We performed a type of risk analysis with Hazus, a risk modeling software package developed by FEMA (FEMA, 2011). The Hazus landslide susceptibility map (created for input into Hazus earthquake module, **Figure 3-1**) follows a specific method outlined in the Hazus technical manual (FEMA, 2011). We created both "dry" and "wet" Hazus landslide susceptibility maps for the study area (**Table 3-2**).

Table 3-2. Landslide susceptibility of geologic groups (Hazus-MH 2.0, Table 4-15 [FEMA, 2011])

		Slope Angle, degrees					
	Geologic Group	0–15	10–15	15–20	20–30	30–40	>40
	(a) Dry (groundwater below level of sliding)						
A	Strongly Cemented Rocks (crystalline rocks and well-cemented sandstone, c' = 300 psf, φ' = 35°)	none	none	I	II	IV	VI
B	Weakly Cemented Rocks (sandy soils and poorly cemented sandstone, c' = 0, φ' = 35°)	none	III	IV	V	VI	VII
C	Argillaceous Rocks (shales, clayey soil, existing landslides, poorly compacted fills, c' = 0, φ' = 20°)	V	VI	VII	IX	IX	IX
	(b) Wet (groundwater level at ground surface)						
A	Strongly Cemented Rocks (crystalline rocks and well-cemented sandstone, c' = 300 psf, φ' = 35°)	none	III	VI	VII	VIII	VIII
B	Weakly Cemented Rocks (sandy soils and poorly cemented sandstone, c' = 0, φ' = 35°)	V	VIII	IX	IX	IX	X
C	Argillaceous Rocks (shales, clayey soil, existing landslides, poorly compacted fills, c' = 0, φ' = 20°)	VII	IX	X	X	X	X

3.2 Asset Data Compilation and Creation Methods

Next, we compiled and created asset datasets that included permanent population distribution, buildings and land, critical facilities, and roads. We overlaid these asset datasets along with the *SP-42 inventory* and shallow and deep landslide susceptibility datasets to evaluate exposure of the assets to the landslide hazard. We followed the same general methods to create and perform exposure outlined by Burns and others (2013) in Clackamas County.

3.2.1 Permanent population distribution dataset

Permanent population (resident) figures are needed to accurately estimate losses from disasters. However, it is challenging to map this asset because people tend to travel on yearly, seasonal, monthly, daily, and hourly bases.

In the study area, U.S. Census population data are organized in spatial units called census block-groups. Block-groups are statistical divisions of census tracts and generally contain between 600 and 3,000 people. Blocks can be as small as 125 acres (50 hectares) and are typically bounded by streets, roads, or creeks. In urban areas census blocks are small, usually defined by one city block, while in rural areas with fewer roads, blocks are larger and can be bound by other geographic and geomorphic features. Within each block-group the census provides no information on the spatial distribution of population. The census

provides only one population number per block-group (**Figure 3-2**). To estimate the size and distribution of permanent population for most of the study area, we used the dasymetric mapping method developed by the U.S. Geological Survey (Sleeter and Gould, 2007). Dasymetric mapping is a process that allocates population data to residential units. Datasets like land cover and census data are used in the dasymetric process to more precisely map population over an area. To assess and geographically distribute permanent population within the study area, we created a dasymetric population grid ($62ft^2$). To make improvements to the population distribution we also used tax lots, which differentiate lots that generally have people living on them from those that do not. We also used building footprints to determine the likely locations of people within those tax lots designated as residential (**Figure 3-2**).

Figure 3-2. Dasymetric population distribution map input data and result examples.

3.2.2 Buildings and land

DOGAMI acquired and edited building locations from Metro's (the Portland, Oregon, metropolitan area regional government) Regional Land Information System (RLIS; Metro, 2015). Parts of the study area were not covered by the RLIS data, so DOGAMI staff digitized the buildings in those areas. To do this, we converted digital elevation models (DEMs, derived from lidar first returns) to hillshade imagery and used these together with orthophotos to locate building locations. After we finalized the generalized land-use GIS layer, we transferred the improvement values and generalized land-use categories from the tax lot dataset into the building dataset.

Zoning refers to the permitted land use designation such as agricultural, industrial, residential, recreational, or other land-use purposes. Zoning data are commonly included in tax lot databases along with land-use designations. Data from tax lot databases also include information about the dollar value of the land and any improvements, such as houses. To evaluate land assets for this project, we combined county and city tax lot databases to create a layer that identifies generalized land use (residential, commercial, or public) information for each piece of property.

While creating the generalized tax lot dataset, we noticed the lack of dollar value for most public land and therefore recommend all public values be considered underestimates.

We created the generalized tax lot dataset with available property tax code data file for Multnomah County acquired from RLIS. Starting with the generalized zoning dataset, we then assigned each tax lot a generalized use of residential, commercial, or public. We classified generalized use classes from the parcel's defined chief zoning and land-use of the property. This methodology potentially introduces errors where the tax code for a parcel might not reflect real infrastructure or use at time of publication. We classified selected property that had no ownership information or property tax code according to occupancy class seen in or estimated from orthophotos. We classified government and education occupancy parcels from existing critical facility datasets. Community (sometimes jurisdictional) boundaries were manually populated, so that parcel counts were not duplicated during inventory/exposure analysis. In scenarios where parcels crossed multiple community boundaries, we selected the community to which the parcel appeared to be most appropriately associated.

3.2.3 Critical facilities

Critical facilities are typically defined as emergency facilities such as hospitals, fire stations, police stations, and school buildings (FEMA, http://www.fema.gov/national-flood-insurance-program-2/critical-facility). We used the definitions and data created for the DOGAMI Statewide Seismic Needs Assessment (SSNA; Lewis, 2007) to identify the critical facilities. The critical facilities included in this project are schools, police stations, fire stations, and hospitals. We extracted critical facilities as points from the SSNA. These points were buffered into polygons, which were used to complete the exposure analysis.

3.2.4 Roads

Roads were divided into three categories:
- freeways, highways, and major arterials
- minor arterials and collectors/connectors
- local streets

We acquired the road and railroad data from RLIS (Metro, 2015). We found the railroad data to have significant spatial error when compared to the lidar-based imagery, so we did not include them in the analysis.

3.3   Risk Analysis Methods

When landslides affect assets, landslides become natural hazards. Natural hazard risk assessment is the characterization of the overlap of natural hazards and assets. Risk analysis can range from simple to complicated. In this project we selected two types of regional risk analysis: 1) hazard and asset exposure, and 2) Hazus-MH analysis. Hazus-MH is a multi-hazard (MH) analysis program that estimates physical, economic, and social impacts of a disaster (FEMA, 2011). To better understand the risk, we also collected historic landslide data for the study area and estimated actual historic losses.

3.3.1   Exposure analysis

A building is considered to be exposed to the hazard if it is located within a selected hazard area. We performed exposure analysis with Esri ArcGIS software. We determined exposure through a series of spatial and tabular queries between hazards and assets. We then summarized the results by community (**Table 3-3**). Landslide hazard datasets used in the exposure analysis are:

- shallow landslides (inventory polygons; see section 3.1.1)
- deep landslides (inventory polygons; see section 3.1.1)
- debris flow fans (inventory polygons; see section 3.1.1)
- 1996 landslide historic points converted to polygons in the City of Portland (see section 3.3.1.1)
- shallow landslide susceptibility (low, moderate, and high—see section 3.1.2)
- deep landslide susceptibility (low, moderate, and high—see section 3.1.3)

Asset data (section 3.2) used in the exposure analysis are:
- population (people per 62 ft^2)
- buildings and land in three generalized use classes: residential, commercial, and public
  - buildings reported by count, count percent of total, and value (dollars)
  - land reported by count, count percent of total, area (square feet and acres), area percent of total, value (dollars)
- critical facilities buildings: fire stations, police stations, and school buildings
  - buildings reported by count, count percent of total, and value (dollars)
- roads: freeways, highways and major arterials—lines
  - report by length (feet and miles), and percent of total

In other words, we used GIS to find which community assets fell in which hazard zones. For example, we superimposed the buildings layer for the study area on the deep-landslide high-susceptibility zone layer to determine which buildings are exposed to that level of hazard. The result of this analysis is both a map of the community assets exposed to the hazard and a table with the corresponding numbers of community assets exposed.

Table 3-3. Communities for exposure reporting. Community extents are shown in Figure 2.

Community	Area (mi²)
Multnomah County (West/Central; Maywood Park)	121.7
City of Fairview	3.4
City of Gresham	23.5
City of Troutdale	6.1
City of Wood Village	0.9
City of Portland Neighborhoods	
Central City (CENT)	4.7
Airport	8.6
Neighbors West/Northwest (NWNW)	19.3
Southeast Uplift Neighborhood (SEUL)	21.1
North Portland Neighborhood (NPNS)	27.5
East Portland Neighborhood (EPNO)	29.0
Northeast Coalition Neighborhood (NECN)	7.2
Central Northeast Neighborhood (CNN)	10.5
Southwest Neighborhood (SWNI)	17.9
City of Portland (total)	145.7

3.3.1.1 Exposure analysis of City of Portland 1996 event landslide points converted to polygons

Point data cannot be used to perform exposure analysis, so we converted the points to polygons. The method used to calculate exposure on the 1996 event landslides was performed on the *preliminary historic landslide points* (Burns and others, 2017). As previously mentioned, the preliminary dataset has 1,806 landslide records from 1928 through the first half of 2016 (**Figure 3-3**).

The concentration of historic landslides in certain neighborhoods (**Figure 3-3**) is due to several geologic and geomorphic conditions. Northwest and southwest of the Willamette River (neighborhoods NWNW and SWNI) the surficial geologic conditions often consist of loess deposits overlying bedrock and steep topography created by the Portland Hills anticline (Evarts and others, 2009). The landslide pattern in the NPNS neighborhood follows the rivers bluff, a high-relief feature caused by the catastrophic Missoula floods.

Figure 3-3. Map of the 1,806 preliminary historic landslide points (red dots) recorded for the period 1928–2016 (Burns and others, 2017).
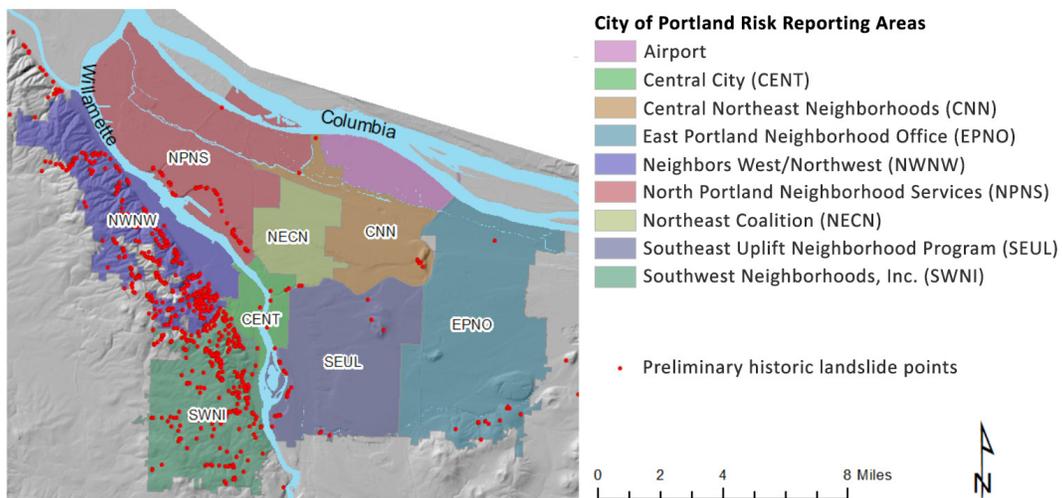
The *preliminary historic landslide points* and *historic landslide points* include point location data, rather than a polygon that represents areal extent of a landslide. Records often contained limited or generic site information, such as only an address, which was not enough detail to create a polygon.

Of the 1,806 landslides, 831 occurred during 1996. Records often contained limited or generic site information, such as only an address, which was not enough detail to create a polygon. However, records for 457 of the 891 landslides (*preliminary historic landslide points*) that occurred during the 1996 event (**Figure 3-4**) included length and width data for the landslide. Drazba (2008) created simple polygons for some of these points; we augmented these with more simple polygons for application in exposure analysis (**Figure 3-5**).

Figure 3-4. Map showing locations of the 457 *preliminary historic landslide points* from the 1996 event that have landslide length and width data. Detail map shows some of the 1996 event points expanded to landslide polygons for exposure analysis.
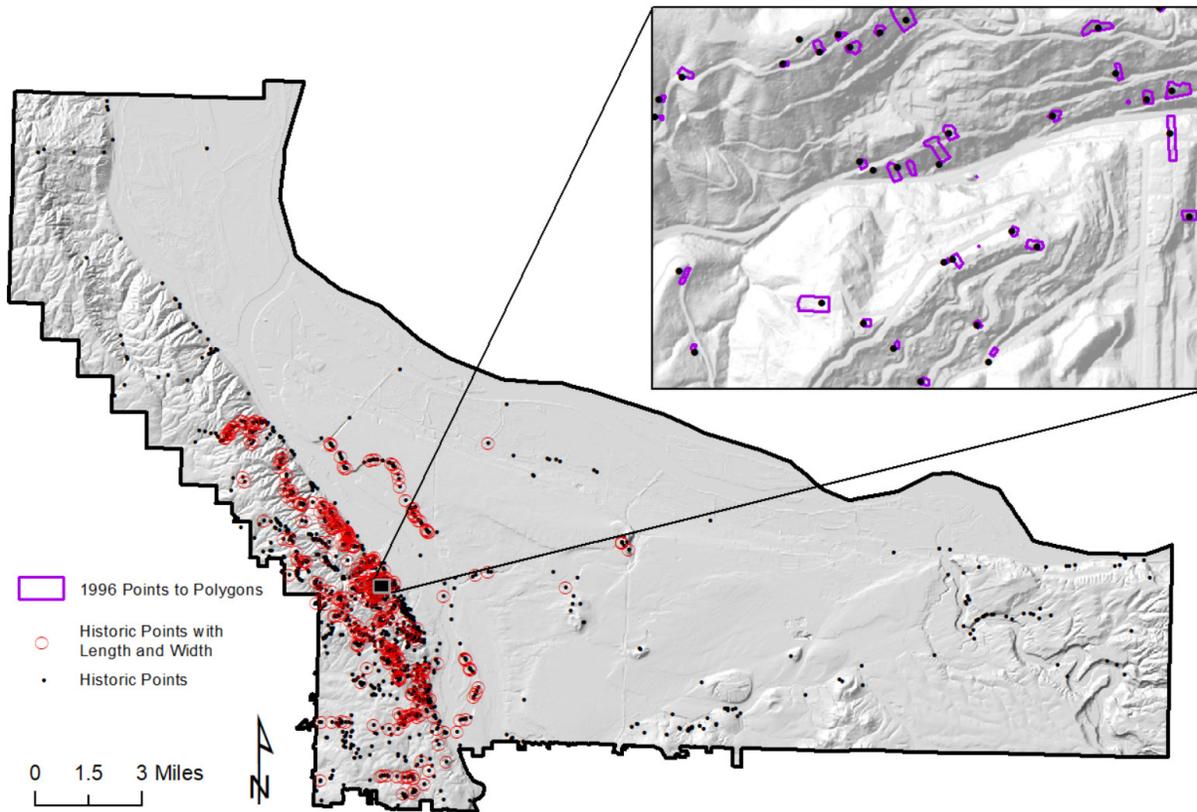
Using the 457 *preliminary historic landslide points* converted to polygons, we calculated land and building exposure values by using the area of the generated landslide polygon. While examining the tax lot values, we noticed the significant lack of dollar values for public land. Of these 457 polygons, only 177 (39%) were located with more than 50 percent of their area overlapping private land. Therefore, we performed this exposure analysis on only the 177 landslides located predominantly on private tax lots. Instead of including the entire house value if touched by a landslide, as previously done in exposure analysis, we combined the building and land values and distributed the total value equally across the lot in the exposure calculation. We used this method to reduce inflated exposure when including the entire building value. Distribution of the structure value over the property also provides a proxy method to account for other exposed improvements such as driveways, retaining walls, and outbuildings, which are commonly damaged in landslides (**Figure 3-5**).

Figure 3-5. Schematic showing the difference in landslide exposure value for landslide point (solid black dot) data versus landslide polygon (hashed rectangle) data in the same parcel.
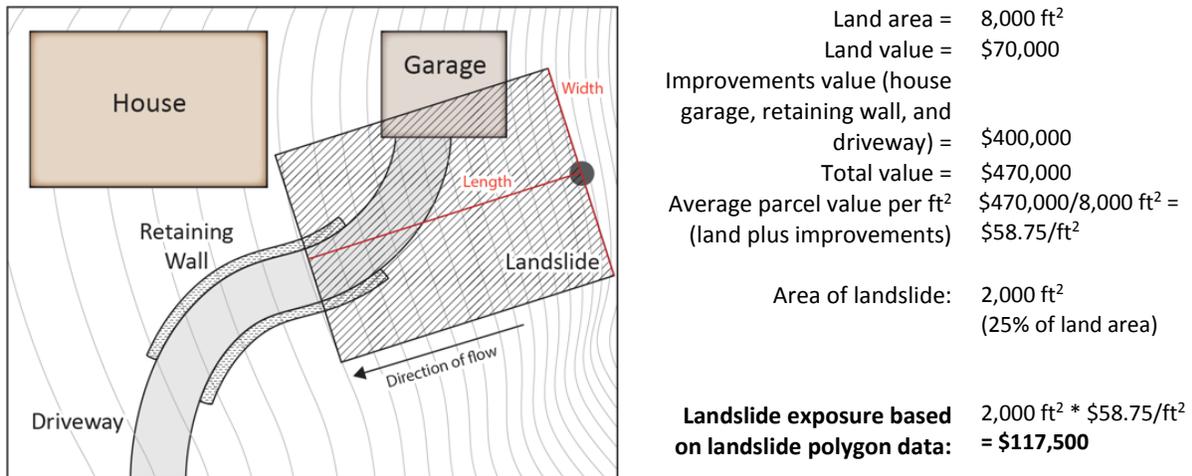
Gray lines are elevation contours.

Land area =	8,000 ft^2
Land value =	$70,000
Improvements value (house garage, retaining wall, and driveway) =	$400,000
Total value =	$470,000
Average parcel value per ft^2 (land plus improvements)	$470,000/8,000 ft^2 = $58.75/ft^2
Area of landslide:	2,000 ft^2 (25% of land area)
Landslide exposure based on landslide polygon data:	2,000 ft^2 * $58.75/ft^2 = **$117,500**

3.3.2 Hazus-MH analysis

We performed the second type of risk analysis with Hazus-MH, a multi-hazard risk modeling software package developed by FEMA, the National Institute of Building Sciences (NIBS), and other public and private partners (FEMA, 2011). Hazus software can be used to model a variety of earthquake, flood, and wind probabilistic hazards and/or hazard event scenarios. Although Hazus-MH has limitations, we chose to use Hazus-MH as part of our risk analysis because it is the only widely and publicly available risk analysis program with data for the United States that can produce casualty and fatality estimates. We also focused on loss ratios rather than absolute numbers, because we know that absolute numbers can be inaccurate at the local scale. For example, instead of examining the absolute count of buildings at various levels of damage, we looked at the ratio of the estimated damaged buildings to the total buildings in the Hazus-MH database. Although the absolute numbers may be inaccurate, the ratios are very likely in the realistic range and could be applied to the much more accurate local database to obtain a realistic absolute number.

To work around the lack of a landslide scenario module in Hazus-MH, we used the earthquake module with and without earthquake-induced landslide hazards. Then we subtracted the earthquake-without-

landslides model results from the earthquake-with-landslides model results so that earthquake-induced landslide damage and losses could be examined separately.

Default hazard and asset databases are included with the Hazus-MH program. Most data are based on national-scale information that generally does not accurately reflect local conditions. To better account for local variability, the software is designed to incorporate user-specific updates to the hazard and asset databases (FEMA, 2011). To update the asset database, detailed building-specific data must be collected.

The smallest areal extent allowed for analysis in the Hazus earthquake module is the census tract level. We selected the 171 census tracts that best represent the study area (**Figure 3-6**). Although the extent of the 171 tracts is in some places larger than the study area and in some places smaller, overall an analysis extent based on tract level best represented the study area. One limitation of Hazus is that census tract areas can be too coarse for small areas mapped as hazard zones.

Figure 3-6. Map of the 171 census tracts used in Hazus analysis, risk reporting areas/community boundaries, and study area.
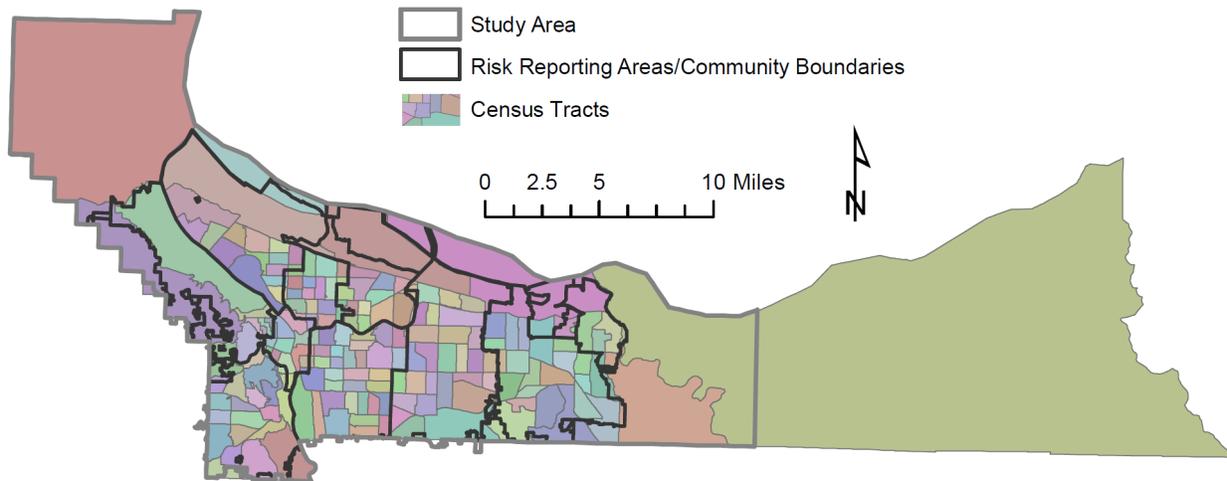
The goal for our Hazus analysis was to estimate damage and losses from two kinds of earthquakes (local crustal and Cascadia Subduction Zone), both with and without earthquake-induced landslides, so that we could examine the difference in damage and losses caused by just the earthquake-induced land-slides. We also ran landslides in dry and wet conditions (see **Table 3-2**) for each scenario to make sure the changes were continuing above the analysis level (detailed landslides). This resulted in six different Hazus analyses (see Appendix C):

- Portland Hills Fault (local crustal)
  - No landslides
  - Landslides Dry
  - Landslides Wet
- Cascadia Subduction Zone
  - No landslides
  - Landslides Dry
  - Landslides Wet

3.3.3 Annualized loss

To better understand landslide risk, we used the *preliminary historic landslide points* dataset to estimate the annualized loss in the City of Portland. Of the 1,806 landslides in that dataset, 831 occurred during 1996 and are located in the City of Portland. Further examination of the data found incomplete records or lack of data collection from 1928 to 1973 (**Figure 3-7**). If the 831 landslides that occurred in the City of Portland in 1996 are excluded, records from 1974 to 2016 result in an average of 20 recorded landslides per year, providing a minimum annual estimate for the City of Portland (**Figure 3-7**, insert chart).

Figure 3-7. Chart of all *preliminary historic landslide points* in the City of Portland displayed as number of land-slides per year from 1928–2016 and (inset chart) 1974–2016 (Burns and others, 2017).
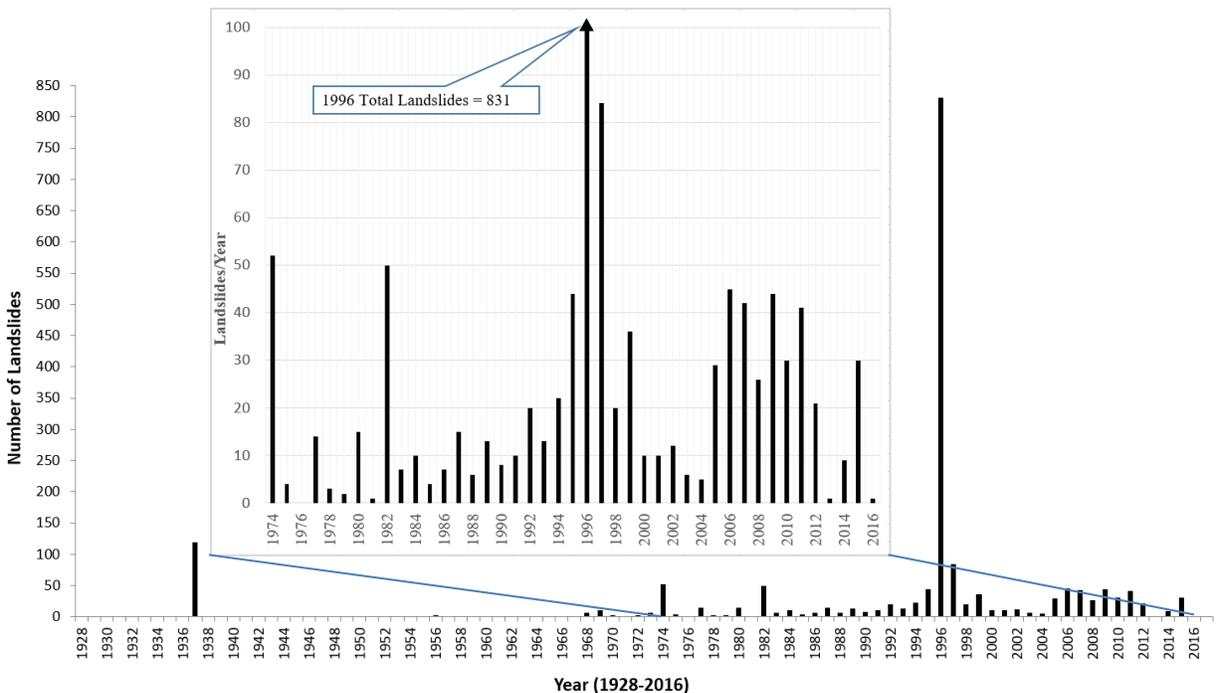
This portion of the project was published with greater detail in the Third North American Symposium on Landslide conference proceedings, titled Estimating Losses from Landslide in Oregon, however a brief overview is provided below (Burns and others, 2017). All values in this paper were converted to 2016 dollars by using http://www.usinflationcalculator.com/. In this study, we performed the following tasks:

- o Examined original loss estimates for the 1996 events from Wang and others (2002). This was mostly losses on public property.
- o Performed exposure analyses with the City of Portland 1996 event landslide points con-verted to polygons on private property (see section 3.3.1.1 of this report).
- o Compiled cost data from permits for landslide repair on private property (2000–2013)
- o Compiled total loss data for landslides that occurred during the winter of 2015- 2016.

We examined the data listed above using simple statistics including mean and range. The results of this analysis are summarized in **Table 3-4**.

Table 3-4. Summary of annualized loss estimates (2016 dollar values).

Dataset	Estimated Mean Dollars per Landslide	Estimated Loss in Typical Year (20 Landslides)	Estimated Loss in Extreme Year
Public land (extrapolated from 1996 data)	$67,600#	$1.4M	$34M
Public land (extrapolated from 1996 data)	$102,500##	$2.1M	$34M
Private land exposure (1996 landslide polygons)	$144,000	$2.9M	$47M*
Private land (1996 permits)	$99,000	$1.9M	$32M*
Private land (permits 2000–2013)	$93,100	$1.9M	$30M*
Private and public land (2015-2016 season)	$67,500	$1.4M	$56M**

#507 landslides; includes recreational land such as parks or greenspaces, which may have minimal infrastructure, or damageable property.

##333 landslides; does not include recreation land.

*324 landslides on private land multiplied by mean per landslide.

**831 landslides on private and public land multiplied by mean per landslide.

4.0   RESULTS

We produced three detailed hazard maps from data collected and analyzed in this study. Plate 1 is a landslide inventory, Plate 2 shows shallow landslide susceptibility, and Plate 3 shows deep landslide susceptibility. We combined the hazard maps with asset data to complete a landslide risk analysis.

4.1   Landslide Inventory Findings

Before the use of lidar to map existing landslides (Burns and Duplantis, 2010) in the study area, 97 landslides areas (polygons) were mapped and included in SLIDO-1 (Burns and others, 2008). In contrast, the *SP-42 inventory* (Burns and Madin, 2009), used for the current project, includes 1,996 landslides in the study area. The surface area of these landslides covers approximately 25 square miles, or approximately 8 percent of the study area (300.6 mi^2; Plate 1). These landslides range in size from 250 square feet to more than 11 square miles. Of the 1,996 *SP-42 inventory* landslides, 820 are shallow and 781 are deep. The other 395 landslides are mostly debris flow fans (347) and rock fall talus. Details for each community are shown in **Table 4-1**.

Out of the 1,996 *SP-42 inventory* landslides, 1,288 are known or are estimated to have moved in the last 150 years. A very simplified historical constant rate of landslides would then be 8-9 landslides per year (1,288 landslides/150 years). However, as noted in this study and other studies (Burns and others, 2013; Wang and others, 2002), it is much more common in Oregon for tens to hundreds of landslides to occur during single large storm events with periods of no or very few landslides between storm events.

The updated *historic landslide points* inventory contains 1,700 landslide records from 1928 to 2016. Of the 1,700 landslides, 891 occurred during 1996 or are noted to have occurred during 1996-1997 or have a reactivation date including 1996. The *historic landslide points* dataset is displayed on Plate 1, and details for each community are shown in **Table 4-1**. Records for 457 of the 831 *preliminary historic landslide points* that occurred during 1996 included length and width data were used to create simple polygons (**Figure 3-4**). The 457-simple-polygon dataset allowed us to compare a known reoccurrence interval event (widespread 100-year rainfall event) to the new shallow landslide susceptibility map and perform exposure analysis.

Table 4-1. Summary of landslide inventories for each community.

Community	SP-42 Inventory	Historic Landslide Points
Multnomah County (West/Central)	1,115	205
City of Fairview	0	0
City of Gresham	55	7
City of Troutdale	44	2
City of Wood Village	1	1
City of Portland Neighborhoods		
Central City (CENT)	2	39
Airport	1	6
Neighbors West/Northwest (NWNW)	437	635
Southeast Uplift (SEUL)	18	41
North Portland (NPNS)	31	60
East Portland (EPNO)	42	49
Northeast Coalition (NECN)	3	5
Central Northeast (CNN)	9	11
Southwest (SWNI)	307	659
City of Portland (total)	847	1,505

*Some landslides overlap community boundaries, so totals will not equal total landslides in study area.

4.2 Shallow Landslide Susceptibility Findings

We classified the entire study area into zones of low, moderate, and high susceptibility to shallow land-slides. Approximately 63% of the study area is classified as low, 21% as moderate, and 16% as high susceptibility (Plate 2). It is important to remember that the shallow landslide susceptibility map can be thought of as a worst-case scenario. We produced the worst-case scenario by setting the groundwater table level to the ground surface throughout the study area. This worst-case scenario would be unlikely to occur everywhere at the same time. However, without better spatial and temporal information about groundwater this is a choice that we were forced to make. We chose a worst-case scenario as the best and most conservative approach. To further examine shallow landslide susceptibility, we examined the study area by the community (**Table 4-2**).

We draped the 457 simple polygons (created from the *preliminary historic landslide points* that occurred during 1996 including length and width data) over the shallow landslide susceptibility map in order to analyze spatial statistics. The ratio of area of the 457 landslide polygons to the shallow landslide susceptibility high zone was extrapolated to the total 831 to find approximately 0.5% of the area mapped as high in the City of Portland moved as landslides in the 1996, 100-year return event (1% probability of occurring in any year).

Table 4-2. Summary of shallow landslide susceptibility by community.

	Percentage by Zone		
Community	**Low**	**Moderate**	**High**
Multnomah County (West/Central)	56%	22%	22%
City of Fairview	74%	20%	6%
City of Gresham	70%	19%	11%
City of Troutdale	71%	20%	9%
City of Wood Village	77%	18%	5%
City of Portland Neighborhoods			
Central City (CENT)	78%	16%	4%
Airport	92%	7%	2%
Neighbors West/Northwest (NWNW)	27%	23%	53%
Southeast Uplift (SEUL)	78%	18%	3%
North Portland (NPNS)	81%	14%	5%
East Portland (EPNO)	80%	16%	5%
Northeast Coalition (NECN)	79%	19%	2%
Central Northeast (CNN)	78%	17%	5%
Southwest (SWNI)	32%	46%	24%
City of Portland (total)	67%	20%	13%
Total study area	63%	21%	16%

Although we did not model susceptibility to channelized debris flow transport and deposition, we did map 347 existing debris flow fans as part of the landslide inventory (**Figure 4-1**). Areas identified as highly susceptible to shallow landsliding are the most likely areas for initiation of debris flows (Plates 1 and 2). A possible method to identify if a particular drainage is susceptible to debris flows is the presence of a fan at the mouth of the drainage developed by past debris flow events. The fan is usually formed by a sequence of debris flows depositing material where the channel gradient is reduced and the channel confinement is lost.

Figure 4-1. Map of channelized debris flow fans in the study area.
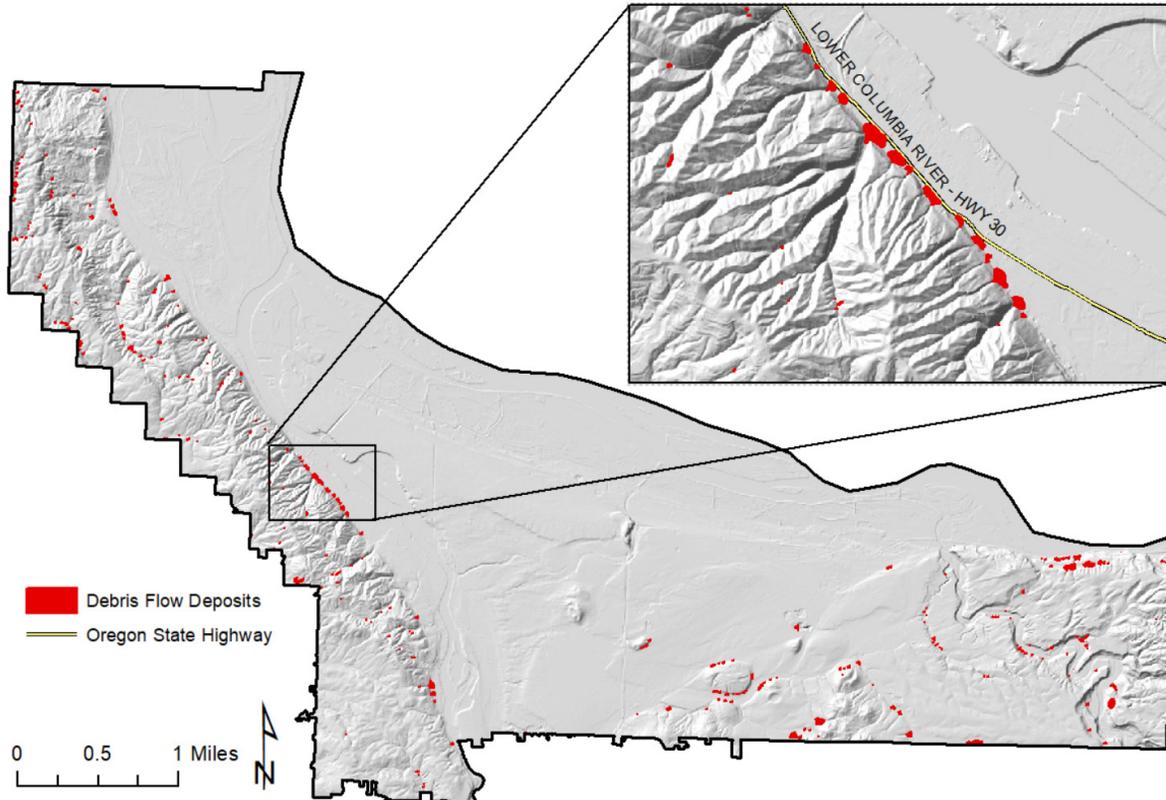
4.3   Deep Landslide Susceptibility Findings

We classified the entire study area into areas of low, moderate, and high susceptibility to deep landslides. Approximately 78% of the study area is classified as low, 15% as moderate, and 7% as high (Plate 3). As previously mentioned, we noted that some historic deep landslides occurred within existing prehistoric landslides. It is important to remember that the susceptibility map can be thought of as a worst-case scenario. This is because we included all deep landslides that have ever occurred throughout geologic time in the high susceptibility zone. However, we do not expect all deep landslides to be active at the same time throughout the watershed. This is the most conservative approach and therefore the worst-case scenario.

As with shallow landslide susceptibility, we calculated the area covered by deep landslide susceptibility within the communities (**Table 4-3**).

Table 4-3. Summary of deep landslide susceptibility by community.

Community	Percentage by Zone		
	Low	**Moderate**	**High**
Multnomah County (West/Central)	65%	21%	14%
City of Fairview	100%	0%	0%
City of Gresham	95%	4.5%	0.5%
City of Troutdale	96%	2.5%	1.5%
City of Wood Village	100%	0%	0%
City of Portland Neighborhoods			
Central City (CENT)	98%	2%	1%
Airport	100%	0%	0%
Neighbors West/Northwest (NWNW)	30%	58%	12%
Southeast Uplift (SEUL)	100%	0%	0%
North Portland (NPNS)	100%	0%	0%
East Portland (EPNO)	98%	2%	0%
Northeast Coalition (NECN)	100%	0%	0%
Central Northeast (CNN)	99%	1%	0%
Southwest (SWNI)	64%	31%	5%
City of Portland (total)	86%	12%	2%
Total study area	78%	15%	7%

4.4   Risk Analysis and Loss Estimation Results

We performed two types of risk analysis: 1) hazard and asset exposure and 2) Hazus earthquake-triggered landslide risk analysis.

4.4.1   Exposure analysis results

We performed hazard and community asset exposure analysis on the 10 hazard datasets/zones:
- shallow landslides (inventory polygons)
- deep landslides (inventory polygons)
- debris flow fans (inventory polygons)
- 1996 landslide historic points converted to polygons in the City of Portland
- shallow landslide susceptibility (low, moderate, and high)
- deep landslide susceptibility (low, moderate, and high)

and asset datasets: permanent population; critical facilities and roads; and land and buildings. Tables showing the all the results of this analysis are provided in Appendix B.

As noted previously, while performing the exposure analysis we noticed the significant lack of dollar values for public land in the tax lot data. Therefore, for public land we consider the exposure analysis values as minimum values.

Table 4-4 is a summary of the exposure of select assets to the three landslide types. We found that almost 6,700 people and approximately $1.65 billion in land and buildings are located on existing landslides.

Table 4-4. Summary of the exposure of select assets to three existing landslide types.

Landslide Type	Permanent Population	Buildings	Building Value	Land Parcels	Land Value	Roads (Miles)	Critical Facilities
Shallow landslides	187	132	$25.8M	1,985	$34.9M	1.0	3
Deep landslides	6,129	2,196	$988.8M	4,023	$501.6M	44.8	2
Debris flow fans	371	342	$53.4M	900	$42.3M	2.9	0

Recall that records for 457 of the 831 *preliminary historic landslide points* that occurred during 1996 were used to create "simple" polygons. Of the 457, 177 (39%) had more than 50% area on private property, for a total exposure value of $25.5M and a mean value of $144,000 per landslide (private property in the City of Portland; Burns and others, 2017).

In order to approximate total private property exposure, 39% was applied to the total 831 landslides, equaling approximately 324 (831*0.39) landslides (private property in the City of Portland). To estimate the total exposure, the mean exposure value ($144,000 per landslide) was multiplied by the 324 private property landslides, resulting in approximately $47M in 1996 landslide exposure to private property (Burns and others, 2017).

The remaining 507 of the total 831 landslides are therefore on public land and caused approximately $34.3M in losses (Wang and others, 2002). However, these 507 landslides touched 174 pieces (34%) of recreational land, as classified in the tax lot data, that are considered parks or greenspaces, and so may have minimal infrastructure or damageable property. The remaining 66% of landslides on public land were not located on recreational land, and therefore this estimate included the majority of the $34.3M in public losses. This would equal an average of approximately $102,500 per landslide (on public property in the City of Portland). Together the total estimated losses from landslides in the City of Portland during 1996 on public land is $34.3M and exposure on private land of $47M, which is a total of approximately $81.3M (Burns and others, 2017).

Table 4-5 is a summary of exposure of select assets to the six landslide susceptibility classes from the deep and shallow susceptibility maps. We found approximately $8.7 billion in land and building values are located in xxx. More than 29,000 people live in the shallow landslide high susceptibility hazard zone and nearly 8,000 people live in the deep landslide high susceptibility zone.

Table 4-5. Summary of exposure of select assets to shallow and deep landslide susceptibility zones.

Susceptibility Class	Permanent Population	Buildings	Building Value	Land Parcels	Land Value	Roads (Miles)	Critical Facilities
Shallow Landslide Susceptibility							
Low	552,707	261,617	$55,621.6M	204,855	$31,652.0M	2,356.4	326
Moderate	141,892	103,601	$72,223.1M	97,279	$9,359.2M	998.3	287
High	29,294	62,100	$3,631.6M	79,857	$3,201.4M	44.7	277
Deep Landslide Susceptibility							
Low	686,765	278,773	$70,320.5M	207,919	$40,282.5M	3,029.3	318
Moderate	29,240	12,489	$5,886.1M	14,753	$3,221.6M	301.2	17
High	7,901	3,020	$1,236.5M	3,674	$708.9M	69.1	2

4.5 Hazus analysis results

To examine the estimated damage and losses from future landslides triggered by an earthquake, we performed three different Hazus analyses on each of two earthquake scenarios (Appendix C):

Crustal M6.8 earthquake scenario: Portland Hills Fault

- No landslides
- Dry scenario landslides
- Wet scenario landslides

Subduction Zone M9.0 earthquake scenario: Cascadia Fault

- No landslides
- Dry scenario landslides
- Wet scenario landslides

These two scenarios were selected because the crustal M6.8 Portland Hills Fault earthquake represents a less likely but worst-case scenario and the M9.0 Cascadia Subduction Zone earthquake represents the more likely but less damaging scenario.

Hazus reports for each of the six analyses are provided in Appendix C. The results show that in a subduction zone event the earthquake-induced landslide hazard alone would result in economic loss to buildings of approximately $500M (**Table 4-6**) and in a local crustal earthquake approximately $3B. Hazus estimates a replacement value for buildings at approximately $86B for both scenarios, which is more than the taxable improvements (building) value of $75B we derived from tax lot data (Appendix C). The reason for the difference in total building value between our database and the Hazus database is unclear and points to the need to update the Hazus general building stock inventory data with more accurate local data in future earthquake risk analysis studies.

Total economic loss values are likely either over- or underestimates due to the low quality of the standard Hazus asset data, especially the critical facilities and infrastructure data. However, loss ratios are likely to be better estimates than the absolute numbers.

The analysis estimates damage by landslides alone triggered in a Cascadia or crustal earthquake will result in an estimated 1,344 or 4,992 buildings being moderately to completely damaged and 600 to 2,761 residents needing shelter (Appendix C). In Multnomah County, the loss ratio increased from 10% to 13% when landslides in a "wet" condition are added to the scenario. This is a 31% increase; overall, almost 25% of the damage comes from landslides. Similar increases in loss ratios are calculated in the Neighbors

West/Northwest (NWNW) and Southwest (SWNI) neighborhoods in the city of Portland. However, some communities had minimal increases. These include the Southeast Uplift (SEUL), Northeast Coalition (NECN), Central Northeast (CNN), and Airport neighborhoods.

Table 4-6. Summary of Hazus analysis results for the Cascadia Subduction Zone M9.0 earthquake scenario: building dollar values only. Other results are included in Appendix C.

		Building Losses							
		Cascadia—No Landslide		Cascadia with Landslide (Dry)		Cascadia with Landslide (Wet)		Landslide (Wet) Only*	% of
	Total Building Value ($)	Loss ($)	Loss Ratio (%)	Loss ($)	Loss Ratio (%)	Loss ($)	Loss Ratio (%)	Difference in Losses ($)	Total Losses from Landslides
Multnomah County (west/central)	$1,832.8M	$177.9M	10%	$177.9M	10%	$232.7M	13%	$54.8M	24%
Cities of Troutdale, Wood Village, Gresham, Fairview	$11,626.8M	$597.2M	5%	$597.2M	5%	$617.3M	5%	$20.1M	3%
City of Portland Neighborhoods									
Airport	$1,234.8M	$246.6M	20%	$246.6M	20%	$246.6M	20%	$0	0%
Central City (CENT)	$11,000.8M	$3,990.3M	36%	$3,990.5M	36%	$4,122.8M	37%	$0.3M	3%
Central Northeast (CNN)	$5,210.9M	$288.0M	6%	$288.0M	6%	$288.0M	6%	$0	0%
East Portland (EPNO)	$11,539.3M	$695.6M	6%	$695.6M	6%	$695.9M	6%	$0.3M	0%
Northeast Coalition (NECN)	$5,683.4M	$447.6M	8%	$447.6M	8%	$447.6M	8%	$0	0%
North Portland (NPNS)	$7,477.2M	$1,269.6M	17%	$1,269.7M	17%	$1,294.1M	17%	$24.5M	2%
Neighbors West/Northwest (NWNW)	$5,271.5M	$424.9M	8%	$432.5M	8%	$530.9M	10%	$106.0M	20%
Southeast Uplift (SEUL)	$15,628.6M	$1,093.0M	7%	$1,093.0M	7%	$1,093.0M	7%	$0	0%
Southwest (SWNI)	$9,775.4M	$505.7M	5%	$505.7M	5%	$687.1M	7%	$181.4M	26%
City of Portland Total	$72,821.7M	$8,961.3M	12%	$8,969.1M	12%	$9,405.9M	13%	$444.6M	5%
Total study area	$86,281.3M	$9,736.4M		$9,744.3M		$10,255.9M		$519.5M	

 * "Landslides (Wet) Only" is the difference between "Cascadia – No Landslide" and "Cascadia Landslide Wet" values.

4.6   Annualized Loss Results

On the basis of historical data, there is an average of 20 landslides per year in the City of Portland (**Figure 3-7**). Stormy, wet, or otherwise extreme landslide years, such as the 1996 winter, can cause hundreds of landslides. The number of landslides multiplied by the average loss estimates provides a preliminary estimate of losses per year. We found an average cost of $99,000 from building/construction permits and $144,000 per landslide on private property and $102,500 per landslide on public property in the City of Portland from exposure (**Table 3-4**). From these numbers, one can conclude that annual loss estimates from landslides in the City of Portland have ranged from ~$1.5M to ~$3M (in 2016 dollars) over the last 20 years. In extreme years, this annual estimate increased to approximately $34M for public and $47M for private property. Together, the estimated total ranges from approximately $64M to $81M. If the typical annual loss values are inferred over the 42 years (1974–2016), the total cumulative losses are likely in

the range of $84M to $126M for the City of Portland. This indicates that losses from just one or two extreme landslide years are the equivalent of ~40 years' worth of typical losses (Burns and others, 2017).

5.0 CONCLUSIONS, DISCUSSION, AND RECOMMENDATIONS

This study was initiated to alert communities in the study area of the need to be prepared for landslides. Although we cannot predict when landslide events will occur or how big they will be, we have provided a detailed understanding of landslide events in the past, the estimated scale of a potential disaster, the areas susceptible to future landslides, and an estimate of what the damage and losses might be. We note that the portion of Oregon included in this study has high average annual precipitation as well as high 24-hour-duration precipitation related to storm events. The area also has a relatively moderate to high seismic hazard. Both high precipitation and large earthquakes are primary triggers for new landslides and the reactivation of existing landslides. Human activities can also trigger landslides. The main purpose of this project was to help communities in the study area become more resilient to landslide hazards by providing detailed, new digital databases describing the landslide hazards as well as community assets and the risk that exists where the two overlap.

Lidar-based landslide inventory mapping (Plate 1) using the SP-42 method found 1,996 landslides, which cover approximately 8% (~24 mi^2) of the study area. Land and buildings valued at approximately $1.65B and almost 6,700 people are located on these existing landslides. Our new historic landslide points dataset has 1,700 records with dates ranging from 1928 to 2013 within the study area. We conclude that annual loss estimates from landslides in the City of Portland range from ~$1.5M to ~$3M; in extreme years (such as 1996), this increases to approximately $64M to $81M. We also found almost 8,000 people live in the deep landslide high susceptibility zone and approximately 29,000 live in the shallow landslide high susceptibility zone. We also found that the loss ratio for the Cascadia earthquake scenario without landslides increased approximately 25–35% when landslides were added in NWNW and SWNI neighborhoods in the city of Portland and Multnomah County. For example, in Multnomah County the loss ratio increased from 10% to 13%, which is a 30% increase.

Many of the historic and more recent landslides were reactivations of existing landslides. These younger landslides are located within and at the toe of older slides (Plate 3). Although we did not create a channelized debris flow susceptibility map, the combination of the shallow susceptibility map and the landslide inventory map showing debris flow fans could be used to identify where these types of landslides might initiate and where they might deposit. In addition, DOGAMI Interpretive Map 22 (Hofmeister and others, 2002) could be used with these other datasets to evaluate potential channelized debris flow hazards. In many cases, debris flow fan deposits areas have the potential for life safety risk and therefore we recommend extra caution is taken in these areas.

The main reason for the landslide hazard in the current study appears to be the combination of weak rock and soil, steep slopes, riverine and glacial outburst flood erosion, possible outburst flood rapid water level drawdown, and exposure to high precipitation and earthquake shaking. The loess and loess colluvium in the Tualatin Mountains, the Missoula Flood deposits along the Willamette River and other stream banks, and most places where there are generally steeper slopes are susceptible to shallow landslides (Plate 1 and 2, Burns and others, 1998). The highly weathered Columbia River Basalts and the weak sedimentary rock in the Tualatin Mountains and in the eastern portion of the study area are generally susceptible to deep landslides (Plate 1 and 3).

We have discussed detailed study results in this report and have provided detailed data in appendices and on GIS-based map plates. Three primary conclusions of the project are:

- Large, deep landslides are a primary threat in the study area, and asset exposure to these landslides is significant. More than 6,000 residents, more than 2,000 buildings, and a combined building and land value of almost $1.5B are affected.
- Annual historic landslide losses range from ~$1.5M to ~$3M; in extreme years (such as 1996), this increases to approximately $64M to $81M.
- Damage and losses from landslides alone, induced by a local crustal or a Cascadia Subduction Zone earthquake, may result in an estimated 1,344 to 4,992 buildings being moderately to completely damaged and 600 to 2,761 residents in need of shelter. In some communities, potential landslides triggered by the earthquakes could cause a 31% increase in damage and losses.
- 16% of the study area is classified as highly susceptible to shallow landslides.

These data indicate a significant landslide hazard and risk in the study area. When we examined the hazard and risk at the community scale, we found Multnomah County (west/central), Portland Neighbors West/Northwest, and Portland Southwest Neighborhood had consistently higher hazard and risk. However, there is some level of landslide hazard and risk in all the communities. This amount of landslide risk indicates a strong need for continuing landslide risk management. Landslide risk management can be performed in various ways. One way to conceptualize the risk management components is illustrated in **Figure 5-1**.

Figure 5-1. Landslide risk management diagram showing (written communication Wang, 2010).

We provide the following recommendations to communities in the study area for continued work on landslide risk management. These recommendations are not comprehensive, but they should provide an adequate foundation for many of the risk management phases shown in **Figure 13**. The primary actions are related awareness, regulations, and planning.

5.1 Awareness

Awareness of local hazards is crucial to understanding associated dangers and how to prepare for them. One of the main purposes of this report and maps is to help residents and land owners in the study area become aware of the parts they can play in readiness for hazardous events and risk reduction. Once the hazard is understood better, residents and landowners can work on risk reduction. To increase awareness, we will post this report and the map plates on the DOGAMI website. Helpful flyers can be linked from DOGAMI websites and/or distributed to help educate landowners of activities individuals can initiate to reduce landslide risk. Helpful flyers include the "Homeowners Guide to Landslides" (http://www.oregongeology.org/sub/Landslide/ger_homeowners_guide_landslides.pdf) and the DOGAMI fact sheet "Landslide Hazards in Oregon" (http://www.oregongeology.org/sub/publications/landslide-factsheet.pdf; DOGAMI, 2006).

City, county, neighborhood, and other local community leaders can implement awareness campaigns to educate neighborhoods, businesses, and individual home owners about the locations of local hazards and how to reduce risk. For example, homeowners unintentionally increase their own risk through discharge of stormwater onto slopes that are susceptible to landslides. Landslides resulting from this type of discharge were observed after the 1996 events (Burns and others, 1998). Just knowing which slopes are susceptible can provide the impetus to switch from unknowingly increasing risk to actively reducing risk through very cost-effective methods such as extending stormwater discharge pipes beyond the high hazard zone.

5.2 Warnings

Preparing for emergency situations such as storm events and earthquakes can be done in several ways. One can assess the level of readiness and preparedness to deal with a disaster before disaster occurs by estimating damage and losses from specific hazard events. This was done at a regional scale during this project. Another way to prepare is to better understand when these events might happen through the development of a landslide warning system. Oregon has a general statewide landslide warning system: when the National Weather Service (NWS) initiates warnings, several Oregon state agencies (Oregon Emergency Management [OEM], Oregon Department of Transportation [ODOT], and DOGAMI) disseminate the warnings. The current warning system could be used by the communities in the study area. In the future, local rainfall thresholds could be developed for landslide initiation in the communities by monitoring precipitation and resulting slide activity. Knowing when there will be periods of increased landslide potential will help communities prepare, respond, and recover, should landsliding occur. If known very high hazard areas with the potential for life safety issues are identified, such as the debris flow fans, evacuation could be considered, recommended or required.

5.3 Development and Infrastructure Planning

Planning is an effective method to work on risk reduction and can be initiated in a variety of ways using the maps and data produced in this project. Two types of planning that engage leaders, residents, and landowners in planning are: 1) focus on future development and 2) focus on existing infrastructure.

These new hazard data should be used in long-term planning. The data should also be included in assessments when discussing expansion of urban growth boundaries. Another long-term planning tool is the inclusion of the data in this report into comprehensive plans, which most cities and counties use to

identify community goals. Some planning could result in the avoidance of proposed development in high-hazard areas and even public buyouts in very high or life-threatening areas. Additional planning can focus on maintenance of road-related grading, repeated asphalt overlays, or expanding roadways. Keeping good records of maintenance practices is another way to track risk reduction effects.

Controlling stormwater runoff routing must be done carefully so that water is not directed onto or into unstable slope areas. Planning could focus on private landowner education and awareness to enhance landowner initiative in the control of stormwater. Planning of the public stormwater system, for example, should include culvert outlets in order to evaluate any discharge onto highly susceptible zones.

5.4 Regulation

Connecting landslide inventory and susceptibility maps and data to regulations such as development codes and ordinances can be very effective. Such regulations use landslide hazard maps to identify proposed development and grading or other activities that may increase landslide risk in high hazard areas. These regulations have requirements (usually) to perform site-specific geotechnical analysis and mitigation design. Regulations can also reduce grading related landslides. For example, relatively shallow grading activities can unintentionally cause slope failures, especially in conditions where existing landslides or slopes in high susceptibility zones may be only marginally stable. Placing debris or soil in the wrong location, for example, near the heads of existing landslides, can also unknowingly cause slope failure simply by adding more weight to the slope.

5.5 Large Deep Landslide Risk Reduction

Large, deep landslides are commonly harder to mitigate because they often have multiple land owners on an individual deep landslide. Mitigation may require cooperating effort from public and private entities (usually city or county and landowners) because the slides can span or even cross entire neighborhoods. To reduce the likelihood of a slide reactivation, a public awareness campaign could be undertaken to educate homeowners and landowners about landslide hazards in their areas and how to reduce their risk. Residents on mapped landslide areas should participate in a neighborhood risk reduction program where all affected entities help reduce the overall risk. Risk reduction measures should include:
- minimizing irrigation on slopes
- avoiding removing material from bases of slopes
- avoiding adding material or excess water to tops of slopes
- draining water from surface runoff, downspouts, and driveways well away from slopes and into storm drains or natural drainages
- consulting an expert to conduct a site-specific evaluation before considering major construction

5.6 Emergency Response

Finally, we recommend that neighborhoods and communities create landslide emergency response plans before the next disaster. One component of the plan should include identifying local engineering geologists and geotechnical engineers and establishing working relationships with them so they can be asked to evaluate landslides or areas during and directly after the next disaster. Their evaluations would help determine the immediate actions required following the disaster. For example, they would determine if a neighborhood should be evacuated or if the area is stable enough to perform an emergency response.

6.0 ACKNOWLEDGMENTS

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8.0   APPENDICES

Appendices are available as separate documents in the digital file set.

Appendix A. Historic Landslide Inventory Methodology (PDF)

Appendix B. Exposure Analysis Results (Microsoft® Excel® spreadsheet and PDF formats)

Appendix C. Hazus Analysis Results (PDFs):

Crustal M6.8 earthquake scenario: Portland Hills Fault
- No landslides   (phf6_8_sl_no_cb.pdf)
- Dry scenario landslides   (phf6_8_sl_dry_cb_gsreport.pdf)
- Wet scenario landslides   (phf6_8_sl_wet_cb_run2_gsreport.pdf)

Subduction Zone M9.0 earthquake scenario: Cascadia Fault
- No landslides   (cascadia9_0_no_gsreport.pdf)
- Dry scenario landslides   (cascadia9_0_dry_cb_gsreport.pdf)
- Wet scenario landslides   (cascadia9_0_wet_cb_gsreport.pdf)

Appendix A: Historic Landslide Point Update Details

This appendix describes the methods followed to add new landslide locations and/or merge new landslide information with existing landslides inside the City of Portland to the Statewide Landslide Inventory for Oregon (SLIDO) 3.2 dataset. It also details the development and use of a processing script that estimates landslide footprints from location point data.

CONTENTS

MERGING THE CITY OF PORTLAND AND SLIDO HISTORIC LANDSLIDE RECORDS

City of Portland's Landslide Records

Since 1928, records for landslide occurrences in the city of Portland (PDX) have been compiled by various departments and individuals. The Portland Bureau of Development Services scanned paper files and created a database of landslides that included landslide date, location, response information, movement type, and other notes. These records were not geolocated, nor did they record all landslides that have occurred in Portland city limits. The PDX database contains 1,484 records, and DOGAMI SLIDO-3.2 contains 820 historic landslide points within Portland city limits.

The first step in processing these new data was to compare the two datasets, match those landslide records that record the same event, and resolve any duplicate landslide records. The steps are as follows:

1) We located a Portland city landslide record in Google Maps®, using the address information provided.
2) We found this location in the SLIDO-3.2 geodatabase in Esri ArcMap®. And selected nearby SLIDO historic landslide points. We checked if the SLIDO landslides were a) in the same year and b) in the same location.
    i. If there was a match in location and date between the Portland city database and SLIDO, we recorded the corresponding Unique_IDs in a compilation spreadsheet. The information from the PDX landslide records was incorporated into the matched SLIDO record attributes, if they were determined to be the same landslide as SLIDO (same dates, addresses, etc.).
    ii. If there were multiple, potential matches between PDX and SLIDO records, these records needed further investigation. First, the PDX landslides were all digitized in Google Earth as points by using methods in the "Creating PDX Point Dataset" section below. These points were then used as a spatial reference to help determine matches between PDX and SLIDO landslides. If the PDX and SLIDO landslides had enough similar attributes (same dates, addresses, etc.) and had similar spatial locations, they were considered the same landslide. Ambiguous potential matches were flagged and resolved by committee. If they were determined not to be a SLIDO match, they were considered unique landslide points and were digitized by using methods in the "Creating PDX Landslide Location Point Dataset" section below.
    iii. If there was no match, these PDX landslides were determined to be unique landslides, not already in the SLIDO database. These records were digitized in Google Earth by using methods in the "Creating PDX Landslide Location Point Dataset" section below.
    iv. If the location description in the Portland city database was inadequate or non-locatable, the record was highlighted. These records remained in the spreadsheet but were not digitized into the SLIDO database.
    v. If the Portland city record appeared to be a duplicate within the database (i.e., matching place, year, and/or description), the record was highlighted and further investigated. These records were resolved by committee to be either unresolvable or unique and thus were added into the SLIDO database.

Additional Guidelines

- If landslides with similar locations were within the same year and there was a minimal amount of other attribute data, the landslides were generally considered to be the same landslide.
- Landslides with similar locations/dates but with drastically different landslide description data (length, width, depth, etc.) were not considered to be a match and were treated as new landslides.
- Landslides could have had different addresses but basically the same spatial locations (e.g., adjacent streets). This was checked in ArcMap after PDX landslides were digitized.

Creating PDX Landslide Location Point Dataset

PDX landslide data did not have a spatial component; location points needed to be created so that they could be incorporated into SLIDO. Google Earth was used to create spatial locations (placemarks), based on address or location information in the PDX spreadsheet. After using the address data to find the general landslide location in Google Earth, the surrounding terrain was analyzed to determine where exactly to put the placemark (i.e., steeper slopes, etc.). The steps are as follows:

1. In Google Earth, create a new folder in "My Places" (highlight "My Places" and go to Add > Folder)
2. Name the folder based on groupings of landslides (usually by Microsoft Excel® worksheet name).
3. Place a new placemark for each landslide within the new folder. Make sure to name the placemark with the correct UNIQUE_ID from the PDX spreadsheet (this UNIQUE_ID is the primary key that will allow you to join an Excel worksheet with the newly created PDX landslide shapefile).
4. When finished placing all of the landslide location points, right-click on new folder > Save Place As…
5. Save the new folder as a .kmz (.kmz should contain all of the placemarks within the "My Places" folder).

Saving the placemarks data from Google Earth outputs a .kml file. Then transform this to an Esri shapefile (.shp) in ArcMap:

1. In ArcToolbox, open "KML to Layer" tool (Conversion Tools > From KML > KML to Layer) and input the .kmz file that you exported out of Google Earth. The Arc tool will input either .kml or .kmz without effecting the output.
2. Save a new layer (.lyr) file and add it to ArcMap.
3. In ArcMap, right-click on the .lyr file and go to Data > Export Data. Save as a shapefile (.shp). Add the new shapefile to ArcMap.
4. Open the attribute table of the new shapefile. Check to make sure that there is a field that includes the UNIQUE_ID (usually called "Name"). Delete all of the other fields using the "Delete Fields" tool (ArcToolbox > Data Management > Fields > Delete Fields).
5. At this point, the new shapefile will be projected in GCS_WGS_1984. It should be re-projected into NAD_1983_HARN_Oregon_Statewide_Lambert_Feet_Intl.

Formatting Excel Spreadsheet to Match SLIDO Attribute Table

At this point in the process, there is a shapefile representing all new PDX points, with UNIQUE_ID field (called "Name") values and UNIQUE_ID values matching those in the PDX spreadsheet. The shapefile will eventually be joined to the finalized PDX landslide spreadsheet based on this UNIQUE_ID field. This section describes how to format the PDX landslide spreadsheet and get it ready for the join.

PDX to SLIDO Formatting

NOTE: The PDX landslide spreadsheet had to be reformatted to match the fields used in the SLIDO dataset. These reformatting changes were resolved before joining the table to the shapefile. First, the format of the SLIDO geodatabase feature class is outlined. Then, the steps to bring the Excel workbook data into the SLIDO geodatabase is outlined. This section provides detailed formatting information and tools used to join the PDX data into the spatial SLIDO geodatabase.

SLIDO Formatting Specifics

The table below details SLIDO 3.2 attribute field formatting. In order to join new data to the SLIDO dataset, the new data's attribute table must be formatted exactly as described in the chart.

FIELD	TYPE	LENGTH	PRECISION	SCALE	NULL
FID	Object ID				Yes
Shape	Geometry				Yes
OBJECTID_1	Long				Yes
REF_ID_COD	Text	50			Yes
UNIQUE_ID	Text	50			Yes
DATA_SOURC	Text	100			Yes
LOC_METHOD	Text	100			Yes
ORIG_ID	Text	25			Yes
SLIDE_NAME	Text	50			Yes
DATE	Text	25			Yes
LENGTH_ft	Float		0	0	Yes
WIDTH_ft	Float		0	0	Yes
DEPTH_ft	Float		0	0	Yes
SLOPE	Float		0	0	Yes
TYPE_MOVE	Text	50			Yes
MOVE_CLASS	Text	50			Yes
CONTR_FACT	Text	100			Yes
TYPE_MTRL	Text	25			Yes
AREA_ft2	Float		0	0	Yes
VOLUME_ft3	Float		0	0	Yes
DEEP_SHAL	Text	25			Yes
DAMAGES	Text	254			Yes
LOSSES	Text	50			Yes
COMMENTS	Text	254			Yes
Annual_Cos	Float		0	0	Yes
Repair_Cos	Float		0	0	Yes
Year	Short		0		Yes
Date_Range	Text	25			Yes
Reactivati	Text	50			Yes
Month	Text	2			Yes
Day	Text	2			Yes

SLIDO Table to ArcMap Table Idiosyncrasies

A new top row was added to the Excel spreadsheet and populated with a "1" for numeric fields and an "x" for text fields. ArcGIS looks at the first 8–10 values within a field and, if they are blank, none of the field values are be included.

From Esri: "ArcMap scans the first eight rows to determine the field type that should be used. If there are other types of data in those rows, the field is converted to text when the table is in ArcMap."

Character Limits: "ArcMap can only read the first 255 characters of a cell. If you have more characters than that, ArcMap converts the field to a BLOB type and you won't be able to read its contents."

Table to Table

Joining a table (spreadsheet) directly to a shapefile in ArcMap can be problematic. The method used to join a large table to a large shapefile with minimal errors was to import the table to a File Geodatabase first. The steps below describe this method.

1. Create an empty File Geodatabase in ArcCatalog.
2. In ArcToolbox, open "Table to Table" tool (Conversion Tools > To Geodatabase > Table to Table)
3. Input Rows > the Excel worksheet with new attributes (may need to convert Excel to a .csv first)
4. In "Table to Table" tool, right-click on each of the fields in the Field Map window and re-format each field so that it is similar to the SLIDO attribute table fields (see table in "SLIDO Formatting Specifics" chapter). Make sure that you set NULL = No.
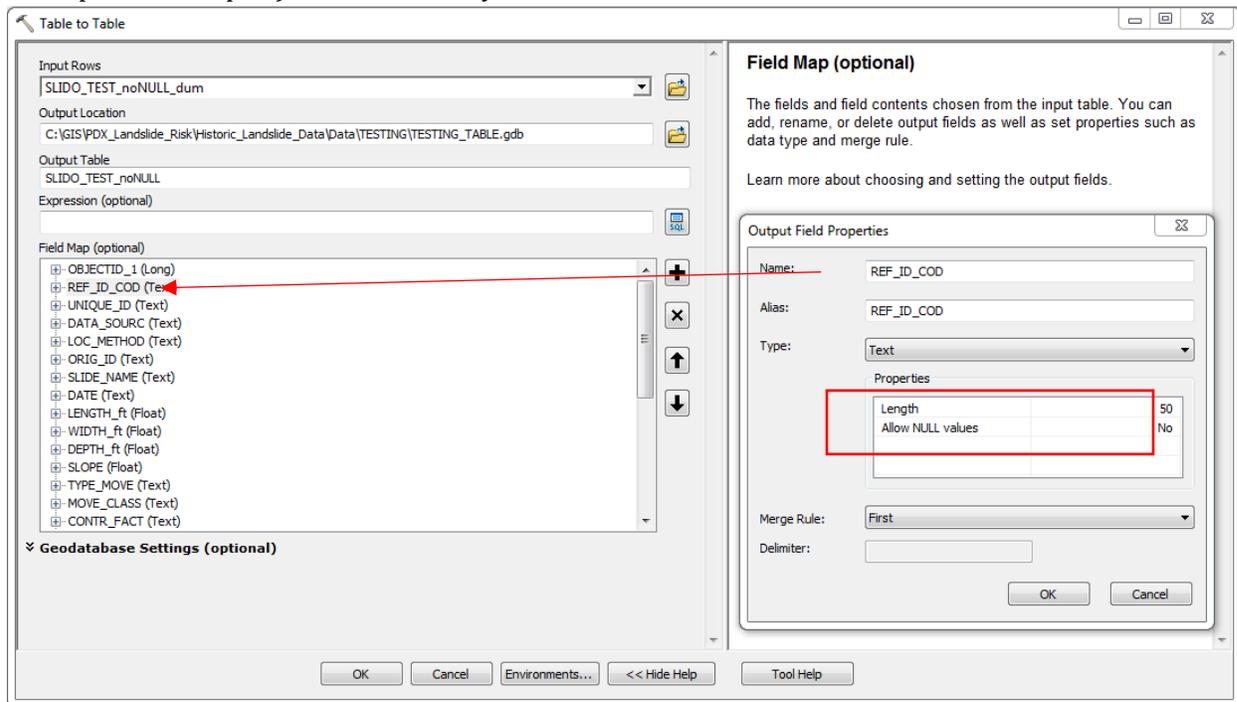
5. Check the table for data dropouts and compare to the Excel spreadsheet.
6. Output the table into the new File Geodatabase.

Joining Table to Shapefile

After a new table based on the SLIDO-formatted PDX shapefile was created in the File Geodatabase, it was ready to be joined to the PDX landslide shapefile. This is done in ArcMap.

1. Bring the shapefile into ArcMap and right-click on shapefile > Joins and Relates > Join. In the Join Data Window, choose "Join attributes from a table" and "Keep only matching records" in the Join Options.
2. Right-click on the PDX landslide shapefile with the table join and save as new shapefile.
3. **TROUBLESHOOT:** Do multiple checks to the new PDX landslide shapefile. Compare the attribute table to the Excel worksheet to make sure that all of the values are included.

CREATING LANDSLIDE POLYGONS

The exposure analysis relies on landslide polygons overlapping with generalized taxlot values. However, the historic landslide points from the PDX and SLIDO datasets lack polygon extents. In some of the landslide records, the landslide length and width were recorded and this information was used to create estimated landslide polygons. This section explains the tools and steps used to turn landslide points to polygons.

Python Script

Using the Python scripting language, a processing script was designed that creates a separate landslide polygon for each point in the landslide point dataset. These polygons are then merged into one final landslide shapefile. The inputs are the historical landslide point dataset and a DEM. The point shapefile must contain three fields in order to work properly: "LENGTH_ft", "WIDTH_ft", and "OBJECT_ID" (or some type of unique ID).

Assumptions

The script was designed with two assumptions. If these assumptions are not applicable for the scope of the research, don't use the script.
1. Each point in the landslide point dataset represents the top of the landslide.
2. The lowest point in the first (circular) buffer defines the direction of the landslide. This might not be correct, as the terrain within the buffer might lead the landslide to flow in a different direction.

Input Data Needed

The data needed to run the script include the landslide point dataset (.shp) and a DEM (1-m resolution) that covers the extent of the point dataset. Within the attribute table of the point dataset, there must be values for the LENGTH_ft and WIDTH_ft fields. It is possible that additional historical landslide data would have to be modified to conform to the processing script requirements.

How the Script Works

This describes the design of the script and what it does (using one landslide location point as an example).
1. It buffers the landslide location point using the LENGTH_ft value as the "Distance" input in the "Buffer" tool. This creates a circular polygon around the landslide point where the radius is equal to the landslide's attribute LENGTH_ft.
2. Because landslides tend to move downward, the script uses the DEM to determine the lowest elevation cell within the circular buffer and create a point in that location. Now there are two

   points, one representing the landslide location and the other representing the lowest elevation at a specific length from the landslide point.

3. Next, it creates a line between those two points.
4. Then it buffers the line using half the value of the WIDTH_ft value as the "Distance" input in the tool.
5. Each of these output polygons is then merged into one final shapefile.

Final Output

The final output of the script is a polygon for each landslide that has the length and width equal to the LENGTH_ft and WIDTH_ft attribute values contained in the attribute table. Each polygon has an OBJECT_ID field with a value that is equal to the landslide point's UNIQUE_ID.

Asset Inventory - Multnomah County and Portland Neighborhoods 2016

Buildings

Communities (Multnomah County)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Value (dollars)	Commercial Count	Commercial (Count of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count of Total) (percent)	Government Value (dollars)	Other (unassigned) Buildings Count	(Count of Total) (percent)	Value (dollars)	All Buildings Total Count	Percent Total (Count of Total) (percent)	Total Value (dollars)
Fairview	2586	0.96%	$357,181,545	167	0.80%	$105,893,719.98	92	2.89%	$42,702,579.26	0	0.00%	$0.00	2845	0.97%	$505,777,844.25
Gresham	29283	10.91%	$3,743,314,143	2097	10.03%	$1,496,030,474.18	299	9.38%	$513,152,873.44	2	4.88%	$0.00	31681	10.83%	$5,752,497,490.69
Multnomah County	9229	3.44%	$1,414,617,345	2742	13.12%	$210,099,708.98	201	6.31%	$86,657,651.75	0	0.00%	$0.00	12172	4.16%	$1,711,374,705.49
Portland	221125	82.37%	$41,907,373,378	15489	74.11%	$17,109,052,797.13	2443	76.60%	$6,807,312,468.66	39	95.12%	$2,627,859.97	239096	81.72%	$65,826,366,503.66
Troutdale	5083	1.89%	$574,154,000	293	1.40%	$303,724,334.10	142	4.46%	$90,299,740.34	0	0.00%	$0.00	5518	1.89%	$968,178,074.53
Wood Village	1135	0.42%	$75,555,077	113	0.54%	$107,222,649.36	10	0.31%	$632,670.00	0	0.00%	$0.00	1258	0.43%	$183,410,396.54
Total (cities + county)	268441	100.00%	$48,072,195,488	20901	100.00%	$19,332,023,683.73	3187	100.00%	$7,540,757,983.45	41	100.00%	$2,627,859.97	292570	100.00%	$74,947,605,015.16

Neighborhoods (City of Portland)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Value (dollars)	Commercial Count	Commercial (Count of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count of Total) (percent)	Government Value (dollars)	Other (unassigned) Buildings Count	(Count of Total) (percent)	Value (dollars)	All Buildings Total Count	Percent Total (Count of Total) (percent)	Total Value (dollars)
Airport (no code)	8	0.00%	$0.00	247	1.58%	$34,753,645.13	446	18.25%	$943,787,337.31	15	27.78%	$0.00	716	0.30%	$978,540,982.44
Central City (CENT)	740	0.33%	$6,303,875,818.19	1919	12.25%	$6,165,131,659.79	134	5.48%	$1,901,143,490.90	1	1.85%	$0.00	2794	1.17%	$14,370,150,968.88
Central Northeast Neighborhoods (CNN)	22843	10.32%	$2,960,453,281.89	1449	9.25%	$839,447,784.98	114	4.66%	$174,044,047.20	3	5.56%	$75,140.00	24409	10.19%	$3,974,020,254.07
East Portland Neighborhood Office (EPNO)	47537	21.48%	$4,859,591,244.06	2637	16.84%	$2,033,410,292.30	274	11.21%	$577,033,270.77	1	1.85%	$306,849.99	50449	21.07%	$7,470,106,697.13
Neighbors West/Northwest (NWNW)	6492	2.93%	$3,587,589,292.38	1565	9.99%	$1,434,534,933.61	229	9.37%	$313,388,762.40	1	1.85%	$306,849.99	8287	3.46%	$5,335,819,838.39
North Portland Neighborhood Services (NPNS)	27756	12.54%	$3,349,490,895.87	2683	17.13%	$3,144,130,869.19	758	31.01%	$388,603,779.04	7	12.96%	$638,329.99	31204	13.03%	$6,075,063,874.09
Northeast Coalition (NECN)	26239	11.86%	$4,945,378,571.72	1165	7.44%	$1,065,963,274.72	93	3.81%	$181,685,261.22	3	5.56%	$0.00	27500	11.48%	$6,193,027,107.66
Southeast Uplift Neighborhood Program (SEUL)	65047	29.39%	$10,228,429,850.44	3152	20.13%	$2,387,157,392.82	217	8.88%	$475,184,869.17	23	42.59%	$1,537,549.99	68439	28.58%	$13,092,309,762.42
Southwest Neighborhoods, Inc. (SWNI)	24654	11.14%	$5,704,532,618.34	842	5.38%	$995,538,008.31	179	7.32%	$1,660,616,478.32	0	0.00%	$0.00	25675	10.72%	$8,360,687,104.96
Total (cities + county)	221308	100.00%	$41,939,343,572.89	15659	100.00%	$17,100,267,860.85	2444	100.00%	$6,807,487,296.33	54	100.00%	$2,627,859.97	239473	100.00%	$65,849,726,590.04

Land

Communities (Multnomah County)	Residential Single Family Count	SF (Count % of Total) (percent)	SF Area (feet2)	SF Value (dollars)	Other Residential Count	(Count of Total) (percent)	Other Residential Area (feet2)	Residential Value (dollars)	Commercial Count	(Count % of Total) (percent)	Commercial Area (feet2)	Commercial Area (acres)	Commercial (Area % of Total) (percent)	Commercial Value (dollars)	Public Government Count	(Count of Total) (percent)	Government Area (feet2)	Government Area (acres)	Government (Area % of Total) (percent)	Government Value (dollars)	All Land Count	(Count of Total) (percent)	Area (feet2)	Total Area (acres)
Fairview	1569	0.84%	19286746	$224,135,000.00	169	1.09%	11143671	$45,613,520.00	85	0.62%	23710873	544.3268	1.07%	$106,767,400.00	114	1.89%	46402983	1065.2659	1.44%	$34,209,690.00	1891	0.86%	95111864	2183
Gresham	21483	11.45%	223505065	$2,301,308,900.00	1078	7.90%	140185807	$365,692,660.00	1032	7.56%	1065314591	24456.2586	33.05%	$113,850,140.00	653	10.82%	209410561	4807.4051	6.50%	$220,889,050.00	24493	11.13%	656453749	15070
Multnomah County	3511	1.87%	242182207	$1,003,304,218.00	2850	18.36%	1005846490	$593,067,574.00	1032	7.56%	1284245656	29482.2245	58.08%	$110,937,000.00	883	14.63%	—	—	33.05%	$113,850,140.00	7412	3.37%	3392022814	77870
Portland	156307	83.29%	1220469143	$23,166,570,037.00	10638	68.53%	422328922	$3,015,651,844.00	11209	82.12%	718359916	16491.2750	32.49%	$8,728,612,708.00	4140	68.60%	1812280602	41604.2392	56.23%	$1,095,779,688.00	180867	82.16%	4018853013	92260
Troutdale	4257	2.27%	41384734	$467,376,550.00	180	1.16%	20229667	$66,954,150.00	182	1.33%	34734023	797.3835	1.57%	$164,553,640.00	217	3.60%	84615448	1942.5035	2.63%	$111,152,670.00	4667	2.12%	170551581	3915
Wood Village	544	0.29%	8638120	$78,686,890.00	175	1.13%	2147467	$8,262,520.00	63	0.46%	11813441	271.1993	0.53%	$89,911,580.00	28	0.46%	5099772	117.0747	0.16%	$4,009,510.00	804	0.37%	25951276	596
Total (cities + county)	187671	100.00%	1755466016	$27,241,381,595.00	15522	100.00%	1611882024	$4,095,242,268.00	13649	100.00%	—	50763	100.00%	$10,091,197,648.00	6035	100.00%	—	73993	100.00%	$3,579,890,748.00	220134	100.00%	—	191895

Neighborhoods (City of Portland)	Residential Single Family Count	SF (Count % of Total) (percent)	SF Area (feet2)	SF Value (dollars)	Commercial Count	(Count of Total) (percent)	Commercial Area (feet2)	Commercial Area (acres)	Commercial (Area % of Total) (percent)	Commercial Value (dollars)	Public Government Count	(Count of Total) (percent)	Government Area (feet2)	Government Area (acres)	Government (Area % of Total) (percent)	Government Value (dollars)	Unassigned Count	(Count of Total) (percent)	Unassigned Area (feet2)	Unassigned Area (acres)	Unassigned (Area % of Total) (percent)	Unassigned Value (dollars)	All Land Count	(Count of Total) (percent)
Airport	2	0.00%	209436468	$322,500.00	32	0.29%	11775332	270.32	1.62%	$26,330,630.00	124	3.00%	217074206	4983.3382	12.26%	$980,037,290.00	8	8.60%	3552	0.0815	0.83%	$0.00	158	0.09%
Central City (CENT)	636	0.38%	9376979	$544,606,180.00	1827	16.28%	44167722	1013.95	6.08%	$2,852,404,770.00	328	7.92%	78197668	1795.1715	4.42%	$712,230,040.00	3	3.23%	23455	0.5385	5.35%	$0.00	2791	1.54%
Central Northeast Neighborhoods (CNN)	15128	9.14%	107601453	$2,181,702,450.00	1051	9.36%	73848745	1695.33	10.17%	$544,827,450.00	271	6.55%	109495018	2513.6598	6.18%	$69,730,790.00	6	6.45%	92925	2.1333	21.18%	$0.00	16450	9.09%
East Portland Neighborhood Office (EPNO)	36092	21.80%	428026664	$3,711,460,784.00	1779	15.85%	147488387	3385.87	20.31%	$5,214,269,550.00	934	22.57%	224950674	5164.1571	12.71%	$184,119,277.00	6	6.45%	13535	0.3107	3.09%	$0.00	38805	21.45%
Neighbors West/Northwest (NWNW)	6036	3.65%	151436573	$1,794,857,620.00	908	8.09%	84608450	1942.34	11.65%	$879,244,410.00	498	12.03%	296562744	6808.1440	16.75%	$125,436,960.00	7	7.53%	8143	0.1869	1.86%	$0.00	7442	4.11%
North Portland Neighborhood Services (NPNS)	19491	11.77%	134807607	$2,508,339,650.00	1403	12.50%	234073550	5373.59	32.23%	$1,272,387,950.00	573	13.84%	381551673	8759.2214	21.55%	$574,104,080.00	18	19.35%	115118	2.6427	26.24%	$0.00	21467	11.86%
Northeast Coalition (NECN)	18883	11.40%	102396872	$3,393,948,800.00	1014	9.04%	20880158	479.34	2.87%	$426,059,380.00	204	4.93%	68770270	1578.7482	3.88%	$42,249,110.00	4	4.30%	22365	0.5134	5.10%	$0.00	20101	11.11%
Southeast Uplift Neighborhood Program (SEUL)	47699	28.81%	295028701	$7,275,358,240.00	2508	22.35%	75674493	1737.25	10.42%	$1,024,605,368.00	558	13.48%	216401383	4967.8923	12.22%	$175,708,781.00	39	41.94%	147814	3.3933	33.69%	$0.00	50765	28.06%
Southwest Neighborhoods, Inc. (SWNI)	21616	13.05%	285801177	$4,384,569,719.00	701	6.25%	33801096	775.97	4.65%	$497,009,550.00	649	15.68%	177539183	4075.7390	10.03%	$232,194,540.00	2	2.15%	11817	0.2713	2.69%	$0.00	22966	12.69%
Total (cities + county)	165583	100.00%	1514685462	$25,795,165,943.00	11223	100.00%	726317933	16674	18.10%	$8,737,139,058.00	4139	100.00%	1770542819	40646	44.13%	$3,095,810,868.00	93	100.00%	438725	10.0717	100.00%	$0.00	180945	100.00%

Transportation

Communities (Multnomah County)	Freeways, Highways & Major Arterials Length (feet)	Length (miles)	Percent of Total Area (%)	Minor Arterials & Collect/Connectors Length (feet)	Length (miles)	Percent of Total Area %	Local Streets Length (feet)	Length (miles)	Percent of Total Area %	Total Road Length (feet)	Length (miles)	Length (miles)
Fairview	43364	8.21291	2.024%	42719	0.00	1.530%	143513	27.18	1.103%	229596	43.48417	1.279%
Gresham	182122	34.49284	8.500%	176219	0.00	6.310%	1317459	249.52	10.123%	1675800	317.38644	9.336%
Multnomah County	247155	46.80967	11.535%	477013	0.15	17.079%	1065465	0.14	8.187%	1389633	338.94561	9.970%
Portland	1597680	302.59088	74.560%	2045137	0.15	73.233%	10166930	0.57	78.121%	13809947	2615.52019	76.936%
Troutdale	59934	11.35111	2.797%	34105	6.46	1.221%	266174	0.06	2.045%	360213	68.22207	2.007%
Wood Village	12397	2.34792	0.579%	17507	3.32	0.627%	54837	10.39	0.421%	84740	16.04927	0.472%
Total (cities + county)	2142652	405.80532	100.000%	2792900	10.03	100.000%	13014377	287.85153	100.000%	17949929	3399.60775	100.000%

Neighborhoods (City of Portland)	Freeways, Highways & Major Arterials Length (feet)	Length (miles)	Percent of Total Area (%)	Minor Arterials & Collect/Connectors Length (feet)	Length (miles)	Percent of Total Area (juris) Area %	Local Streets Length (feet)	Length (miles)	Percent of Total Area %	Total Road Length (feet)	Length (miles)	Length %
Airport	63486	12.02386	3.980%	65851	12.47	3.213%	127402	24.12916	1.252%	256711	48.63948	1.857%
Central City (CENT)	201978	38.25338	12.663%	149504	28.32	7.295%	450443	85.31121	4.426%	801849	151.86530	5.801%
Central Northeast Neighborhoods (CNN)	153067	28.98997	9.596%	139750	26.47	6.820%	812168	153.81971	7.979%	1104871	209.25585	7.994%
East Portland Neighborhood Office (EPNO)	311041	58.90934	19.500%	379827	71.94	18.535%	1964686	372.09954	19.303%	2655403	502.91715	19.212%
Neighbors West/Northwest (NWNW)	98710	18.69506	6.188%	202056	38.27	9.860%	852523	161.46268	8.376%	1153204	218.40987	8.344%
North Portland Neighborhood Services (NPNS)	271144	51.35311	16.999%	191768	36.32	9.358%	1553707	294.26270	15.265%	2016391	381.89222	14.589%
Northeast Coalition (NECN)	74189	14.05098	4.651%	158837	30.08	7.751%	850862	161.14820	8.360%	1083776	205.26054	7.841%
Southeast Uplift Neighborhood Program (SEUL)	193101	36.57215	12.106%	406520	76.99	19.837%	2263665	428.72440	22.240%	2863033	542.24111	20.714%
Southwest Neighborhoods, Inc. (SWNI)	228364	43.25072	14.317%	355151	67.26	17.331%	1302849	246.75178	12.800%	1886211	357.23694	13.647%
Total (cities + county)	1595080	302	100.000%	2049265	388	100%	10178305	1928	100%	13821448	2618	100.000%

Critical Facilities: Buildings

Communities (Multnomah County)	School Buildings Count	School Buildings (Count % of Total) (percent)	Fire Buildings (count)	Fire Buildings (Count % of Total)	Police Buildings (count)	Police Buildings (Count % of Total)	Hospital Buildings (count)	Hospital Buildings (Count % of Total)	All Critical Buildings Total Count	Percent Total (Count % of Total) (percent)
Fairview	16	6.27%	0	0.00%	1	7.69%	0	0.00%	17	5.21%
Gresham	56	21.96%	4	9.76%	1	7.69%	1	5.88%	62	19.02%
Multnomah County	13	5.10%	6	14.63%	0	0.00%	0	0.00%	19	5.83%
Portland	161	63.14%	31	75.61%	11	84.62%	16	94.12%	219	67.18%
Troutdale	9	3.53%	0	0.00%	0	0.00%	0	0.00%	9	2.76%
Wood Village	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Total (cities + county)	255	100.00%	41	100.00%	13	100.00%	17	100.00%	326	100.00%

Exposure - Landslide Inventory - Shallow Landslide Deposits

Buildings

Buildings — Communities (Multnomah County)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Value (dollars)	Commercial Commercial Count	Commercial (Count % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Value (dollars)	Other (unassigned) Buildings Count	(Count of Total) (percent)	Value (dollars)	All Buildings Total Count	Percent Total (Count % of Total) (percent)	Total Value (dollars)
Fairview	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Gresham	1	0.00%	$1,021,150.01	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	1	0.00%	$6,319,936.43
Multnomah County	30	0.33%	$6,319,936.43	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	30	0.25%	$6,319,936.43
Portland	101	0.05%	$18,540,546.46	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	101	0.04%	$18,540,546.46
Troutdale	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Wood Village	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Total (cities + county)	**132**	**0.05%**	**$25,881,632.90**	**0**	**0.00%**	**$0.00**	**0**	**0.00%**	**$0.00**	**0**	**0.00%**	**$0.00**	**132**	**0.05%**	**$25,881,632.90**

Buildings — Neighborhoods (City of Portland)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Value (dollars)	Commercial Commercial Count	Commercial (Count % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Value (dollars)	Other (unassigned) Buildings Count	(Count of Total) (percent)	Value (dollars)	All Buildings Total Count	Percent Total (Count % of Total) (percent)	Total Value (dollars)
Airport	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Central City (CENT)	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Central Northeast Neighborhoods (CNN)	2	0.01%	$89,739.51	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	2	0.01%	$89,739.51
East Portland Neighborhood Office (EPNO)	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Neighbors West/Northwest (NWNW)	33	0.51%	$9,617,314.75	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	33	0.40%	$9,617,314.75
North Portland Neighborhood Services (NPNS)	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Northeast Coalition (NECN)	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Southeast Uplift Neighborhood Program (SEUL)	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Southwest Neighborhoods, Inc. (SWNI)	68	0.28%	$8,861,946.87	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	68	0.26%	$8,861,946.87
Total (cities + county)	**103**	**0.05%**	**$18,569,001.12**	**0**	**0.00%**	**$0.00**	**0**	**0.00%**	**$0.00**	**0**	**#DIV/0!**	**$0.00**	**103**	**0.67%**	**$18,569,001.12**

Land

Land — Communities (Multnomah County)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Area (feet2)	Residential Value (dollars)	Other Residential Count	Other Residential (Count % of Total) (percent)	Other Residential Area (feet2)	Other Residential Value (dollars)	Commercial Commercial Count	Commercial (Count % of Total) (percent)	Commercial Area (feet2)	Commercial Area (acres)	Commercial (Area % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Area (feet2)	Government Area (acres)	Government (Area % of Total) (percent)	Government Value (dollars)	All Land Count	(Count % of Total) (percent)	Area (feet2)	Total Area (acres)
Fairview	0	0.00%	$0.00	$0.00	0	0.00%	$0.00	$0.00	0	0.00%	0	0.00	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000
Gresham	31	0.14%	111445	$523,789.98	9	0.60%	14254	$46,843.32	3	0.28%	19301	0.44	0.01%	$19,524.73	19	2.91%	406500	9.3320	0.19%	$148,902.28	62	0.25%	551501	12.6607
Multnomah County	123	3.50%	942811	$5,251,082.54	263	9.23%	3394834	$1,625,880.17	142	13.76%	2208905	50.71	0.17%	$75,288.48	171	19.37%	1187432	27.2597	0.11%	$190,110.54	699	9.43%	7733982	177.5478
Portland	326	0.21%	1207292	$18,085,198.00	215	2.02%	1936963	$5,152,516.33	49	0.44%	272113	6.25	0.04%	$1,067,508.38	566	13.67%	4448381	102.1208	0.25%	$2,405,852.55	1156	0.64%	7864750	180.5498
Troutdale	14	0.33%	40866	$134,626.79	23	12.78%	85591	$145,825.66	1	0.55%	4844	0.11	0.01%	$699.20	30	13.82%	260098	5.9710	0.31%	$91,052.54	68	1.46%	391399	8.9853
Wood Village	0	0.00%	$0.00	$0.00	0	0.00%	0	$0.00	0	0.00%	0	0.00	0.00%	$0.00	0	0.00%	0	0.0000	0.31%	$0.00	0	0.00%	0	0.0000
Total (cities + county)	**494**	**0.26%**	**2302414**	**$23,994,697.30**	**510**	**3.29%**	**5431643**	**$6,971,065.48**	**195**	**1.43%**	**2505164**	**57.51**	**0.11%**	**$1,163,020.78**	**786**	**13.02%**	**6302411**	**144.6835**	**0.31%**	**$2,835,917.91**	**1985**	**0.90%**	**16541632**	**379.7436**
																								16541623

Land — Neighborhoods (City of Portland)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Area (feet2)	Residential Value (dollars)	Other Residential Count	Other Residential (Count % of Total) (percent)	Other Residential Area (feet2)	Other Residential Value (dollars)	Commercial Commercial Count	Commercial (Count % of Total) (percent)	Commercial Area (feet2)	Commercial Area (acres)	Commercial (Area % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Area (feet2)	Government Area (acres)	Government (Area % of Total) (percent)	Government Value (dollars)	All Land Count	(Count % of Total) (percent)	Area (feet2)	Total Area (acres)
Airport	0	0.00%	$0.00	$0.00	0	#REF!	0	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000
Central City (CENT)	0	0.00%	$0.00	$0.00	0	#REF!	0	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	2	0.61%	7097	0.1629	0.01%	$0.00	2	0.07%	7097	0.1629
Central Northeast Neighborhoods (CNN)	7	0.05%	9309.684408	$119,188.65	4	#REF!	72689	$274,881.49	0	0.00%	0	0.0000	0.00%	$0.00	16	5.90%	278979	6.4045	0.25%	$82,801.30	27	0.16%	360977	8.2869
East Portland Neighborhood Office (EPNO)	6	0.02%	22403.51302	$58,479.84	4	#REF!	39944	$9,697.49	2	0.11%	13188	0.3028	0.01%	$29,678.58	3	0.32%	53317	1.2240	0.02%	$100,831.59	15	0.04%	128853	2.9581
Neighbors West/Northwest (NWNW)	119	1.97%	430712.6537	$6,311,185.72	98	#REF!	585724	$915,191.45	11	1.21%	39329	0.9029	0.05%	$303,377.62	239	47.99%	1860472	42.7106	0.63%	$567,769.41	467	6.28%	2916236	66.9476
North Portland Neighborhood Services (NPNS)	20	0.10%	78255.13105	$845,565.22	16	#REF!	391547	$1,146,901.09	17	1.21%	122039	2.8016	0.05%	$324,863.35	29	5.06%	89685	2.0589	0.02%	$33,735.20	82	0.38%	681527	15.6457
Northeast Coalition (NECN)	2	0.01%	6992.81975	$120,305.10	1	#REF!	10407	$0.00	1	0.10%	3934	0.0903	0.02%	$15,352.80	0	0.00%	0	0.0000	0.00%	$0.00	4	0.02%	21334	0.4898
Southeast Uplift Neighborhood Program (SEUL)	4	0.01%	10393.14642	$103,007.27	4	#REF!	7884	$6,996.13	6	0.24%	23504	0.5396	0.03%	$83,373.38	31	5.56%	118937	2.7304	0.05%	$200,901.01	45	0.09%	160718	3.6896
Southwest Neighborhoods, Inc. (SWNI)	170	0.79%	650929.9819	$10,561,418.82	91	#REF!	847195	$3,176,800.05	10	1.43%	51584	1.1842	0.15%	$261,621.58	236	36.36%	1960453	45.0058	1.10%	$1,342,156.17	507	2.21%	3510162	80.5822
Total (cities + county)	**928**	**0.20%**	**1208997**	**$18,119,150.61**	**218**	**#REF!**	**1955391**	**$5,530,467.70**	**47**	**0.42%**	**253578**	**5.8213**	**0.03%**	**$1,018,267.31**	**556**	**5.70%**	**4368939**	**100.2970**	**0.25%**	**$2,328,194.68**	**1149**	**0.63%**	**7786904**	**178.7627**

Transportation

Communities (Multnomah County)	Freeways, Highways & Major Arterials Length (feet)	Freeways, Highways & Major Arterials Length (miles)	Freeways, Highways & Major Arterials Percent of Total Area (%)	Minor Arterials & Collect/Connectors Length (feet)	Minor Arterials & Collect/Connectors Length (miles)	Minor Arterials & Collect/Connectors Percent of Total Area (%)	Local Streets Length (feet)	Local Streets Length (miles)	Local Streets Percent of Total Area %	Total Road Length (feet)	Total Road Length (miles)	Total Road Length %
Fairview	0	0.00000	0.000%	0	0.00	0.000%	0	0.00	0.000%	0	0.00000	0.000%
Gresham	0	0.00000	0.000%	0	0.00	0.000%	0	0.00	0.000%	0	0.00000	0.000%
Multnomah County	0	0.00000	0.000%	789	0.15	4.505%	732	0.14	1.335%	1521	0.28803	0.008%
Portland	0	0.00000	0.000%	580	0.11	0.122%	2991	0.57	0.281%	3571	0.67635	0.020%
Troutdale	0	0.00000	0.000%	0	0.00	0.000%	325	0.06	0.122%	325	0.06145	0.000%
Wood Village	0	0.00000	0.000%	0	0.00	0.000%	0	0.00	0.000%	0	0.00000	0.000%
Total (cities + county)	**0**	**0.00000**	**0.000%**	**1369**	**0.26**	**0.049%**	**4047**	**0.76653**	**0.031%**	**5416**	**1.02584**	**0.030%**

Neighborhoods (City of Portland)	Freeways, Highways & Major Arterials Length (feet)	Freeways, Highways & Major Arterials Length (miles)	Freeways, Highways & Major Arterials Percent of Total Area (%)	Minor Arterials & Collect/Connectors Length (feet)	Minor Arterials & Collect/Connectors Length (miles)	Minor Arterials & Collect/Connectors Percent of Total (Juris) Area (%)	Local Streets Length (feet)	Local Streets Length (miles)	Local Streets Percent of Total Area %	Total Road Length (feet)	Total Road Length (miles)	Total Road Length %
Airport	0	0.00000	0.000%	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%
Central City (CENT)	0	0.00000	0.000%	0	0.00	0.000%	0	0.00000	0.000%	0	0.00	0.000%
Central Northeast Neighborhoods (CNN)	0	0.00000	0.000%	0	0.00	0.000%	0	0.00000	0.000%	0	0.00	0.000%
East Portland Neighborhood Office (EPNO)	0	0.00000	0.000%	583	0.11	0.885%	0	0.00000	0.000%	583	0.11	0.227%
Neighbors West/Northwest (NWNW)	0	0.00000	0.000%	0	0.00	0.000%	1053	0.19949	0.124%	1053	0.20	0.097%
North Portland Neighborhood Services (NPNS)	0	0.00000	0.000%	0	0.00	0.000%	0	0.00000	0.000%	0	0.00	0.000%
Northeast Coalition (NECN)	0	0.00000	0.000%	0	0.00	0.000%	0	0.00000	0.000%	0	0.00	0.000%
Southeast Uplift Neighborhood Program (SEUL)	0	0.00000	0.000%	0	0.00	0.000%	220	0.04174	0.027%	220	0.04	0.020%
Southwest Neighborhoods, Inc. (SWNI)	0	0.00000	0.000%	0	0.00	0.000%	1827	0.34600	0.406%	1827	0.35	0.228%
Total (cities + county)	**0**	**0.00000**	**0.000%**	**583**	**0.11**	**0.028%**	**3101**	**0.58723**	**0.030%**	**3683**	**0.70**	**0.027%**

Critical Facilities: Buildings

Communities (Multnomah County)	School Buildings Count	School Buildings (Count % of Total) (percent)	School Buildings Value (dollars)	Fire Buildings (count)	Fire Buildings (Count % of Total) (percent)	Fire Buildings Value (dollars)	Police Buildings (count)	Police Buildings (Count % of Total) (percent)	Police Buildings Value (dollars)	Hospital Buildings (count)	Hospital Buildings (Count % of Total) (percent)	Hospital Buildings Value (dollars)	All Critical Buildings Total Count	Percent Total (Count % of Total) (percent)	Total Value (dollars)
Fairview	0	0.000%	$0.00	0	#DIV/0!	$0.00	0	0.00%	$0.00	0	#DIV/0!	$0.00	0	0.00%	$0.00
Gresham	0	0.000%	$0.00	1	25.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	1	1.61%	$0.00
Multnomah County	0	0.000%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	#DIV/0!	$0.00	0	0.00%	$0.00
Portland	0	0.000%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Troutdale	2	22.222%	$0.00	0	#DIV/0!	$0.00	0	0.00%	$0.00	0	#DIV/0!	$0.00	2	22.22%	$0.00
Wood Village	0	#DIV/0!	$0.00	0	#DIV/0!	$0.00	0	0.00%	$0.00	0	#DIV/0!	$0.00	0	0.00%	$0.00
Total (cities + county)	**2**	**0.784%**		**1**	**2.44%**		**0**	**0.00%**	**$0.00**	**0**	**0.00%**	**$0.00**	**3**	**0.92%**	

Exposure - Landslide Inventory - Deep Landslides

Buildings

Communities (Multnomah County)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Value (dollars)	Commercial Count	Commercial (Count % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Value (dollars)	Other (unassigned) Buildings Count	(Count % of Total) (percent)	Value (dollars)	All Buildings Total Count	Percent Total (Count % of Total) (percent)	Total Value (dollars)
Fairview	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	#DIV/0!	$0.00	0	0.00%	$0.00
Gresham	5	0.02%	$1,079,369.98	0	0.00%	$0.00	0	0.00%	$0.00	0	#DIV/0!	$0.00	5	0.02%	$1,079,369.98
Multnomah County	581	6.30%	$124,144,628.79	63	2.30%	$2,702,669.58	7	3.48%	$715,350.01	0	0.00%	$0.00	651	5.35%	$127,562,648.38
Portland	1339	0.61%	$698,487,659.37	50	0.32%	$53,065,975.00	122	4.99%	$107,120,414.85	0	0.00%	$0.00	1511	0.63%	$858,674,049.22
Troutdale	28	0.55%	$1,421,969.88	1	0.34%	$41,317.41	0	0.00%	$0.00	0	#DIV/0!	$0.00	29	0.53%	$1,463,287.29
Wood Village	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	#DIV/0!	$0.00	0	0.00%	$0.00
Total (cities + county)	**1953**	**0.73%**	**$825,133,628.02**	**114**	**0.55%**	**$55,809,961.99**	**129**	**4.05%**	**$107,835,764.86**	**0**	**0.00%**	**$0.00**	**2196**	**0.75%**	**$988,779,354.87** 988779355

Neighborhoods (City of Portland)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Value (dollars)	Commercial Count	Commercial (Count % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Value (dollars)	Other (unassigned) Buildings Count	(Count % of Total) (percent)	Value (dollars)	All Buildings Total Count	Percent Total (Count % of Total) (percent)	Total Value (dollars)
Airport	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Central City (CENT)	20	2.70%	$102,865,138.00	27	1.41%	$30,611,608.80	1	0.75%	$3,860,261.58	0	0.00%	$0.00	48	1.72%	$137,337,008.38
Central Northeast Neighborhoods (CNN)	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
East Portland Neighborhood Office (EPNO)	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Neighbors West/Northwest (NWNW)	672	10.35%	$439,760,200.55	21	1.34%	$19,148,850.00	115	50.22%	$101,242,785.07	0	0.00%	$0.00	808	9.75%	$560,151,835.63
North Portland Neighborhood Services (NPNS)	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Northeast Coalition (NECN)	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Southeast Uplift Neighborhood Program (SEUL)	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Southwest Neighborhoods, Inc. (SWNI)	643	2.61%	$154,960,022.59	2	0.24%	$3,305,520.07	6	3.35%	$2,017,368.20	0	0.00%	$0.00	651	2.54%	$160,282,910.87
Total (cities + county)	**1335**	**0.60%**	**$697,585,361.14**	**50**	**0.32%**	**$53,065,978.87**	**122**	**4.99%**	**$107,120,414.85**	**0**	**0.00%**	**$0.00**	**1507**	**0.63%**	**$857,771,754.87**

Land

Communities (Multnomah County)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Area (feet2)	Residential Value (dollars)	Other Residential Count	Other Residential (Count % of Total) (percent)	Other Residential Area (feet2)	Other Residential Value (dollars)	Commercial Count	Commercial (Count % of Total) (percent)	Commercial Area (feet2)	Commercial Area (acres)	Commercial (Area % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Area (feet2)	Government Area (acres)	Government (Area % of Total) (percent)	Government Value (dollars)	All Land Count	(Count % of Total) (percent)	Area (feet2)	Total Area (acres)
Fairview	0	0.00%	0	$0.00	0	0.00%	0	$0.00	0	0.00%	0	0.00	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000
Gresham	7	0.03%	70772	$626,507.60	9	0.60%	477858	$629,708.70	0	0.00%	0	0.00	0.00%	$0.00	11	1.68%	522218	11.9885	0.25%	$442,805.33	27	0.11%	1070848	24.5833
Multnomah County	405	11.54%	14669706	$75,334,147.79	686	24.07%	130551500	$24,986,641.79	421	40.79%	168971076	3879.04	13.16%	$3,884,114.82	447	50.62%	82379405	1891.1710	7.73%	$9,296,950.40	1959	26.43%	396571687	9104.0335
Portland	1279	0.82%	14202966	$250,607,146.63	318	2.99%	10829401	$71,438,552.64	62	0.55%	1301979	29.89	0.18%	$42,390,734.39	346	8.36%	36525326	838.5061	2.02%	$19,006,601.42	2005	1.11%	62859672	1443.0596
Troutdale	11	0.26%	595339	$1,626,915.45	9	5.00%	1214279	$1,285,762.43	2	1.10%	28093	0.64	0.08%	$33,042.18	10	4.61%	313758	7.2029	0.37%	$24,601.82	32	0.69%	2151469	49.3909
Wood Village	0	0.00%	0	$0.00	0	0.00%	0	$0.00	0	0.00%	0	0.00	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000
Total (cities + county)	**1702**	**0.91%**	**29538783**	**$328,194,717.47**	**1022**	**6.58%**	**143073038**	**$98,340,665.55**	**485**	**3.55%**	**170301148**	**3909.58**	**7.70%**	**$46,307,891.40**	**814**	**13.49%**	**119740707**	**2748.8685**	**3.72%**	**$28,770,958.97**	**4023**	**1.83%**	**462653676**	**10621.0673**

Neighborhoods (City of Portland)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Area (feet2)	Residential Value (dollars)	Other Residential Count	Other Residential (Count % of Total) (percent)	Other Residential Area (feet2)	Other Residential Value (dollars)	Commercial Count	Commercial (Count % of Total) (percent)	Commercial Area (feet2)	Commercial Area (acres)	Commercial (Area % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Area (feet2)	Government Area (acres)	Government (Area % of Total) (percent)	Government Value (dollars)	All Land Count	(Count % of Total) (percent)	Area (feet2)	Total Area (acres)
Airport	0	0.00%	0	$0.00	0	#REF!	0	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000
Central City (CENT)	13	2.04%	11775	$818,490.91	12	#REF!	72304	$2,682,139.12	39	2.13%	169557	3.8925	0.38%	$11,774,462.94	6	0.00%	8993	0.2065	0.01%	$311,986.13	70	2.51%	262630	6.0291
Central Northeast Neighborhoods (CNN)	0	0.00%	0	$0.00	0	#REF!	0	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000
East Portland Neighborhood Office (EPNO)	0	0.00%	0	$0.00	0	#REF!	0	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000
Neighbors West/Northwest (NWNW)	646	10.70%	1198174	$35,640,236.01	161	#REF!	423478	$14,254,606.44	31	3.41%	90655	2.0812	0.11%	$4,963,208.82	188	37.75%	265489	6.0948	0.09%	$233,619.65	1026	13.79%	1977796	45.4039
North Portland Neighborhood Services (NPNS)	0	0.00%	0	$0.00	0	#REF!	0	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000
Northeast Coalition (NECN)	0	0.00%	0	$0.00	0	#REF!	0	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000
Southeast Uplift Neighborhood Program (SEUL)	0	0.00%	0	$0.00	0	#REF!	0	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000
Southwest Neighborhoods, Inc. (SWNI)	658	3.04%	1063782	$23,965,246.55	106	#REF!	129607	$968,550.59	3	0.43%	22885	0.5254	0.07%	$667,999.64	43	6.63%	11006	0.2527	0.01%	$41,843.67	810	3.53%	1227280	28.1745
Total (cities + county)	**1317**	**0.80%**	**2261956**	**$59,605,482.56**	**279**	**#REF!**	**625389**	**$17,905,296.15**	**73**	**0.65%**	**283098**	**6.4990**	**0.04%**	**$17,405,671.40**	**237**	**1.04%**	**285487**	**6.5539**	**0.02%**	**$587,449.45**	**1906**	**1.05%**	**3467705**	**79.6076**

Transportation

Communities (Multnomah County)	Freeways, Highways & Major Arterials Length (feet)	Length (miles)	Percent of Total Area (%)	Minor Arterials & Collect/Connectors Length (feet)	Length (miles)	Percent of Total (Juris) Area (%)	Local Streets Length (feet)	Length (miles)	Percent of Total Area %	Total Road Length (feet)	Length (miles)	Length %
Fairview	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%	0	0.00000	0.000%
Gresham	0	0.00	0.000%	787	0.15	0.447%	194	0.04	0.015%	981	0.18570	0.059%
Multnomah County	12883	2.44	5.212%	19075	3.61	3.999%	55323	10.48	5.192%	87282	16.53063	4.877%
Portland	4657	0.88	0.291%	14990	2.84	0.733%	122499	23.20	1.205%	142146	26.92152	7.943%
Troutdale	1973	0.37	3.292%	0	0.00	0.000%	4086	0.77	1.535%	6059	1.14756	1.682%
Wood Village	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%	0	0.00000	0.000%
Total (cities + county)	**19513**	**3.69562**	**0.911%**	**34852**	**6.60**	**1.248%**	**182102**	**34.48898**	**1.399%**	**236467**	**44.78541**	**1.32%**

Neighborhoods (City of Portland)	Freeways, Highways & Major Arterials Length (feet)	Length (miles)	Percent of Total Area (%)	Minor Arterials & Collect/Connectors Length (feet)	Length (miles)	Percent of Total (Juris) Area (%)	Local Streets Length (feet)	Length (miles)	Percent of Total Area %	Total Road Length (feet)	Length (miles)	Length %
Airport	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%
Central City (CENT)	0	0.00	0.000%	714	0.14	0.477%	3807	0.72	0.845%	4521	0.86	0.564%
Central Northeast Neighborhoods (CNN)	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%
East Portland Neighborhood Office (EPNO)	0	0.00	0.000%	0	0.00	0.000%	916	0.17	0.047%	916	0.17	0.034%
Neighbors West/Northwest (NWNW)	437	0.08	0.442%	4039	0.76	1.999%	87911	16.65	10.312%	92386	17.50	8.011%
North Portland Neighborhood Services (NPNS)	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%
Northeast Coalition (NECN)	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%
Southeast Uplift Neighborhood Program (SEUL)	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%
Southwest Neighborhoods, Inc. (SWNI)	4182	0.79	1.831%	9896	1.87	2.787%	30058	5.69	2.307%	44136	8.36	2.340%
Total (cities + county)	**4618**	**0.87**	**0.290%**	**14649**	**2.77**	**0.715%**	**122692**	**23.24**	**1.205%**	**141959**	**26.89**	**1.027%**

Critical Facilities: Buildings

Communities (Multnomah County)	School Buildings Count	School Buildings (Count % of Total) (percent)	School Buildings Value (dollars)	Fire Buildings (count)	Fire Buildings (Count % of Total) (percent)	Fire Buildings Value (dollars)	Police Buildings (count)	Police Buildings (Count % of Total) (percent)	Police Buildings Value (dollars)	Hospital Buildings (count)	Hospital Buildings (Count % of Total) (percent)	Hospital Buildings Value (dollars)	All Critical Buildings Total Count	Percent Total (Count % of Total) (percent)	Total Value (dollars)
Fairview	0	0.000%	n/a	0	0.000%	n/a	0	0.000%	n/a	0	0.000%	n/a	0	0.00%	n/a
Gresham	0	0.000%	n/a	0	0.000%	n/a	0	#DIV/0!	n/a	0	0.000%	n/a	0	0.00%	n/a
Multnomah County	0	0.000%	n/a	0	0.000%	n/a	0	#DIV/0!	n/a	0	0.000%	n/a	0	0.00%	n/a
Portland	1	0.621%	n/a	1	3.226%	n/a	0	0.000%	n/a	0	0.000%	n/a	2	0.91%	n/a
Troutdale	0	0.000%	n/a	0	#DIV/0!	n/a	0	#DIV/0!	n/a	0	#DIV/0!	n/a	0	0.00%	n/a
Wood Village	0	#DIV/0!	n/a	0	#DIV/0!	n/a	0	#DIV/0!	n/a	0	#DIV/0!	n/a	0	0.00%	n/a
Total (cities + county)	**1**	**0.392%**	**n/a**	**1**	**2.439%**	**n/a**	**0**	**0.000%**	**n/a**	**0**	**0.000%**	**n/a**	**2**	**0.61%**	**n/a**

Exposure - Landslide Inventory - Debris Flow & Fans

Buildings

Communities (Multnomah County)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Value (dollars)	Commercial Commercial Count	Commercial (Count % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Value (dollars)	Other (unassigned) Buildings Count	(Count of Total) (percent)	Value (dollars)	All Buildings Total Count	Percent Total (Count % of Total) (percent)	Total Value (dollars)
Fairview	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Gresham	35	0.12%	$2,600,994.94	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	35	0.01%	$2,600,994.94
Multnomah County	53	0.57%	$4,346,468.70	4	0.02%	$353,089.99	2	0.06%	$115,840.00	0	0.00%	$0.00	59	0.02%	$4,815,398.69
Portland	222	0.10%	$35,152,182.76	26	0.12%	$10,839,297.30	0	0.00%	$0.00	0	0.00%	$0.00	248	0.10%	$45,991,480.06
Troutdale	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Wood Village	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Total (cities + county)	**310**	**0.12%**	**$42,099,646.41**	**30**	**0.14%**	**$11,192,387.28**	**2**	**0.06%**	**$115,840.00**	**0**	**0.00%**	**$0.00**	**342**	**0.14%**	**$53,407,873.69**

Neighborhoods (City of Portland)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Value (dollars)	Commercial Commercial Count	Commercial (Count % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Value (dollars)	Other (unassigned) Buildings Count	(Count of Total) (percent)	Value (dollars)	All Buildings Total Count	Percent Total (Count % of Total) (percent)	Total Value (dollars)
Airport	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Central City (CENT)	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Central Northeast Neighborhoods (CNN)	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
East Portland Neighborhood Office (EPNO)	34	0.07%	$55,852.73	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	34	0.07%	$55,852.73
Neighbors West/Northwest (NWNW)	32	0.49%	$70,401.84	24	1.53%	$115,426.09	0	0.00%	$0.00	0	0.00%	$0.00	56	0.68%	$185,827.92
North Portland Neighborhood Services (NPNS)	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Northeast Coalition (NECN)	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Southeast Uplift Neighborhood Program (SEUL)	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	#DIV/0!	$0.00	0	0.00%	$0.00
Southwest Neighborhoods, Inc. (SWNI)	156	0.63%	$272,989.59	2	0.24%	$7,549.17	0	0.00%	$0.00	0	0.00%	$0.00	158	0.62%	$280,538.76
Total (cities + county)	**156**	**0.07%**	**$399,244.16**	**26**	**2600.00%**	**$122,975.25**	**0**	**0.00%**	**$0.00**	**0**	**0.00%**	**$0.00**	**248**	**0.10%**	**$522,219.42**

Land

Communities (Multnomah County)	Single Family Count	Single Family (Count % of Total) (percent)	Single Family Area (feet2)	Residential Value (dollars)	Other Residential Count	Other Residential (Count % of Total) (percent)	Other Residential Area (feet2)	Other Residential Value (dollars)	Commercial Commercial Count	Commercial (Count % of Total) (percent)	Commercial Area (feet2)	Commercial Area (acres)	Commercial (Area % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Area (feet2)	Government Area (acres)	Government (Area % of Total) (percent)	Government Value (dollars)	All Land Count	(Count % of Total) (percent)	Area (feet2)	Total Area (acres)
Fairview	0	0.00%	0	$0.00	0	0.00%	0	$0.00	0	0.00%	0	0.00	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000
Gresham	35	0.16%	860904	$2,666,718.65	11	0.73%	418669	$366,799.12	2	0.19%	42191	0.97	0.03%	$45,096.42	20	3.06%	735580	16.8866	0.35%	$188,635.39	68	0.28%	2057344	47.2301
Multnomah County	25	0.71%	616983.42	$1,019,985.60	121	4.25%	3611578	$1,794,863.94	95	9.21%	1750229	40.18	0.14%	$171,142.61	123	13.93%	2445233	56.1348	0.23%	$392,349.29	364	4.91%	8424023	193.3890
Portland	215	0.14%	1074971	$22,485,070.62	61	0.57%	849260	$6,069,750.90	52	0.46%	763787	17.53	0.11%	$6,291,303.45	131	3.16%	1195191	27.4378	0.07%	$630,790.26	459	0.25%	3883210	89.1462
Troutdale	0	1.8161	0	$0.00	0	0.00%	0	$0.00	1	0.55%	11899	0.27	0.03%	$60,957.23	7	3.23%	67210	1.5429	0.08%	$89,036.86	8	0.17%	79109	1.8161
Wood Village	0	0.00%	0	$0.00	0	0.00%	0	$0.00	0	0.00%	0	0.00	0.00%	$0.00	0	3.57%	25756	0.5913	0.51%	$58,203.38	1	0.12%	25756	0.5913
Total (cities + county)	**275**	**0.15%**	**2552859**	**$26,171,774.87**	**193**	**1.24%**	**4879507**	**$8,231,413.97**	**150**	**1.10%**	**2568106**	**58.96**	**0.12%**	**$6,568,499.71**	**282**	**4.67%**	**4468970**	**102.5934**	**0.14%**	**$1,359,015.17**	**900**	**0.41%**	**14469442**	**332.1727**

Neighborhoods (City of Portland)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Area (feet2)	Residential Value (dollars)	Commercial Commercial Count	Commercial (Count % of Total) (percent)	Commercial Area (feet2)	Commercial Area (acres)	Commercial (Area % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Area (feet2)	Government Area (acres)	Government (Area % of Total) (percent)	Government Value (dollars)	All Land Count	(Count % of Total) (percent)	Area (feet2)	Total Area (acres)	(Area % of Total) (percent)	Value (dollars)
Airport	0	0.00%	0	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00
Central City (CENT)	0	0.00%	0	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00
Central Northeast Neighborhoods (CNN)	0	0.00%	0	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00
East Portland Neighborhood Office (EPNO)	37	0.10%	37888.29061	$321,849.99	0	0.00%	0	0.0000	0.00%	$0.00	2	0.21%	34	0.0008	0.00%	$0.00	39	0.10%	37923	0.8706	0.00%	$321,849.99
Neighbors West/Northwest (NWNW)	35	0.58%	37066.58819	$643,845.51	28	3.08%	89427	2.0530	0.11%	$1,001,919.05	3	0.60%	273	0.0063	0.00%	$0.00	66	0.89%	126766	2.9102	0.02%	$1,645,764.56
North Portland Neighborhood Services (NPNS)	0	0.00%	0	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00
Northeast Coalition (NECN)	0	0.00%	0	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00
Southeast Uplift Neighborhood Program (SEUL)	0	0.00%	0	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00
Southwest Neighborhoods, Inc. (SWNI)	187	0.87%	194486.8098	$7,323,128.66	2	0.29%	7048	0.1618	0.00%	$210,461.37	5	0.77%	615	0.0141	0.00%	$0.00	194	0.84%	202149	4.6407	0.04%	$7,533,590.03
Total (cities + county)	**259**	**0.16%**	**269442**	**$8,288,824.16**	**30**	**0.27%**	**96474**	**2.2147**	**0.01%**	**$1,212,380.43**	**10**	**0.12%**	**922**	**0.0212**	**0.00%**	**$0.00**	**299**	**0.00**	**366838**	**8.4214**	**0.00**	**$9,501,204.59**

Transportation

Communities (Multnomah County)	Freeways, Highways & Major Arterials Length (feet)	Freeways, Highways & Major Arterials Length (miles)	Freeways, Highways & Major Arterials Percent of Total Area (%)	Minor Arterials & Collect/Connectors Length (feet)	Minor Arterials & Collect/Connectors Length (miles)	Minor Arterials & Collect/Connectors Percent of Total (Juris) Area (%)	Local Streets Length (feet)	Local Streets Length (miles)	Local Streets Percent of Total Area %	Total Road Length (feet)	Total Road Length (miles)	Total Road Length %
Fairview	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%	0	0.00000	0.000%
Gresham	0	0.00	0.000%	774	0.15	0.439%	0	0.00	0.000%	774	0.14659	0.046%
Multnomah County	59	0.01	0.473%	525	0.10	2.999%	6085	1.15	11.097%	6669	1.26305	7.870%
Portland	0	0.00	0.000%	1044	0.20	0.219%	7293	1.38	0.685%	8337	1.57901	0.466%
Troutdale	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%	0	0.00000	0.000%
Wood Village	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%	0	0.00000	0.000%
Total (cities + county)	**59**	**0.01109**	**0.003%**	**2343**	**0.44**	**0.08%**	**13379**	**2.53384**	**0.10%**	**15780**	**2.98865**	**0.09%**

Neighborhoods (City of Portland)	Freeways, Highways & Major Arterials Length (feet)	Freeways, Highways & Major Arterials Length (miles)	Freeways, Highways & Major Arterials Percent of Total Area (%)	Minor Arterials & Collect/Connectors Length (feet)	Minor Arterials & Collect/Connectors Length (miles)	Minor Arterials & Collect/Connectors Percent of Total (Juris) Area (%)	Local Streets Length (feet)	Local Streets Length (miles)	Local Streets Percent of Total Area %	Total Road Length (feet)	Total Road Length (miles)	Total Road Length %
Airport	0	0.00	0.000%	0	0.00	0.000%	0	0.00000	0.000%	0	0.00000	0.000%
Central City (CENT)	0	0.00	0.000%	0	0.00	0.000%	0	0.00000	0.000%	0	0.00000	0.000%
Central Northeast Neighborhoods (CNN)	0	0.00	0.000%	0	0.00	0.000%	0	0.00000	0.000%	0	0.00000	0.000%
East Portland Neighborhood Office (EPNO)	0	0.00	0.000%	252	0.05	0.383%	1856	0.35160	1.457%	2108	0.39933	0.821%
Neighbors West/Northwest (NWNW)	0	0.00	0.000%	0	0.00	0.000%	2343	0.44383	0.275%	2343	0.44383	0.216%
North Portland Neighborhood Services (NPNS)	0	0.00	0.000%	0	0.00	0.000%	0	0.00000	0.000%	0	0.00000	0.000%
Northeast Coalition (NECN)	0	0.00	0.000%	0	0.00	0.000%	0	0.00000	0.000%	0	0.00000	0.000%
Southeast Uplift Neighborhood Program (SEUL)	0	0.00	0.000%	0	0.00	0.000%	0	0.00000	0.000%	0	0.00000	0.000%
Southwest Neighborhoods, Inc. (SWNI)	0	0.00	0.000%	792	0.15	0.530%	3094	0.58602	0.687%	3886	0.73599	0.485%
Total (cities + county)	**0**	**0.00**	**0.000%**	**1044**	**0.20**	**0.051%**	**7294**	**1.38145**	**0.072%**	**8338**	**1.57915**	**0.060%**

Critical Facilities: Buildings

Communities (Multnomah County)	School Buildings Count	School Buildings (Count % of Total) (percent)	School Buildings Value (dollars)	Fire Buildings (count)	Fire Buildings (Count % of Total) (percent)	Fire Buildings Value (dollars)	Police Buildings (count)	Police Buildings (Count % of Total) (percent)	Police Buildings Value (dollars)	Hospital Buildings (count)	Hospital Buildings (Count % of Total) (percent)	Hospital Buildings Value (dollars)	All Critical Buildings Total Count	Percent Total (Count % of Total) (percent)	Total Value (dollars)
Fairview	0	0	0	0	#DIV/0!	0	0	0.000%	0	0	#DIV/0!	0	0	0.000%	0
Gresham	0	0	0	0	0.000%	0	0	0.000%	0	0	0.000%	0	0	0.00%	0
Multnomah County	0	0	0	0	0.000%	0	0	0.000%	0	0	#DIV/0!	0	0	0.00%	0
Portland	0	0	0	0	0.000%	0	0	0.000%	0	0	0.000%	0	0	0.00%	0
Troutdale	0	0	0	0	#DIV/0!	0	0	#DIV/0!	0	0	#DIV/0!	0	0	0.00%	0
Wood Village	0	#DIV/0!	0	0	#DIV/0!	0	0	#DIV/0!	0	0	#DIV/0!	0	0	#DIV/0!	0
Total (cities + county)	**0**	**0**	**0**	**0**	**0.00%**	**0**	**0**	**0.00%**	**0**	**0**	**0.00%**	**0**	**0**	**0.00%**	**0**

Exposure - Landslide Inventory - Low Shallow LS Susceptibility

Buildings

Communities (Multnomah County)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Value (dollars)	Commercial Count	Commercial (Count % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Value (dollars)	Other (unassigned) Buildings Count	(Count of Total) (percent)	Value (dollars)	All Buildings Total Count	Percent Total (Count % of Total) (percent)	Total Value (dollars)
Fairview	2534	97.99%	$309,383,187.79	159	95.21%	$99,301,110.13	89	96.74%	$41,576,169.53	0		$0.00	2782	97.79%	$450,260,467.45
Gresham	27300	93.23%	$2,895,011,794.86	2063	98.38%	$1,374,173,855.62	280	93.65%	$394,926,797.22	2	1.00	$0.00	29645	93.57%	$4,664,112,447.69
Multnomah County	7167	77.66%	$601,440,384.74	2459	89.68%	$128,177,565.35	176	87.56%	$72,539,785.91	0		$0.00	9802	80.53%	$802,157,736.00
Portland	195718	88.51%	$29,168,200,473.52	14925	96.36%	$14,716,954,781.51	2276	93.16%	$4,806,395,695.24	38	0.97	$2,067,397.11	212957	89.07%	$48,693,618,347.37
Troutdale	4797	94.37%	$476,504,770.07	281	95.90%	$289,854,978.36	132	92.96%	$84,972,794.86	0		$0.00	5210	94.42%	$851,332,543.29
Wood Village	1105	97.36%	$59,469,382.40	108	95.58%	$100,126,435.69	8	80.00%	$473,045.25	0		$0.00	1221	97.06%	$160,068,863.34
Total (cities + county)	**238621**	**88.89%**	**$33,510,009,993.38**	**19995**	**95.67%**	**$16,708,588,726.65**	**2961**	**92.91%**	**$5,400,884,288.01**	**40**	**0.98**	**$2,067,397.11**	**261617**	**89.42%**	**$55,621,550,405.15**

Neighborhoods (City of Portland)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Value (dollars)	Commercial Count	Commercial (Count % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Value (dollars)	Other (unassigned) Buildings Count	(Count of Total) (percent)	Value (dollars)	All Buildings Total Count	Percent Total (Count % of Total) (percent)	Total Value (dollars)
Airport	8	100.00%	$0.00	240	97.17%	$29,041,061.95	431	96.64%	$896,865,595.37	8	0.53	$0.00	687	95.95%	$925,906,657.32
Central City (CENT)	213	28.78%	$5,280,077,113.94	1885	98.23%	$5,565,228,069.98	128	95.52%	$1,476,326,121.19	1	1.00	$0.00	2227	79.71%	$12,321,631,305.11
Central Northeast Neighborhoods (CNN)	21750	95.22%	$2,479,285,513.81	1379	95.17%	$742,893,291.55	109	95.61%	$142,554,983.72	3	1.00	$75,140.00	23241	95.21%	$3,364,608,929.08
East Portland Neighborhood Office (EPNO)	45641	96.01%	$4,203,336,894.59	2586	98.07%	$1,879,960,046.07	261	95.26%	$480,133,664.91	1	1.00	$69,890.00	48489	96.11%	$6,563,500,495.57
Neighbors West/Northwest (NWNW)	2538	39.09%	$1,126,097,773.60	1485	94.89%	$1,199,787,556.23	157	68.56%	$183,967,394.53	1	1.00	$288,699.00	4181	50.45%	$2,510,141,423.44
North Portland Neighborhood Services (NPNS)	26888	96.87%	$2,913,222,891.98	2612	97.35%	$1,908,231,266.74	732	96.57%	$558,005,331.24	7	1.00	$530,517.30	30239	96.91%	$5,379,990,007.26
Northeast Coalition (NECN)	24738	94.28%	$1,959,844,058.00	1130	97.00%	$858,899,705.69	95	102.15%	$159,050,450.41	2	0.67	$0.00	25965	94.42%	$4,977,794,214.10
Southeast Uplift Neighborhood Program (SEUL)	59748	91.85%	$7,657,105,920.24	3064	97.21%	$1,953,079,688.75	204	94.01%	$398,829,691.43	23	1.00	$1,103,150.73	63039	92.11%	$10,010,118,451.15
Southwest Neighborhoods, Inc. (SWNI)	13931	56.51%	$1,565,093,279.18	713	84.68%	$571,128,854.35	160	89.39%	$510,837,282.88	0		$0.00	14804	57.66%	$2,647,059,416.42
Total (cities + county)	**195455**	**88.32%**	**$29,184,063,445.34**	**15094**	**96.39%**	**$14,708,049,541.32**	**2277**	**93.17%**	**$4,806,570,515.69**	**46**	**0.85**	**$2,067,397.11**	**212872**	**88.89%**	**$48,700,750,899.46**

Land

Communities (Multnomah County)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Area (feet2)	Residential Value (dollars)	Other Residential Count	Other Residential (Count % of Total) (percent)	Other Residential Area (feet2)	Other Residential Value (dollars)	Commercial Count	Commercial (Count % of Total) (percent)	Commercial Area (feet2)	Commercial Area (acres)	Commercial (Area % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Area (feet2)	Government Area (acres)	Government (Area % of Total) (percent)	Government Value (dollars)	Unassigned Count	Unassigned (Count % of Total) (percent)	Unassigned Area (feet2)	Unassigned Area (acres)
Fairview	1549	98.73%	14502428	$171,873,697.20	162	95.86%	8291275	$36,783,420.19	92	108.24%	19025394.31	436.76	80.24%	$94,277,762.07	134	117.54%	52944874	1215.4471	114.10%	$29,539,855.20	0	#DIV/0!	0	0.0000
Gresham	20592	95.85%	161316041	$1,728,708,016.96	1390	92.05%	78376997	$271,244,936.99	1091	101.21%	119223656.97	2737.00	86.15%	$5,783,851,521.73	649	99.39%	154010090	3535.5853	73.54%	$167,279,075.89	23	#DIV/0!	809146	18.5754
Multnomah County	2381	67.82%	76066424	$301,355,073.51	2213	77.65%	258566909	$228,516,444.82	965	93.51%	774956059.62	17790.54	60.34%	$54,038,309.88	694	78.60%	518574591	11904.8349	48.68%	$52,103,175.62	0	#DIV/0!	0	0.0000
Portland	144082	92.18%	812313840	$15,552,023,623.79	8727	82.04%	146733168	$1,795,986,988.32	11033	98.43%	559243145.16	12838.46	77.85%	$7,261,835,246.12	3778	91.26%	1354467149	31094.2882	74.74%	$2,384,849,333.76	89	#DIV/0!	299378	6.8728
Troutdale	4033	94.74%	31621052	$371,262,766.55	151	83.89%	6290497	$26,784,109.17	180	98.90%	34600913.39	794.33	99.62%	$135,343,952.78	202	93.09%	60432187	1387.3322	71.42%	$74,531,603.49	0	#DIV/0!	0	0.0000
Wood Village	528	97.06%	5115731	$55,207,414.57	145	82.86%	6038630	$2,790,082.03	60	95.24%	7053054.38	161.92	59.70%	$67,860,630.93	24	85.71%	3129792	71.8501	61.37%	$5,993,783.24	0	#DIV/0!	0	0.0000
Total (cities + county)	**173165**	**92.27%**	**1100935516**	**$18,180,430,592.59**	**12788**	**82.39%**	**504297476**	**$2,362,105,981.52**	**13421**	**98.33%**	**1514102223.82**	**34759.01**	**68.47%**	**$58,397,207,423.50**	**5481**	**90.82%**	**2143558683**	**49209.3378**	**66.51%**	**$2,713,296,827.20**	**112**	**#DIV/0!**	**1108525**	**25.4482**

208656

Neighborhoods (City of Portland)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Area (feet2)	Residential Value (dollars)	Commercial Count	Commercial (Count % of Total) (percent)	Commercial Area (feet2)	Commercial Area (acres)	Commercial (Area % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Area (feet2)	Government Area (acres)	Government (Area % of Total) (percent)	Government Value (dollars)	All Land Count	(Count % of Total) (percent)	Area (feet2)	Area (acres)	(Area % of Total) (percent)	Value (dollars)
Airport	2	100.00%			30	93.75%		244.9190	90.60%	$19,309,100.69	120	96.77%	196859322.05	4519.2683	90.69%	$897,925,389.99	152	96.20%	211486815	4855.0694	92.3%	$917,492,621.27
Central City (CENT)	547	86.01%	6494856092	$404,738,991.66	1809	93.95%	36369801.83	834.9358	82.34%	$2,463,207,537.99	315	96.04%	62423204.40	1433.0396	79.83%	$505,522,807.31	2671	95.70%	103425633	2374.3259	78.5%	$3,373,469,336.96
Central Northeast Neighborhoods (CNN)	14807	97.88%	91052222.75	$1,854,369,268.34	1031	98.10%	53722777.49	1233.3053	72.75%	$437,474,621.24	247	91.14%	80937000.93	1858.0579	73.92%	$53,266,830.62	16085	97.78%	228048552	5235.2746	78.4%	$2,345,110,720.20
East Portland Neighborhood Office (EPNO)	35382	98.03%	344338217.4	$3,209,083,947.46	1774	99.72%	118781580.27	2726.8500	80.54%	$1,064,500,419.21	890	95.29%	171766769.27	3943.2226	76.36%	$143,380,560.91	38046	98.04%	643517244	14773.1236	80.4%	$4,416,964,927.59
Neighbors West/Northwest (NWNW)	2816	46.65%	15046524.86	$329,588,420.26	883	97.25%	63629895.29	1460.7414	75.21%	$707,104,007.59	325	65.26%	48545324.49	1114.4473	16.37%	$46,719,809.15	4024	54.07%	141566211	3249.9131	26.6%	$1,083,412,237.01
North Portland Neighborhood Services (NPNS)	18512	99.08%	114042702.4	$2,198,853,941.22	1369	97.58%	18846050.42	4326.4579	80.51%	$1,070,729,784.75	552	96.34%	306473017.69	7035.6526	80.32%	$481,056,454.46	21233	98.51%	605206440	13893.6286	80.6%	$3,750,640,180.14
Northeast Coalition (NECN)	18518	98.07%	82711618.57	$2,720,628,078.30	1008	99.41%	16282229.92	373.7886	77.98%	$353,356,541.71	198	97.06%	52640386.47	1208.4570	76.55%	$36,741,000.19	19724	98.12%	151907976	3487.3274	79.1%	$3,110,725,620.20
Southeast Uplift Neighborhood Program (SEUL)	46329	97.13%	229550665.4	$5,473,920,719.21	2492	99.36%	57430441.78	1318.4216	75.89%	$882,656,640.27	545	97.67%	172380610.51	3957.3144	79.66%	$143,182,918.20	49366	97.24%	455809743	10463.9522	77.6%	$6,499,760,277.69
Southwest Neighborhoods, Inc. (SWNI)	15146	70.07%	79736953.02	$1,167,206,542.80	642	91.58%	17069460.99	391.8609	0.00%	$265,721,363.81	538	82.90%	56431494.52	1295.4889	31.79%	$66,684,743.76	16326	71.09%	157777947	3622.0834	31.7%	$1,499,612,650.36
Total (cities + county)	**152859**	**92.32%**	**962973760**	**$17,358,648,039.85**	**11038**	**98.35%**	**562415358.19**	**12911.2805**	**77.43%**	**$7,264,060,017.27**	**3730**	**13.00%**	**1148457130.33**	**26364.9488**	**64.86%**	**$2,374,480,514.59**	**167627**	**92.64%**	**2698746561**	**61954.6981**	**67.3%**	**$26,997,188,571.71**

Transportation

Communities (Multnomah County)	Freeways, Highways & Major Arterials Length (feet)	Freeways, Highways & Major Arterials Length (miles)	Freeways, Highways & Major Arterials Percent of Total Area (%)	Minor Arterials & Collect/Connectors Length (feet)	Minor Arterials & Collect/Connectors Length (miles)	Minor Arterials & Collect/Connectors Percent of Total (Juris) Area (%)	Local Streets Length (feet)	Local Streets Length (miles)	Local Streets Percent of Total Area %	Total Road Length (feet)	Total Road Length (miles)	Total Road Length %
Fairview	28895	5.47	66.634%	29614	5.61	69.322%	127614	24.17	88.922%	186123	35.25	81.065%
Gresham	157597	29.85	86.534%	132217	25.04	75.030%	1099592	208.26	83.463%	1389407	263.15	82.910%
Multnomah County	130233	24.67	52.693%	143141	27.11	30.008%	478843	90.69	44.942%	752217	142.47	42.032%
Portland	1082831	205.08	67.775%	1348723	255.44	65.941%	7318754	1386.13	71.986%	9750308	1846.65	70.604%
Troutdale	39845	7.55	66.482%	24995	4.73	73.288%	227070	43.01	85.309%	291910	55.29	81.038%
Wood Village	7816	1.48	63.044%	15040	2.85	85.908%	49030	9.29	89.412%	71885	13.61	84.830%
Total (cities + county)	**1447217**	**274.09415**	**67.543%**	**1693729**	**320.78**	**60.644%**	**9300903**	**1761.53467**	**71.47%**	**12441850**	**2356.41**	**69.31%**

Neighborhoods (City of Portland)	Freeways, Highways & Major Arterials Length (feet)	Freeways, Highways & Major Arterials Length (miles)	Freeways, Highways & Major Arterials Percent of Total Area (%)	Minor Arterials & Collect/Connectors Length (feet)	Minor Arterials & Collect/Connectors Length (miles)	Minor Arterials & Collect/Connectors Percent of Total (Juris) Area (%)	Local Streets Length (feet)	Local Streets Length (miles)	Local Streets Percent of Total Area %	Total Road Length (feet)	Total Road Length (miles)	Total Road Length %
Airport	54453	10.31	85.771%	29027	5.50	44.080%	117512	22.26	92.245%	201001	38.07	78.299%
Central City (CENT)	127572	24.16	63.161%	130424	24.70	87.238%	389478	73.76	86.466%	647474	122.63	80.748%
Central Northeast Neighborhoods (CNN)	107667	20.39	70.340%	100155	18.97	71.667%	689243	130.54	84.865%	897065	169.90	81.192%
East Portland Neighborhood Office (EPNO)	240555	45.56	77.338%	303901	57.56	80.010%	1755591	332.50	89.357%	2300047	435.61	86.618%
Neighbors West/Northwest (NWNW)	55652	10.54	56.380%	75944	14.38	37.586%	250488	47.44	29.382%	382084	72.36	33.132%
North Portland Neighborhood Services (NPNS)	191710	36.31	70.704%	154794	29.32	80.719%	1310277	248.16	84.332%	1656781	313.78	82.166%
Northeast Coalition (NECN)	53228	10.08	71.746%	124322	23.55	78.270%	638130	120.90	75.021%	815880	154.52	75.281%
Southeast Uplift Neighborhood Program (SEUL)	146881	27.82	76.064%	331075	62.70	81.441%	1741582	329.85	76.936%	2219538	420.37	77.524%
Southwest Neighborhoods, Inc. (SWNI)	104616	19.81	45.811%	98854	18.72	27.834%	432491	81.91	33.196%	635961	120.45	33.716%
Total (cities + county)	**1082334**	**204.99**	**67.855%**	**1348497**	**255.40**	**65.804%**	**7325001**	**1387.31**	**71.967%**	**9755831**	**1847.70**	**70.585%**

Critical Facilities: Buildings

Communities (Multnomah County)	School Buildings Count	School Buildings (Count % of Total) (percent)	Fire Buildings (count)	Fire Buildings (Count % of Total) (percent)	Police Buildings (count)	Police Buildings (Count % of Total) (percent)	Hospital Buildings (count)	Hospital Buildings (Count % of Total) (percent)	All Critical Buildings Total Count	Percent Total (Count % of Total) (percent)
Fairview	16	100.000%	0	0.000%	1	100.000%	0	0.00%	17	100.00%
Gresham	56	100.000%	4	100.000%	1	100.000%	1	100.00%	62	100.00%
Multnomah County	13	100.000%	6	100.000%	0	0.000%	0	0.00%	19	100.00%
Portland	161	100.000%	31	100.000%	11	100.000%	16	100.00%	219	100.00%
Troutdale	9	100.000%	0	0.000%	0	0.000%	0	0.00%	9	100.00%
Wood Village	0	0.000%	0	0.000%	0	0.000%	0	0.00%	0	0.00%
Total (cities + county)	**255**	**100.000%**	**41**	**100.00%**	**13**	**100.00%**	**17**	**100.00%**	**326**	**100.00%**

Exposure - Landslide Inventory - Moderate Shallow LS Susceptibility

Buildings

Communities (Multnomah County)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Value (dollars)	Commercial Commercial Count	Commercial (Count % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Value (dollars)	Other (unassigned) Buildings Count	(percent)	Value (dollars)	All Buildings Total Count	Percent Total (Count % of Total) (percent)	Total Value (dollars)
Fairview	738	28.54%	$131,910,913.78	63	37.72%	$93,295,637.64	18	19.57%	$14,402,827.72	0	#DIV/0!	$0.00	819	28.79%	$239,609,379.14
Gresham	9572	32.69%	$2,070,929,058.57	610	29.09%	$1,846,416,050.81	132	44.15%	$986,648,949.34	0	#DIV/0!	$0.00	10314	32.56%	$4,903,994,058.72
Multnomah County	5774	62.56%	$1,352,576,800.34	1196	43.62%	$188,512,267.87	96	47.76%	$100,313,632.01	0	#DIV/0!	$0.00	7066	58.05%	$1,641,402,700.23
Portland	75853	34.30%	$24,351,752,490.71	6467	41.75%	$18,483,835,846.68	1216	49.77%	$22,175,768,043.12	9	23.08%	$1,309,619.96	83545	34.94%	$65,012,666,000.47
Troutdale	1469	28.90%	$196,012,306.99	111	37.88%	$104,422,608.08	28	19.72%	$25,028,477.59	0	#DIV/0!	$0.00	1608	29.14%	$325,463,392.66
Wood Village	190	16.74%	$26,849,590.41	54	47.79%	$72,521,006.47	5	50.00%	$553,393.08	0	#DIV/0!	$0.00	249	19.79%	$99,923,989.96
Total (cities + county)	**93596**	**34.87%**	**$28,130,031,160.81**	**8501**	**40.67%**	**$20,789,003,417.56**	**1495**	**230.97%**	**$23,302,715,322.86**	**9**	**21.95%**	**$1,309,619.96**	**103601**	**35.41%**	**$72,223,059,521.19**

Neighborhoods (City of Portland)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Value (dollars)	Commercial Commercial Count	Commercial (Count % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Value (dollars)	Other (unassigned) Buildings Count	(Count % of Total) (percent)	Value (dollars)	All Buildings Total Count	Percent Total (Count % of Total) (percent)	Total Value (dollars)
Airport	0	0.00%	$0.00	37	14.98%	$3,868,333.04	89	19.96%	$43,943,241.05	0	0.00%	$0.00	126	17.60%	$47,811,574.09
Central City (CENT)	396	53.51%	$832,925,398.39	566	29.49%	$518,512,603.97	82	61.19%	$332,841,873.17	1	100.00%	$0.00	1045	37.40%	$1,684,279,875.53
Central Northeast Neighborhoods (CNN)	4209	18.43%	$428,941,903.57	610	42.10%	$89,544,076.18	49	42.98%	$25,031,098.56	0	0.00%	$0.00	4868	19.94%	$543,517,078.30
East Portland Neighborhood Office (EPNO)	7524	15.83%	$613,381,577.50	637	24.16%	$144,256,352.70	76	27.74%	$82,678,678.22	0	0.00%	$0.00	8237	16.33%	$840,316,608.41
Neighbors West/Northwest (NWNW)	5731	88.28%	$1,630,977,493.97	707	45.18%	$207,992,957.85	182	79.48%	$114,840,222.05	1	100.00%	$18,150.89	6621	79.90%	$1,953,828,824.76
North Portland Neighborhood Services (NPNS)	4717	16.99%	$398,941,227.89	739	27.54%	$206,365,343.17	155	20.45%	$21,214,242.45	2	28.57%	$107,813.13	5613	17.99%	$626,628,626.64
Northeast Coalition (NECN)	7324	27.91%	$925,620,052.55	426	36.57%	$192,573,340.53	31	33.33%	$21,050,763.91	1	33.33%	$0.00	7782	28.30%	$1,139,244,156.99
Southeast Uplift Neighborhood Program (SEUL)	18494	28.43%	$2,395,462,172.57	887	28.14%	$383,198,217.68	84	38.71%	$43,480,641.01	3	13.04%	$434,504.53	19468	28.45%	$2,822,575,535.78
Southwest Neighborhoods, Inc. (SWNI)	20329	82.46%	$3,193,522,906.17	646	76.72%	$360,877,794.59	132	73.74%	$591,919,391.39	0	#DIV/0!	$0.00	21107	82.21%	$4,146,320,092.15
Total (cities + county)	**68724**	**9.19%**	**$10,419,772,732.59**	**5255**	**33.56%**	**$2,101,189,019.71**	**880**	**36.01%**	**$1,277,000,151.80**	**8**	**14.81%**	**$560,468.55**	**74867**	**31.26%**	**$13,804,522,372.66**

Land

Communities (Multnomah County)	Single Family Count	Single Family (Count % of Total) (feet2)	Single Family Area (feet2)	Residential Value (dollars)	Other Residential Count	Other Residential (Count % of Total) (percent)	Other Residential Area (feet2)	Other Residential Value (dollars)	Commercial Commercial Count	Commercial (Count % of Total) (percent)	Commercial Area (feet2)	Commercial Area (acres)	Commercial (Area % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Area (feet2)	Government Area (acres)	Government (Area % of Total) (percent)	Government Value (dollars)	Unassigned Unassigned Count	Unassigned (Count % of Total) (percent)	Unassigned Area (feet2)	Unassigned Area (acres)
Fairview	586	37.35%	0.0000	2947488	84	49.70%	1492032	$5,643,057.49	75	88.24%	648021	148.76	27.33%	$19,545,577.99	93	81.58%	8385861	192.5129	18.07%	$7,061,676.62	0	#DIV/0!	0	0.0000
Gresham	8946	41.64%	43495556	$454,107,503.42	705	46.69%	16389021	$46,556,237.13	558	51.76%	26321527	604.26	19.02%	$107,562,368.57	522	79.94%	41486161	952.3912	19.81%	$36,140,086.40	16	#DIV/0!	213490	4.9011
Multnomah County	2548	72.57%	68109811	$377,136,567.48	2244	78.74%	234408271	$130,791,666.06	969	93.90%	240721759	5526.21	18.74%	$26,205,660.68	854	96.72%	185436947	4257.0467	17.41%	$28,328,557.23	0	#DIV/0!	0	0.0000
Portland	62293	39.85%	266831115	$5,519,426,216.92	5898	55.44%	84052394	$728,874,995.62	5399	48.17%	121058917	2779.13	16.85%	$1,214,517,177.47	3377	81.57%	347298611	7972.8793	19.16%	$479,707,351.92	39	#DIV/0!	120284	2.7613
Troutdale	1382	32.46%	6108474	$63,708,546.95	96	53.33%	2923039	$12,363,895.72	149	81.87%	6894916	158.29	19.85%	$22,216,257.71	152	70.05%	17681195	405.9044	20.90%	$21,552,820.42	0	#DIV/0!	0	0.0000
Wood Village	128	23.53%	979615	$8,025,509.83	94	53.71%	476095	$1,124,325.06	50	79.37%	2240343	51.43	18.96%	$12,477,507.25	22	78.57%	1026948	23.5755	20.14%	$778,965.15	0	#DIV/0!	0	0.0000
Total (cities + county)	**75883**	**0.07%**	**388472059**	**$6,457,768,632.88**	**9121**	**58.76%**	**339740852**	**$925,354,177.08**	**7200**	**52.75%**	**403717483**	**9268.08**	**18.26%**	**$1,402,524,549.67**	**5020**	**83.18%**	**601315723**	**13804.3100**	**18.66%**	**$573,569,457.73**	**55**	**#DIV/0!**	**333774**	**7.6624**

Neighborhoods (City of Portland)	Land Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Area (feet2)	Residential Value (dollars)	Commercial Commercial Count	Commercial (Count % of Total) (percent)	Commercial Area (feet2)	Commercial Area (acres)	Commercial (Area % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Area (feet2)	Government Area (acres)	Government (Area % of Total) (percent)	Government Value (dollars)	All Land Count	(Count % of Total) (percent)	Area (feet2)	Total Area (acres)	(Area % of Total) (percent)	Value (dollars)
Airport	2	100.00%	28894.49004	44305.49471	30	93.75%	832632	19.1146	7.07%	5104253	90	72.58%	15210260	349.1795	7.01%	65238400	122	77.22%	16071786	368.9575	7.02%	$70,386,958.01
Central City (CENT)	369	58.02%	2123491.978	107045064.3	651	35.63%	6152954	141.2524	13.93%	326796726	242	73.78%	12397206	284.6007	15.85%	167512828	1262	45.22%	20673652	474.6018	15.69%	$601,354,618.64
Central Northeast Neighborhoods (CNN)	4089	27.03%	13104558.42	271562750	621	59.09%	15528535	356.4861	21.03%	87821929	243	89.67%	21403229	491.3505	19.55%	11333510	4953	30.11%	50036323	1148.6759	17.19%	$370,718,188.67
East Portland Neighborhood Office (EPNO)	8445	23.40%	66017121.86	438069772	783	44.01%	23020466	528.4772	15.61%	126067717	615	65.85%	40045002	919.3068	17.80%	29077681	9843	25.37%	129082590	2963.3286	16.13%	$593,215,169.31
Neighbors West/Northwest (NWNW)	5625	93.19%	50088179.91	765066149	555	61.12%	13602818	312.2777	16.08%	138502310	463	92.97%	57150043	1311.9845	19.27%	22890930	6643	89.26%	120841041	2774.1287	22.69%	$926,459,388.67
North Portland Neighborhood Services (NPNS)	5015	25.73%	16247561.25	266600591	771	54.95%	33669090	772.9360	14.38%	152858476	501	87.43%	57498426	1319.9823	15.07%	70734763	6287	29.29%	107415078	2465.9110	14.31%	$490,193,830.13
Northeast Coalition (NECN)	7425	39.32%	17533299	597811207	465	45.86%	3824600	87.8007	18.32%	62147267	163	79.90%	14811360	340.0220	21.54%	4921628	8053	40.06%	36169259	830.3320	18.83%	$664,880,101.23
Southeast Uplift Neighborhood Program (SEUL)	17517	36.72%	56363731.79	1591603839	918	36.60%	13054431	299.6885	17.25%	120886329	431	77.24%	38118048	875.0700	17.61%	24532941	18866	37.16%	107536210	2468.6918	18.31%	$1,737,023,109.19
Southwest Neighborhoods, Inc. (SWNI)	19807	91.63%	137356748	2236109113	607	86.59%	12473197	286.3452	36.90%	179438497	625	96.30%	76977899	1767.1695	43.36%	79838902	21039	91.61%	226807844	5206.7918	45.62%	$2,495,386,512.57
Total (cities + county)	**68724**	**41.24%**	**358863587**	**6166823421**	**5401**	**48.12%**	**122158724**	**2804.3785**	**16.82%**	**1221587203**	**3373**	**81.49%**	**333611472**	**7658.6658**	**18.84%**	**476081582**	**77068**	**42.59%**	**814633783**	**18701.4190**	**+0.31%**	**$7,842,528,506.68**

77335

Transportation

Communities (Multnomah County)	Freeways, Highways & Major Arterials Length (feet)	Freeways, Highways & Major Arterials Length (miles)	Freeways, Highways & Major Arterials Percent of Total Area (%)	Minor Arterials & Collect/Connectors Length (feet)	Minor Arterials & Collect/Connectors Length (miles)	Minor Arterials & Collect/Connectors Percent of Total Area (%)	Local Streets Length (feet)	Local Streets Length (miles)	Local Streets Percent of Total Area %	Total Road Length (feet)	Total Road Length (miles)	Total Road Length %
Fairview	14063	2.66	32.431%	12639	2.39	29.587%	15682	2.97	10.928%	42385	8.02752	18.461%
Gresham	23578	4.47	12.946%	43372	8.21	24.612%	212643	40.27	16.140%	279592	52.95309	16.684%
Multnomah County	113890	21.57	46.080%	321148	60.82	67.325%	538319	101.95	50.524%	973356	184.34779	54.389%
Portland	479371	90.79	30.004%	679959	128.78	33.244%	2738168	518.59	26.932%	3897499	738.16266	28.222%
Troutdale	19321	3.66	32.236%	8860	1.68	25.979%	37628	7.13	14.137%	65808	12.46370	18.269%
Wood Village	4389	0.83	35.403%	2032	0.38	11.604%	5806	1.10	14.429%	12227	2.31568	14.429%
Total (cities + county)	**654612**	**123.97948**	**30.551%**	**1068009**	**202.27**	**38.240%**	**3548247**	**672.01648**	**27.26%**	**5270868**	**998.27045**	**29.36%**

Neighborhoods (City of Portland)	Freeways, Highways & Major Arterials Length (feet)	Freeways, Highways & Major Arterials Length (miles)	Freeways, Highways & Major Arterials Percent of Total Area (%)	Minor Arterials & Collect/Connectors Length (feet)	Minor Arterials & Collect/Connectors Length (miles)	Minor Arterials & Collect/Connectors Percent of Total (Juris) Area (%)	Local Streets Length (feet)	Local Streets Length (miles)	Local Streets Percent of Total Area %	Total Road Length (feet)	Total Road Length (miles)	Total Road Length %
Airport	8036	1.52	12.658%	36698	6.95	55.728%	9627	1.82	7.557%	54361	10.30	21.176%
Central City (CENT)	66804	12.65	33.075%	16932	3.21	11.325%	57564	10.90	12.779%	141300	26.76	17.622%
Central Northeast Neighborhoods (CNN)	42788	8.10	27.954%	38398	7.27	27.476%	121412	22.99	14.949%	202598	38.37	18.337%
East Portland Neighborhood Office (EPNO)	65326	12.37	21.002%	73967	14.01	19.474%	206756	39.16	10.524%	346049	65.54	13.032%
Neighbors West/Northwest (NWNW)	42406	8.03	42.960%	123684	23.43	61.213%	541673	102.59	63.538%	707763	134.05	61.374%
North Portland Neighborhood Services (NPNS)	73694	13.96	27.179%	35838	6.79	18.688%	238980	45.26	15.381%	348512	66.01	17.284%
Northeast Coalition (NECN)	19173	3.63	25.843%	33959	6.43	21.380%	212199	40.19	24.939%	265331	50.25	24.482%
Southeast Uplift Neighborhood Program (SEUL)	44191	8.37	22.885%	73792	13.98	18.152%	518638	98.23	22.911%	636621	120.57	22.236%
Southwest Neighborhoods, Inc. (SWNI)	114952	21.77	50.337%	250540	47.45	70.545%	836670	158.46	64.218%	1202162	227.68	63.734%
Total (cities + county)	**477370**	**90.41**	**29.928%**	**683808**	**129.51**	**33.368%**	**2743519**	**519.61**	**26.955%**	**3904697**	**739.53**	**28.251%**

Critical Facilities: Buildings

Communities (Multnomah County)	School Buildings Count	School Buildings (Count % of Total) (percent)	Fire Buildings (count)	Fire Buildings (Count % of Total) (percent)	Police Buildings (count)	Police Buildings (Count % of Total) (percent)	Hospital Buildings (count)	Hospital Buildings (Count % of Total) (percent)	All Critical Buildings Total Count	Percent Total (Count % of Total) (percent)
Fairview	10	62.500%	0	0.000%	1	100.000%	0	0.000%	11	64.71%
Gresham	42	75.000%	4	100.000%	1	100.000%	1	100.000%	48	77.42%
Multnomah County	13	100.000%	6	100.000%	0	0.000%	0	0.000%	19	0.00%
Portland	146	90.683%	30	96.774%	11	100.000%	16	0.000%	203	1068.42%
Troutdale	6	66.667%	0	0.000%	0	0.000%	0	0.000%	6	66.67%
Wood Village	0	0.000%	0	0.000%	0	0.000%	0	0.000%	0	0.00%
Total (cities + county)	**217**	**0.000%**	**40**	**97.56%**	**13**	**100.00%**	**17**	**100.00%**	**287**	**88.04%**

Exposure - Landslide Inventory - High Shallow LS Susceptibility

Buildings

Communities (Multnomah County)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Value (dollars)	Commercial Commercial Count	Commercial (Count % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Value (dollars)	Other (unassigned) Buildings Count	(Count of Total) (percent)	Value (dollars)	All Buildings Total Count	Percent Total (Count % of Total) (percent)	Total Value (dollars)
Fairview	201	7.77%	$1,280,204.66	32	19.16%	$5,398,540.47	3	3.26%	$55,691.98	0	#DIV/0!	$0.00	236	8.30%	$6,754,437.11
Gresham	4562	15.58%	$94,368,522.90	351	16.74%	$9,471,139.84	42	14.05%	$11,311,714.76	0	0.00%	$0.00	4955	15.64%	$115,151,377.50
Multnomah County	4103	44.46%	$147,790,741.12	650	23.71%	$11,917,998.64	46	22.89%	$996,968.85	0	#DIV/0!	$0.00	4799	39.43%	$160,705,708.60
Portland	45963	20.79%	$2,330,876,089.48	4566	29.48%	$284,039,482.74	864	35.37%	$723,916,419.84	1	2.56%	$0.00	51394	21.50%	$3,338,831,992.06
Troutdale	512	10.07%	$6,875,171.53	66	22.53%	$1,265,774.81	18	12.68%	$730,272.69	0	#DIV/0!	$0.00	596	10.80%	$8,871,219.03
Wood Village	100	8.81%	$1,255,442.88	20	17.70%	$77,146.49	0	0.00%	$0.00	0	#DIV/0!	$0.00	120	9.54%	$1,332,589.36
Total (cities + county)	**55441**	**20.65%**	**$2,582,446,172.56**	**5685**	**27.20%**	**$312,170,082.97**	**973**	**30.53%**	**$737,031,068.13**	**1**	**2.44%**	**$0.00**	**62100**	**21.23%**	**$3,631,647,323.66**

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Neighborhoods (City of Portland)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Value (dollars)	Commercial Commercial Count	Commercial (Count % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Value (dollars)	Other (unassigned) Buildings Count	(Count of Total) (percent)	Value (dollars)	All Buildings Total Count	Percent Total (Count % of Total) (percent)	Total Value (dollars)
Airport	0	0.00%	$0.00	13	5.26%	$1,844,251.86	47	10.54%	$2,978,577.53	0	0.00%	$0.00	60	8.38%	$4,822,829.40
Central City (CENT)	275	37.16%	$190,874,171.75	353	18.39%	$81,390,944.41	54	40.30%	$91,975,642.91	1	100.00%	$0.00	683	24.45%	$364,240,759.08
Central Northeast Neighborhoods (CNN)	1405	6.15%	$52,225,803.26	276	19.05%	$7,210,467.37	24	21.05%	$6,457,984.35	0	0.00%	$0.00	1705	6.99%	$65,894,254.97
East Portland Neighborhood Office (EPNO)	2643	5.56%	$42,852,389.16	307	11.64%	$9,192,523.29	29	10.58%	$14,222,742.15	0	0.00%	$0.00	2979	5.90%	$66,267,654.60
Neighbors West/Northwest (NWNW)	4687	72.20%	$830,339,054.39	331	21.15%	$26,745,329.35	89	38.36%	$14,578,165.21	0	0.00%	$0.00	5107	61.63%	$871,662,548.95
North Portland Neighborhood Services (NPNS)	1226	4.42%	$37,325,042.96	317	11.82%	$29,731,551.73	41	5.41%	$1,384,204.25	0	0.00%	$0.00	1584	5.08%	$68,440,798.94
Northeast Coalition (NECN)	2108	8.03%	$59,914,602.59	216	18.54%	$14,490,094.04	15	16.13%	$1,584,036.33	0	0.00%	$0.00	2339	8.51%	$75,988,732.96
Southeast Uplift Neighborhood Program (SEUL)	6947	10.68%	$175,896,360.55	438	13.90%	$49,954,779.58	35	16.13%	$32,874,596.00	0	0.00%	$0.00	7420	10.84%	$258,725,736.13
Southwest Neighborhoods, Inc. (SWNI)	12951	52.53%	$945,720,233.73	425	50.48%	$63,471,809.32	91	50.84%	$557,860,466.56	0	#DIV/0!	$0.00	13467	52.45%	$1,567,052,509.61
Total (cities + county)	**32242**	**14.57%**	**$2,335,147,658.39**	**2676**	**17.09%**	**$284,031,750.95**	**425**	**17.39%**	**$723,916,415.31**	**1**	**1.85%**	**$0.00**	**35344**	**14.76%**	**$3,343,095,824.65**

Land

Communities (Multnomah County)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Value (dollars)	Residential Area (feet2)	Other Residential Count	Other Residential (Count % of Total) (percent)	Other Residential Area (feet2)	Other Residential Value (dollars)	Commercial Commercial Count	Commercial (Count % of Total) (percent)	Commercial Area (feet2)	Commercial Area (acres)	Commercial (Area % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Area (feet2)	Government Area (acres)	Government (Area % of Total) (percent)	Government Value (dollars)	Unassigned Unassigned Count	Unassigned (Count % of Total) (percent)	Unassigned Area (feet2)	Unassigned Area (acres)
Fairview	439	27.98%	480077	$5,777,456.06	73	0.43	638786	$1,818,148.77	76	89.41%	2235048	51.31	9.43%	$5,398,540.47	93	81.58%	2864979	65.7709	6.17%	$2,415,690.16	0	#DIV/0!	18971	0.4355
Gresham	6897	32.10%	15357766	$104,200,705.39	578	0.38	18971565	$19,752,698.10	469	43.51%	6795779	156.01	4.91%	$17,643,384.36	464	71.06%	36287929	833.0563	17.33%	$40,806,110.63	15	#DIV/0!	53210	1.2215
Multnomah County	2135	60.81%	421832652.6	$154,569,501.13	2029	0.71	276418673	$79,732,653.83	882	85.47%	242616905	5569.72	18.89%	$10,207,710.07	729	82.56%	197253450	4528.3163	18.52%	$40,806,110.63	0	#DIV/0!		
Portland	50351	32.21%	114018700	$1,856,231,615.22	5258	0.49	101878246	$339,669,909.15	4579	40.85%	47583540	1092.37	6.62%	$276,644,806.25	3149	76.06%	244091628	5603.5729	13.47%	$227,037,614.83	26	#DIV/0!	0	0.0000
Troutdale	1061	24.92%	2232203	$16,336,233.10	80	0.44	2742826	$4,782,019.97	140	76.92%	3152914	72.38	9.08%	$6,868,137.53	132	60.83%	7444664	170.9060	8.80%	$6,318,957.93	0	#DIV/0!	0	0.0000
Wood Village	105	19.30%	288282	$2,069,471.28	31	0.18	187989	$428,348.89	44	69.84%	407449	9.35	3.45%	$2,433,010.09	22	78.57%	353978	8.1262	6.94%	$252,125.40	0	#DIV/0!	0	0.0000
Total (cities + county)	**60988**	**32.50%**	**174560292**	**$2,139,184,962.19**	**8049**	**0.52**	**401238084**	**$446,183,778.72**	**6190**	**45.35%**	**302791634**	**6951.14**	**13.69%**	**$319,195,588.77**	**4589**	**76.04%**	**488296629**	**11209.7485**	**15.15%**	**$296,860,321.92**	**41**	**#DIV/0!**	**72181**	**1.6571**

Neighborhoods (City of Portland)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Area (feet2)	Residential Value (dollars)	Commercial Commercial Count	Commercial (Count % of Total) (percent)	Commercial Area (feet2)	Commercial Area (acres)	Commercial (Area % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Area (feet2)	Government Area (acres)	Government (Area % of Total) (percent)	Government Value (dollars)	All Land Count	(Count % of Total) (percent)	Area (feet2)	Total Area (acres)	(Area % of Total) (percent)	Value (dollars)
Airport	2	100.00%	13142.98305	$19,917.29	29	90.63%	273495	6.2786	2.32%	$1,912,295.49	86	69.35%	5008469	114.9786	2.31%	$16,922,663.36	117	74.05%	5295108	121.5589	2.31%	$18,854,876.15
Central City (CENT)	326	51.26%	758956.003	$32,910,599.46	524	28.68%	1652325	37.9322	3.74%	$63,012,265.29	223	67.99%	3385798	77.7272	4.33%	$39,185,332.69	1073	38.45%	5797080	133.0826	4.40%	$135,108,197.44
Central Northeast Neighborhoods (CNN)	2953	19.51%	3460880.771	$56,063,866.50	547	52.05%	4603139	105.6735	6.23%	$19,621,122.54	229	84.50%	7168052	164.5558	6.55%	$80,826,380.08	3727	22.66%	15232072	349.6803	5.23%	$80,826,380.08
East Portland Neighborhood Office (EPNO)	6169	17.09%	17636654.15	$63,003,144.71	674	37.89%	5693602	130.7071	3.86%	$23,696,565.91	502	53.75%	13127188	301.3588	5.84%	$11,656,784.33	7345	18.93%	36457444	836.9478	4.55%	$98,354,494.95
Neighbors West/Northwest (NWNW)	5456	90.39%	86375559.97	$699,168,121.62	477	52.53%	7387273	169.5885	8.73%	$33,760,083.83	466	93.57%	191047853	4385.8553	64.42%	$55,736,017.17	6399	85.98%	284810686	6538.3539	53.47%	$788,664,222.62
North Portland Neighborhood Services (NPNS)	3303	16.95%	4534726.266	$43,277,884.21	666	47.47%	11955609	274.4630	5.11%	$48,968,308.40	453	79.06%	17591818	403.8526	4.61%	$22,325,730.67	4422	20.60%	34082153	782.4186	4.54%	$114,571,923.28
Northeast Coalition (NECN)	5482	29.03%	2162243.224	$75,730,548.74	375	28.55%	775856	17.8112	3.72%	$10,642,167.09	149	73.04%	1333801	30.6199	1.94%	$589,618.42	6006	29.88%	4271899	98.0693	2.22%	$86,962,334.25
Southeast Uplift Neighborhood Program (SEUL)	13582	28.47%	9103906.9	$209,438,886.79	716	28.55%	5197708	119.3230	6.87%	$20,225,085.46	278	49.82%	5941117	136.3893	2.75%	$8,023,925.31	14576	28.71%	20242732	464.7092	3.45%	$237,687,897.57
Southwest Neighborhoods, Inc. (SWNI)	18138	83.91%	68576376.46	$977,821,201.57	563	80.31%	4256404	97.7136	12.59%	$51,244,904.51	587	90.45%	44086611	1012.0894	24.83%	$84,660,337.01	19288	83.99%	116919392	2684.1000	23.12%	$1,113,726,443.10
Total (cities + county)	**55409**	**33.46%**	**192622447**	**$2,157,432,170.89**	**4571**	**40.73%**	**41795411**	**959.4906**	**5.75%**	**$273,082,798.52**	**2973**	**14.18%**	**288690707**	**6627.4269**	**16.31%**	**$244,241,800.01**	**62953**	**34.79%**	**523108565**	**12008.9206**	**13.04%**	**$2,674,756,769.42**

Transportation

Communities (Multnomah County)	Freeways, Highways & Major Arterials Length (feet)	Freeways, Highways & Major Arterials Length (miles)	Freeways, Highways & Major Arterials Percent of Total Area (%)	Minor Arterials & Collect/Connectors Length (feet)	Minor Arterials & Collect/Connectors Length (miles)	Minor Arterials & Collect/Connectors Percent of Total (Juris) Area (%)	Local Streets Length (feet)	Local Streets Length (miles)	Local Streets Percent of Total Area %	Total Road Length (feet)	Total Road Length (miles)	Total Road Length %
Fairview	405	0.08	0.935%	466	0.09	1.091%	216	0.04	0.151%	1088	0.20604	0.474%
Gresham	947	0.18	0.520%	630	0.12	0.357%	5196	0.98	0.394%	6773	1.28271	0.404%
Multnomah County	3089	0.58	24.914%	11952	2.26	68.272%	48119	9.11	87.750%	63160	11.96205	74.533%
Portland	35473	6.72	14.353%	16710	3.16	3.503%	110007	20.83	10.325%	162191	30.71794	9.063%
Troutdale	768	0.15	1.282%	250	0.05	0.733%	1476	0.28	0.555%	2495	0.47246	0.693%
Wood Village	193	0.04	0.012%	435	0.08	0.021%	0	0.00	0.000%	628	0.11894	0.005%
Total (cities + county)	**40875**	**7.74157**	**1.908%**	**30444**	**5.77**	**1.09%**	**165014**	**31.25274**	**1.27%**	**236334**	**44.76013**	**1.32%**

Neighborhoods (City of Portland)	Freeways, Highways & Major Arterials Length (feet)	Freeways, Highways & Major Arterials Length (miles)	Freeways, Highways & Major Arterials Percent of Total Area (%)	Minor Arterials & Collect/Connectors Length (feet)	Minor Arterials & Collect/Connectors Length (miles)	Minor Arterials & Collect/Connectors Percent of Total (Juris) Area (%)	Local Streets Length (feet)	Local Streets Length (miles)	Local Streets Percent of Total Area %	Total Road Length (feet)	Total Road Length (miles)	Total Road Length %
Airport	997	0.19	0.437%	127	0.02	0.036%	253	0.05	0.019%	1377	0.26	0.073%
Central City (CENT)	7602	1.44	3.937%	2147	0.41	0.528%	3401	0.64	0.150%	13149	2.49	0.459%
Central Northeast Neighborhoods (CNN)	2615	0.50	2.649%	1198	0.23	0.593%	1513	0.29	0.177%	5325	1.01	0.462%
East Portland Neighborhood Office (EPNO)	5158	0.98	8.125%	1614	0.31	2.450%	2353	0.45	1.847%	9125	1.73	3.555%
Neighbors West/Northwest (NWNW)	651	0.12	0.877%	2424	0.46	1.526%	60393	11.44	7.098%	63468	12.02	5.856%
North Portland Neighborhood Services (NPNS)	5743	1.09	1.846%	1144	0.22	0.301%	4449	0.84	0.226%	11335	2.15	0.427%
Northeast Coalition (NECN)	1789	0.34	0.660%	555	0.11	0.290%	335	0.06	0.022%	2680	0.51	0.133%
Southeast Uplift Neighborhood Program (SEUL)	2029	0.38	1.325%	1654	0.31	1.184%	3464	0.66	0.427%	7147	1.35	0.647%
Southwest Neighborhoods, Inc. (SWNI)	8791	1.67	4.353%	3747	0.71	3.844%	33661	6.38	7.473%	48200	9.13	6.011%
Total (cities + county)	**35375**	**6.70**	**2.218%**	**16610**	**3.15**	**0.811%**	**109822**	**20.80**	**1.079%**	**161806**	**30.65**	**1.171%**

Critical Facilities: Buildings

Communities (Multnomah County)	School Buildings Count	School Buildings (Count % of Total) (percent)	Fire Buildings (count)	Fire Buildings (Count % of Total) (percent)	Police Buildings (count)	Police Buildings (Count % of Total) (percent)	Hospital Buildings (count)	Hospital Buildings (Count % of Total) (percent)	All Critical Buildings Total Count	Percent Total (Count % of Total) (percent)
Fairview	9	56.250%	0	0.000%	1	100.000%	0	0.000%	10	58.82%
Gresham	41	73.214%	4	100.000%	1	100.000%	1	100.000%	47	75.81%
Multnomah County	13	100.000%	6	0.000%	0	0.000%	0	0.000%	19	0.00%
Portland	139	86.335%	29	483.333%	11	0.000%	16	0.000%	195	1026.32%
Troutdale	6	66.667%	0	0.000%	0	0.000%	0	0.000%	6	66.67%
Wood Village	0	0.000%	0	0.000%	0	0.000%	0	0.000%	0	0.00%
Total (cities + county)	**208**	**81.569%**	**39**	**95.12%**		**0.00%**		**0.00%**	**277**	**84.97%**

Exposure - Landslide Inventory - Deep Landslide Susceptibility (Low)

Buildings

Communities (Multnomah County)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Value (dollars)	Commercial Commercial Count	Commercial (Count % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Value (dollars)	Other (unassigned) Buildings Count	(Count of Total) (percent)	Value (dollars)	All Buildings Total Count	Percent Total (Count % of Total) (percent)	Total Value (dollars)
Fairview	2586	100.00%	$2,852,679,413.52	167	100.00%	$105,893,719.98	92	100.00%	$42,702,579.26	0	#DIV/0!	$0.00	2845	100.00%	$3,001,275,712.77
Gresham	29075	99.29%	$3,695,223,189.42	2096	99.95%	$1,496,011,881.33	296	99.00%	$509,463,452.97	2	100.00%	$0.00	31469	99.33%	$5,700,698,523.72
Multnomah County	6687	72.46%	$768,456,516.06	2496	91.03%	$175,380,357.38	163	81.09%	$73,916,184.41	0	#DIV/0!	$0.00	9346	76.78%	$1,017,753,057.85
Portland	210859	95.36%	$37,584,870,266.02	15289	98.71%	$16,771,290,745.77	2194	89.81%	$5,095,127,974.17	39	100.00%	$2,627,859.97	228381	95.52%	$59,453,916,845.93
Troutdale	5040	99.15%	$569,829,542.89	292	99.66%	$303,306,724.09	142	100.00%	$90,299,740.34	0	#DIV/0!	$0.00	5474	99.20%	$963,436,007.31
Wood Village	1135	100.00%	$75,555,077.18	113	100.00%	$107,222,649.36	10	100.00%	$632,670.00	0	#DIV/0!	$0.00	1258	100.00%	$183,410,396.54
Total (cities + county)	**255382**	**95.14%**	**$45,546,614,005.09**	**20453**	**97.86%**	**$18,959,106,077.91**	**2897**	**90.90%**	**$5,812,142,601.15**	**41**	**100.00%**	**$2,627,859.97**	**278773**	**95.28%**	**$70,320,490,544.12**

Neighborhoods (City of Portland)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Value (dollars)	Commercial Commercial Count	Commercial (Count % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Value (dollars)	Other (unassigned) Buildings Count	(Count of Total) (percent)	Value (dollars)	All Buildings Total Count	Percent Total (Count % of Total) (percent)	Total Value (dollars)
Airport	8	100.00%	$0.00	247	100.00%	$34,753,645.13	446	100.00%	$943,787,337.31	0	0.00%	$0.00	701	97.91%	$978,540,982.44
Central City (CENT)	640	86.49%	$6,057,715,677.85	1879	97.52%	$6,080,379,331.76	134	100.00%	$173,530,104.58	1	100.00%	$75,140.00	2654	94.99%	$14,213,249,859.58
Central Northeast Neighborhoods (CNN)	22811	99.86%	$2,949,871,926.91	1449	100.00%	$839,447,784.98	113	99.12%	$173,530,104.58	3	100.00%	$75,140.00	24376	99.86%	$3,962,924,956.47
East Portland Neighborhood Office (EPNO)	47404	99.72%	$4,839,107,176.08	2637	100.00%	$2,032,895,058.81	271	98.91%	$576,850,411.22	1	100.00%	$69,890.00	50313	99.73%	$7,448,922,536.11
Neighbors West/Northwest (NWNW)	2213	34.09%	$1,485,855,904.03	1489	95.14%	$1,349,886,081.90	71	31.00%	$136,156,894.35	1	100.00%	$306,849.99	3774	45.54%	$2,972,205,730.29
North Portland Neighborhood Services (NPNS)	27756	100.00%	$3,349,490,885.87	2683	100.00%	$2,144,130,869.19	758	100.00%	$580,603,779.04	7	100.00%	$638,329.99	31204	100.00%	$6,075,063,874.09
Northeast Coalition (NECN)	26239	100.00%	$4,945,378,571.60	1165	100.00%	$1,065,963,275.28	93	100.00%	$181,685,261.22	3	100.00%	$0.00	27500	100.00%	$6,193,027,108.10
Southeast Uplift Neighborhood Program (SEUL)	65047	100.00%	$10,228,429,850.44	3152	100.00%	$2,386,235,394.81	217	100.00%	$475,184,869.17	23	100.00%	$1,537,649.99	68439	100.00%	$13,091,387,764.41
Southwest Neighborhoods, Inc. (SWNI)	18920	76.74%	$3,754,873,881.82	759	90.14%	$828,138,467.56	92	51.40%	$152,349,294.98	0	#DIV/0!	$0.00	19779	77.04%	$4,735,361,644.36
Total (cities + county)	**211038**	**95.36%**	**$37,610,723,884.63**	**15460**	**98.73%**	**$16,762,029,909.42**	**2195**	**89.81%**	**$5,095,302,801.84**	**39**	**72.22%**	**$2,627,859.97**	**228740**	**95.52%**	**$59,470,684,455.86**

Land

Communities (Multnomah County)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Area (feet2)	Single Family Value (dollars)	Other Residential Count	Other Residential (Count % of Total) (percent)	Other Residential Area (feet2)	Other Residential Value (dollars)	Commercial Commercial Count	Commercial (Count % of Total) (percent)	Commercial Area (feet2)	Commercial Area (acres)	Commercial (Area % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Area (feet2)	Government Area (acres)	Government (Area % of Total) (percent)	Government Value (dollars)	All Land Count	(Count % of Total) (percent)	Area (feet2)	Total Area (acres)
Fairview	1533	97.71%	16622140	$204,113,550.00	159	94.08%	8375868	$40,416,370.00	85	100.00%	23710873	544.33	100.00%	$106,767,400.00	114	100.00%	6450789	148.10	100.00%	$34,209,690.00	1891	100.00%	95111863	2183.4680
Gresham	21148	98.44%	213529973	$2,246,202,881.34	1386	91.79%	84597399	$318,629,981.24	1078	100.00%	137630757	3159.57	99.45%	$890,293,721.83	648	99.23%	189216167	4343.8056	90.36%	$214,063,513.68	24283	99.14%	626057597	14372.3053
Multnomah County	1883	53.63%	103939885.38	$442,536,243.59	1937	67.96%	348627059	$328,505,928.88	895	86.72%	909819497	20886.58	70.84%	$88,735,817.85	673	76.22%	833031616	19123.7751	78.20%	$75,984,536.57	5388	72.60%	2195418058	50399.8652
Portland	147237	94.20%	1055676368	$20,509,133,815.91	8850	83.19%	229427457	$2,460,587,472.02	11055	98.63%	703075771	16140.40	97.87%	$8,537,915,202.79	3684	88.99%	1481772557	34016.8183	81.76%	$2,852,679,413.52	170919	94.50%	3470390649	79669.2094
Troutdale	4093	96.15%	37914334	$443,872,939.92	150	83.33%	9512117	$43,155,076.51	180	98.90%	34674529	796.02	99.83%	$164,440,550.00	211	97.24%	81370373	1868.0068	96.16%	$110,402,537.59	4634	99.29%	163471353	3752.7860
Wood Village	541	99.45%	7521004	$71,929,100.00	172	98.29%	1517058	$4,055,720.00	63	100.00%	11813441	271.20	100.00%	$89,911,580.00	28	100.00%	5099772	117.0747	100.00%	$4,009,510.00	804	100.00%	25951276	595.7593
Total (cities + county)	**176435**	**94.01%**	**1435203705**	**$23,917,788,530.77**	**12654**	**81.52%**	**682056958**	**$3,195,350,548.64**	**13356**	**97.85%**	**1820724868**	**41798.09**	**82.34%**	**$9,878,064,272.47**	**5358**	**88.78%**	**2636893467**	**60534.7464**	**81.81%**	**$3,291,349,201.36**	**207919**	**94.45%**	**6576400796**	**150973.3933**

Neighborhoods (City of Portland)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Area (feet2)	Residential Value (dollars)	Commercial Commercial Count	Commercial (Count % of Total) (percent)	Commercial Area (feet2)	Commercial Area (acres)	Commercial (Area % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Area (feet2)	Government Area (acres)	Government (Area % of Total) (percent)	Government Value (dollars)	All Land Count	(Count % of Total) (percent)	Area (feet2)	Total Area (acres)	(Area % of Total) (percent)	Value (dollars)
Airport	2	100.00%	209436.6468	$322,500.00	33	103.13%	14759332	270.3244	100.00%	$26,330,630.11	199	160.48%	217074206	4983.3382	100.00%	$64,759,880.23	234	148.10%	229058974	5258.4707	1891	100.00%	$91,413,010.34
Central City (CENT)	536	84.28%	8531832.268	$500,458,492.23	1818	99.51%	4318424b	991.3739	97.77%	$2,788,154,006.83	359	109.45%	76897550	1765.3249	98.34%	$707,933,130.03	2713	97.21%	128613628	2952.5627	97.61%	$3,996,545,629.09
Central Northeast Neighborhoods (CNN)	15126	99.99%	106986665	$2,174,919,437.37	1080	102.76%	73848745	1695.3340	100.00%	$544,827,450.05	337	124.35%	107298487	2463.2344	97.99%	$568,942,228.98	16543	100.57%	288133897	6614.6443	99.00%	$2,788,689,116.39
East Portland Neighborhood Office (EPNO)	36157	100.18%	416130180.6	$3,681,224,704.73	1807	101.57%	146234700	3357.0869	99.15%	$1,211,623,917.56	1105	118.31%	219970222	5049.8216	99.79%	$179,310,414.73	39069	100.68%	782335103	17959.9433	97.73%	$5,072,159,037.02
Neighbors West/Northwest (NWNW)	2050	33.96%	26921422.99	$554,608,283.22	880	96.92%	77742870	1784.7308	91.89%	$825,069,366.04	239	47.99%	54804371	1258.1353	18.48%	$55,881,370.47	3169	42.58%	159468664	3660.8969	29.94%	$1,435,559,519.72
North Portland Neighborhood Services (NPNS)	19647	100.80%	134807607	$2,508,339,650.00	1499	106.84%	234073550	5373.5895	100.00%	$1,272,387,949.99	774	135.08%	381541181	8758.9806	100.00%	$574,104,079.99	21920	102.11%	750422338	17227.3270	99.98%	$4,354,831,679.98
Northeast Coalition (NECN)	18909	100.14%	102396871.9	$3,393,948,800.08	1019	100.49%	20880158	479.3425	100.00%	$426,059,379.91	223	109.31%	68770270	1578.7482	100.00%	$42,249,110.01	20151	100.25%	192047300	4408.7995	99.99%	$3,862,257,290.00
Southeast Uplift Neighborhood Program (SEUL)	47904	100.43%	295028700.9	$295,028,700.89	2526	100.72%	75657193	1736.8502	99.98%	$1,023,558,607.36	767	137.46%	216398994	4967.8375	100.00%	$175,708,704.65	51197	100.85%	587084888	13477.6150	99.97%	$1,494,296,012.90
Southwest Neighborhoods, Inc. (SWNI)	16670	77.12%	190111860.5	$11,550,402,541.67	658	93.87%	28260453	648.7707	83.61%	$427,521,380.60	642	98.92%	99750035	2289.9458	56.18%	$68,316,507.67	17970	78.25%	318122348	7303.0844	63.99%	$3,391,170,853.66
Total (cities + county)	**157001**	**94.82%**	**1272383309**	**$15,503,402,541.67**	**11320**	**100.86%**	**711657247**	**16337.4029**	**97.98%**	**$8,545,532,688.44**	**4645**	**15.51%**	**1442505315**	**33115.3664**	**81.47%**	**$1,937,205,426.76**	**17970**	**9.93%**	**318122348**	**78863.3437**	**85.63%**	**$25,985,340,855.88**

Transportation

Communities (Multnomah County)	Freeways, Highways & Major Arterials Length (feet)	Freeways, Highways & Major Arterials Length (miles)	Freeways, Highways & Major Arterials Percent of Total Area (%)	Minor Arterials & Collect/Connectors Length (feet)	Minor Arterials & Collect/Connectors Length (miles)	Minor Arterials & Collect/Connectors Percent of Total (Juris) Area (%)	Local Streets Length (feet)	Local Streets Length (miles)	Local Streets Percent of Total Area %	Total Road Length (feet)	Total Road Length (miles)	Total Road Length %
Fairview	43364	8.21	100.000%	42719	8.09	100.000%	143513	27.18	100.000%	229596	43.48417	100.000%
Gresham	182122	34.49	100.000%	169449	32.09	96.158%	1304007	246.97	98.979%	1655579	313.55656	98.793%
Multnomah County	109485	20.74	44.298%	303596	57.50	63.645%	740239	140.20	69.476%	1153320	218.43174	64.444%
Portland	1473019	278.98	92.197%	1804319	341.73	88.216%	9242818	1750.53	90.911%	12520156	2371.24161	90.660%
Troutdale	56614	10.72	94.460%	34105	6.46	100.000%	260477	49.33	97.860%	351196	66.51435	97.497%
Wood Village	12397	2.35	100.000%	17507	3.32	100.000%	54837	10.39	100.000%	84740	16.04927	100.000%
Total (cities + county)	**1877001**	**355.49257**	**87.602%**	**2371695**	**449.18**	**84.919%**	**11745891**	**2224.60054**	**90.25%**	**15994586**	**3029.27770**	**89.11%**

Neighborhoods (City of Portland)	Freeways, Highways & Major Arterials Length (feet)	Freeways, Highways & Major Arterials Length (miles)	Freeways, Highways & Major Arterials Percent of Total Area (%)	Minor Arterials & Collect/Connectors Length (feet)	Minor Arterials & Collect/Connectors Length (miles)	Minor Arterials & Collect/Connectors Percent of Total (Juris) Area (%)	Local Streets Length (feet)	Local Streets Length (miles)	Local Streets Percent of Total Area %	Total Road Length (feet)	Total Road Length (miles)	Total Road Length %
Airport	63486	12.02	100.000%	65851	12.47	100.000%	127402	24.13	100.000%	256739	48.62	100.011%
Central City (CENT)	193467	36.64	95.786%	147875	28.01	98.911%	436663	82.70	96.941%	778005	147.35	97.026%
Central Northeast Neighborhoods (CNN)	153067	28.99	100.000%	135847	25.73	97.207%	812031	153.79	99.983%	1100944	208.51	99.645%
East Portland Neighborhood Office (EPNO)	62208	11.78	63.021%	105370	19.96	52.149%	314304	59.53	36.868%	481882	91.27	41.786%
Neighbors West/Northwest (NWNW)	271144	51.35	100.000%	191768	36.32	100.000%	1553706	294.26	100.000%	2016619	381.94	100.011%
North Portland Neighborhood Services (NPNS)	74190	14.05	100.001%	158837	30.08	100.000%	850863	161.15	100.000%	1083890	205.28	100.011%
Northeast Coalition (NECN)	193101	36.57	100.000%	406521	76.99	100.000%	2263665	428.72	100.000%	2863287	542.29	100.009%
Southeast Uplift Neighborhood Program (SEUL)	148961	28.21	65.230%	215951	40.90	60.805%	943180	178.63	72.394%	1308093	247.74	69.350%
Total (cities + county)	**1470665**	**278.54**	**92.200%**	**1806533**	**342.15**	**88.155%**	**9253588**	**1752.57**	**90.915%**	**12530786**	**2373.25**	**90.662%**

Critical Facilities: Buildings

Communities (Multnomah County)	School Buildings Count	School Buildings (Count % of Total) (percent)	Fire Buildings (count)	Fire Buildings (Count % of Total) (percent)	Police Buildings (count)	Police Buildings (Count % of Total) (percent)	Hospital Buildings (count)	Hospital Buildings (Count % of Total) (percent)	All Critical Buildings Total Count	Percent Total (Count % of Total) (percent)
Fairview	16	100.000%	0	0.000%	1	100.000%	0	0.000%	17	100.00%
Gresham	56	100.000%	4	100.000%	1	100.000%	1	100.000%	62	100.00%
Multnomah County	10	0.000%	6	100.000%	0	0.000%	0	0.000%	16	84.21%
Portland	159	1223.077%	30	96.774%	11	100.000%	14	87.500%	214	97.72%
Troutdale	9	100.000%	0	0.000%	0	0.000%	0	0.000%	9	100.00%
Wood Village	0	0.000%	0	0.000%	0	0.000%	0	0.000%	0	0.00%
Total (cities + county)	**250**	**98.039%**	**40**	**97.561%**	**13**	**100.00%**	**15**	**88.24%**	**318**	**97.55%**

Exposure - Landslide Inventory - Deep Landslide Susceptibility (Moderate)

Buildings

Communities (Multnomah County)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Value (dollars)	Commercial Count	Commercial (Count % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Value (dollars)	Other (unassigned) Buildings Count	(Count of Total) (percent)	Value (dollars)	All Buildings Total Count	Percent Total (Count % of Total) (percent)	Total Value (dollars)
Fairview	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	#DIV/0!	$0.00	0	0.00%	$0.00
Gresham	258	0.88%	$46,689,295.71	1	0.05%	$18,592.84	4	1.34%	$3,689,420.74	0	0.00%	$0.00	263	0.83%	$50,397,309.29
Multnomah County	2127	23.05%	$493,346,928.98	216	7.88%	$29,514,183.77	34	16.92%	$12,164,707.24	0	0.00%	$0.00	2377	19.53%	$535,025,820.00
Portland	9405	4.25%	$3,419,678,507.26	234	1.51%	$272,867,474.67	160	6.55%	$1,604,884,415.30	0	0.00%	$0.00	9799	4.10%	$5,297,430,397.23
Troutdale	49	0.96%	$2,902,486.83	1	0.34%	$376,292.97	0	0.00%	$0.00	0	#DIV/0!	$0.00	50	0.91%	$3,278,779.81
Wood Village	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	#DIV/0!	$0.00	0	0.00%	$0.00
Total (cities + county)	**11839**	**4.41%**	**$3,962,617,218.78**	**452**	**2.16%**	**$302,776,544.26**	**198**	**6.21%**	**$1,620,738,543.28**	**0**	**0.00%**	**$0.00**	**12489**	**4.27%**	**$5,886,132,306.33**

Neighborhoods (City of Portland)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Value (dollars)	Commercial Count	Commercial (Count % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Value (dollars)	Other (unassigned) Buildings Count	(Count of Total) (percent)	Value (dollars)	All Buildings Total Count	Percent Total (Count % of Total) (percent)	Total Value (dollars)
Airport	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Central City (CENT)	89	12.03%	$143,295,007.66	39	2.03%	$54,140,708.11	1	0.75%	$22,128,388.96	0	0.00%	$0.00	129	4.62%	$219,564,104.73
Central Northeast Neighborhoods (CNN)	26	0.11%	$6,377,015.25	0	0.00%	$0.00	2	1.75%	$513,942.63	0	0.00%	$0.00	28	0.11%	$6,890,957.88
East Portland Neighborhood Office (EPNO)	211	0.44%	$20,471,307.20	2	0.08%	$515,212.55	4	1.46%	$182,859.47	0	0.00%	$0.00	217	0.43%	$21,169,379.23
Neighbors West/Northwest (NWNW)	3547	54.64%	$1,514,496,168.04	87	5.56%	$65,491,301.60	67	29.26%	$75,315,790.28	0	0.00%	$0.00	3701	44.66%	$1,655,303,259.92
North Portland Neighborhood Services (NPNS)	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Northeast Coalition (NECN)	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Southeast Uplift Neighborhood Program (SEUL)	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Southwest Neighborhoods, Inc. (SWNI)	5552	22.52%	$1,740,166,222.62	104	12.35%	$152,265,425.63	86	48.04%	$1,506,743,433.95	0	#DIV/0!	$0.00	5742	22.36%	$3,399,175,082.20
Total (cities + county)	**9425**	**4.26%**	**$3,424,805,720.77**	**232**	**1.48%**	**$272,412,647.89**	**160**	**6.55%**	**$1,604,884,415.30**	**0**	**0.00%**	**$0.00**	**9817**	**4.10%**	**$5,302,102,783.96**

Land

Communities (Multnomah County)	Single Family Count	Single Family (Count % of Total) (percent)	Single Family Area (feet2)	Residential Value (dollars)	Other Residential Count	Other Residential (Count % of Total) (percent)	Other Residential Area (feet2)	Other Residential Value (dollars)	Commercial Count	Commercial (Count % of Total) (percent)	Commercial Area (feet2)	Commercial Area (acres)	Commercial (Area % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Area (feet2)	Government Area (acres)	Government (Area % of Total) (percent)	Government Value (dollars)	All Land Count	(Count % of Total) (percent)	Area (feet2)	Total Area (acres)
Fairview	0	0.00%	0	$0.00	0	#DIV/0!	0	$0.00	0	#DIV/0!	0	0	0.00%	$0.00	0	#DIV/0!	0	0	0.00%	$0.00	0	0.00%	0	0.0000
Gresham	297	1.38%	4665775	$31,610,429.00	60	0.36	4071411	$3,811,197.70	5	5.88%	754654	17.32	0.55%	$121,597.68	45	39.47%	18076397	414.9770	8.63%	$6,176,479.04	407	1.66%	27568237	632.8797
Multnomah County	1255	35.74%	74940907.20	$336,791,584.08	1030	0.68	306007555	$110,144,374.93	359	33.30%	187156401	4296.52	14.57%	$16,895,995.86	465	71.21%	133068401	3054.8302	12.49%	$26,146,426.20	3109	41.95%	133060401	16096.7238
Portland	8483	5.43%	107225753	$1,995,157,680.62	1549	0.54	88967777	$323,305,603.20	271	26.26%	12979399	297.97	1.81%	$144,970,466.37	786	89.01%	280755498	6445.2596	15.49%	$220,206,389.32	11089	6.13%	489928428	11247.2094
Troutdale	111	2.61%	944272	$4,877,261.63	13	0.00	583991	$552,825.74	2	0.02%	29689	0.68	0.09%	$78,661.22	22	0.53%	2916597	66.9558	3.45%	$725,530.57	148	3.17%	4474549	102.7215
Wood Village	0	0.00%	0	$0.00	0	0.00	0	$0.00	0	0.00%	0	0	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000
Total (cities + county)	**10146**	**5.41%**	**187776708**	**$2,368,436,955.33**	**2652**	**15.15**	**399630734**	**$437,814,001.57**	**637**	**1011.11%**		**4612.49**	**9.09%**	**$162,066,721.13**	**1318**	**4707.14%**	**434816893**	**9982.0227**	**13.49%**	**$253,254,825.13**	**14753**	**6.70%**	**1223144478**	**28079.5344**

Neighborhoods (City of Portland)	Land Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Area (feet2)	Residential Value (dollars)	Commercial Commercial Count	Commercial (Count % of Total) (percent)	Commercial Area (feet2)	Commercial Area (acres)	Commercial (Area % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Area (feet2)	Government Area (acres)	Government (Area % of Total) (percent)	Government Value (dollars)	All Land Count	(Count % of Total) (percent)	Area (feet2)	Total Area (acres)	(Area % of Total) (percent)	Value (dollars)
Airport	0	0.00%	0	$0.00	0	#DIV/0!	0	0.0000	0.00%	$0.00	0	#DIV/0!	0	0.0000	0.000%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00
Central City (CENT)	102	16.04%	540100.4105	$27,916,944.89	33	103.13%	640275	14.6987	1.45%	$41,452,219.09	17	13.710%	1250826	28.7150	1.600%	$3,955,684.49	152	5.45%	2431201	55.8127	1.85%	$73,324,848.47
Central Northeast Neighborhoods (CNN)	49	0.32%	332922.5776	$3,706,182.16	0	0.67%	0	0.0000	0.00%	$0.00	11	3.354%	3955684	90.8100	3.613%	$4,365,704.04	60	0.36%	4288607	98.4529	1.47%	$5,362,792.09
East Portland Neighborhood Office (EPNO)	359	0.99%	11613161.54	$28,828,975.72	7	0.67%	1185307	27.2109	0.80%	$2,334,819.98	47	17.343%	4930033	113.1780	2.192%	$4,803,986.39	413	1.06%	17728502	406.9904	2.21%	$35,967,782.09
Neighbors West/Northwest (NWNW)	3902	64.65%	102051345.9	$952,142,431.06	127	7.14%	5995808	137.6448	7.09%	$36,894,473.72	609	65.203%	202075735	4639.0207	68.139%	$53,788,155.61	4638	62.32%	310122889	7119.4421	58.23%	$1,042,825,060.38
North Portland Neighborhood Services (NPNS)	0	0.00%	0	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	1	0.201%	10492	0.2409	0.003%	$0.00	1	0.00%	10492	0.2409	0.00%	$0.00
Northeast Coalition (NECN)	0	0.00%	0	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.000%	0	0.0000	0.000%	$0.00	0	0.00%	19688	0.4520	0.00%	$0.00
Southeast Uplift Neighborhood Program (SEUL)	0	0.00%	0	$0.00	0	0.10%	17300	0.3971	0.02%	$0.00	1	0.490%	2388	0.0548	0.001%	$0.00	2	0.00%	19688	0.4520	0.00%	$0.00
Southwest Neighborhoods, Inc. (SWNI)	5890	27.25%	79775414.36	$1,307,881,394.44	108	4.31%	4573604	104.9955	13.53%	$63,691,769.68	413	74.014%	68541484	1573.4960	38.606%	$156,551,027.36	6411	27.92%	152890503	3509.8831	30.75%	$1,528,124,191.47
Total (cities + county)	**10302**	**6.22%**	**193772844**	**$2,292,558,983.37**	**276**	**39.37%**	**12412294**	**284.9471**	**1.71%**	**$144,373,282.47**	**1099**	**63.636%**	**280766644**	**6445.5154**	**15.858%**	**$219,758,375.73**	**11677**	**6.45%**	**487491882**	**11191.2741**	**12.15%**	**$2,684,607,586.46**

Transportation

Communities (Multnomah County)	Freeways, Highways & Major Arterials Length (feet)	Freeways, Highways & Major Arterials Length (miles)	Freeways, Highways & Major Arterials Percent of Total Area (%)	Minor Arterials & Collect/Connectors Length (feet)	Minor Arterials & Collect/Connectors Length (miles)	Minor Arterials & Collect/Connectors Percent of Total (Juris) Area (%)	Local Streets Length (feet)	Local Streets Length (miles)	Local Streets Percent of Total Area %	Total Road Length (feet)	Total Road Length (miles)	Total Road Length %
Fairview	0	0.00	0.000%	5822	1.10	3.304%	0	0.00	0.000%	18593	3.52131	1.109%
Gresham	0	0.00	0.000%	12770	2.42	0.969%	12770	2.42	0.969%	18593	3.52131	1.109%
Multnomah County	121058	22.93	976.513%	127943	24.23	730.826%	250376	47.42	23.499%	499377	94.57905	27.904%
Portland	118900	22.52	48.108%	208205	39.43	43.648%	742598	140.64	7.304%	1069703	202.59529	7.746%
Troutdale	1347	0.26	2.248%	0	0.00	0.000%	1364	0.26	0.512%	2711	0.51345	0.753%
Wood Village	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%	0	0	0.000%
Total (cities + county)	**241306**	**45.70187**	**11.262%**	**341970**	**64.77**	**777.78%**	**1007108**	**190.74014**	**32.29%**	**1590384**	**301.20910**	**8.86%**

Neighborhoods (City of Portland)	Freeways, Highways & Major Arterials Length (feet)	Freeways, Highways & Major Arterials Length (miles)	Freeways, Highways & Major Arterials Percent of Total Area (%)	Minor Arterials & Collect/Connectors Length (feet)	Minor Arterials & Collect/Connectors Length (miles)	Minor Arterials & Collect/Connectors Percent of Total (Juris) Area (%)	Local Streets Length (feet)	Local Streets Length (miles)	Local Streets Percent of Total Area %	Total Road Length (feet)	Total Road Length (miles)	Total Road Length %
Airport	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%
Central City (CENT)	8511	1.61	4.214%	914	0.17	0.611%	9973	1.89	2.214%	19397	3.67	0.678%
Central Northeast Neighborhoods (CNN)	0	0.00	0.000%	2478	0.47	1.773%	137	0.03	0.017%	2615	0.50	0.227%
East Portland Neighborhood Office (EPNO)	0	0.00	0.000%	1408	0.27	0.371%	11996	2.27	0.611%	13405	2.54	5.222%
Neighbors West/Northwest (NWNW)	36065	6.83	36.537%	79830	15.12	39.509%	405525	76.80	47.568%	521420	98.75	48.111%
North Portland Neighborhood Services (NPNS)	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%
Northeast Coalition (NECN)	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%
Southeast Uplift Neighborhood Program (SEUL)	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%
Southwest Neighborhoods, Inc. (SWNI)	74117	14.04	32.456%	125667	23.80	35.384%	315249	59.71	24.197%	515034	97.54	64.231%
Total (cities + county)	**118694**	**22.48**	**7.441%**	**210297**	**39.83**	**10.262%**	**742880**	**140.70**	**7.299%**	**1071871**	**203**	**7.755%**

Critical Facilities: Buildings

Communities (Multnomah County)	School Buildings Count	School Buildings (Count % of Total) (percent)	Fire Buildings (count)	Fire Buildings (Count % of Total) (percent)	Police Buildings (count)	Police Buildings (Count % of Total) (percent)	Hospital Buildings (count)	Hospital Buildings (Count % of Total) (percent)	All Critical Buildings Total Count	Percent Total (Count % of Total) (percent)
Fairview	0	0.000%	0	0.000%	0	0.000%	0	0.000%	0	0.00%
Gresham	0	0.000%	0	0.000%	0	0.000%	0	0.000%	0	0.00%
Multnomah County	4	30.769%	1	16.667%	0	0.000%	0	0.000%	5	26.32%
Portland	6	3.727%	4	12.903%	0	0.000%	2	12.500%	12	5.48%
Troutdale	0	0.000%	0	0.000%	0	0.000%	0	0.000%	0	0.00%
Wood Village	0	0.000%	0	0.000%	0	0.000%	0	0.000%	0	0.00%
Total (cities + county)	**10**	**3.922%**	**5**	**12.20%**		**0.00%**		**0.00%**	**17**	**5.21%**

Exposure - Landslide Inventory - Deep Landslide Susceptibility (High)

Landslide Inventory - Deep Landslide Susceptibility (High)

Buildings

Communities (Multnomah County)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Value (dollars)	Commercial Count	Commercial (Count % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Value (dollars)	Other (unassigned) Buildings Count	(Count of Total) (percent)	Value (dollars)	All Buildings Total Count	Percent Total (Count % of Total) (percent)	Total Value (dollars)
Fairview	0	0.000%	$0.00	0	0.000%	$0.00	0	0.000%	$0.00	0	#DIV/0!	$0.00	0	0.00%	$0.00
Gresham	6	0.020%	$5,401,659.98	0	0.000%	$0.00	0	0.000%	$0.00	0	#DIV/0!	$0.00	6	0.02%	$1,401,659.98
Multnomah County	767	8.311%	$152,813,902.87	83	3.027%	$5,205,166.20	8	3.880%	$576,760.01	0	0.00%	$0.00	858	7.05%	$158,595,829.08
Portland	1966	0.889%	$902,824,586.22	58	0.374%	$64,894,575.80	103	4.216%	$107,300,090.96	0	#DIV/0!	$0.00	2127	0.89%	$1,075,019,252.98
Troutdale	28	0.551%	$1,421,969.88	1	0.341%	$41,317.41	0	0.000%	$0.00	0	#DIV/0!	$0.00	29	0.53%	$1,463,287.29
Wood Village	0	0.000%	$0.00	0	0.000%	$0.00	0	0.000%	$0.00	0	#DIV/0!	$0.00	0	0.00%	$0.00
Total (cities + county)	**2767**	**1.031%**	**$1,058,462,118.96**	**142**	**0.679%**	**$70,141,059.41**	**111**	**3.483%**	**$107,876,850.97**	**0**	**0.00%**	**$0.00**	**3020**	**1.03%**	**$1,236,480,029.34**

Neighborhoods (City of Portland)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Value (dollars)	Commercial Count	Commercial (Count % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Value (dollars)	Other (unassigned) Buildings Count	(Count of Total) (percent)	Value (dollars)	All Buildings Total Count	Percent Total (Count % of Total) (percent)	Total Value (dollars)
Airport	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Central City (CENT)	20	2.70%	$102,865,138.00	27	1.43%	$30,611,608.80	1	0.75%	$3,860,261.58	0	0.00%	$0.00	48	1.72%	$137,337,008.38
Central Northeast Neighborhoods (CNN)	21	0.09%	$4,204,339.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	21	0.09%	$4,204,339.00
East Portland Neighborhood Office (EPNO)	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Neighbors West/Northwest (NWNW)	1056	16.27%	$587,228,370.54	21	1.34%	$19,148,850.00	97	42.36%	$101,916,076.82	0	0.00%	$0.00	1174	14.17%	$708,293,297.36
North Portland Neighborhood Services (NPNS)	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Northeast Coalition (NECN)	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Southeast Uplift Neighborhood Program (SEUL)	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00	0	0.00%	$0.00
Southwest Neighborhoods, Inc. (SWNI)	872	3.54%	$209,449,927.33	10	1.19%	$15,134,120.87	5	2.79%	$1,523,752.57	0	#DIV/0!	$0.00	887	3.45%	$226,107,800.77
Total (cities + county)	**1969**	**0.89%**	**$903,747,774.87**	**58**	**0.37%**	**$64,894,579.67**	**103**	**4.21%**	**$107,300,090.96**	**0**	**0.00%**	**$0.00**	**2130**	**0.89%**	**$1,075,942,445.50**

Land

Communities (Multnomah County)	Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Area (feet2)	Residential Value (dollars)	Other Residential Count	Other Residential (Count % of Total) (percent)	Other Residential Area (feet2)	Other Residential Value (dollars)	Commercial Count	Commercial (Count % of Total) (percent)	Commercial Area (feet2)	Commercial Area (acres)	Commercial (Area % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Area (feet2)	Government Area (acres)	Government (Area % of Total) (percent)	Government Value (dollars)	All Land Count	(Count % of Total) (percent)	Area (feet2)	Total Area (acres)
Fairview	0	0.00%	0	$0.00	0	0.00%	0	$0.00	0	0.00%	0	0.00	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000
Gresham	7	0.00%	160209	$725,089.67	9	0.05%	549709	$727,130.93	0	0.00%	0	0.00	0.00%	$0.00	5	4.39%	2118000	48.6226	4.56%	$649,058.73	21	0.09%	2827958	64.9201
Multnomah County	374	10.65%	20568424	$94,987,699.21	483	0.32	15504769	$37,550,305.10	177	17.15%	187269755	4299.72	14.58%	$5,305,187.45	184	28.18%	99214567	2277.6531	47.38%	$11,719,178.19	1218	16.43%	462100437	10608.3667
Portland	1774	1.13%	22204747	$393,440,249.08	359	0.13	17597212	$50,134,233.80	59	0.53%	2304748	52.91	0.32%	$45,727,042.90	213	24.12%	49752552	1142.1615	4.67%	$22,893,886.52	2405	1.33%	91859258	2168.7985
Troutdale	10	0.23%	724042	$1,703,118.58	9	0.00	1523354	$1,360,877.95	2	1.10%	29805	0.68	0.00%	$34,428.76	9	0.22%	328478	7.5408	0.02%	$24,601.82	30	0.64%	2605679	59.8182
Wood Village	0	0.00%	0	$0.00	0	0.00	0	$0.00	0	0.00%	0	0.00	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000
Total (cities + county)	**2165**	**1.15%**	**43657422**	**$490,856,156.54**	**860**	**4.91**	**174717966**	**$131,772,547.78**	**238**	**1.74%**	**$51,066,659.11**				**411**	**1467.86%**	**151413597**	**3475.9780**	**2969.03%**	**$35,286,725.26**	**3674**	**1.67%**	**559393292**	**12841.9034**

Neighborhoods (City of Portland)	Land Residential Single Family Count	Single Family (Count % of Total) (percent)	Single Family Area (feet2)	Residential Value (dollars)	Commercial Count	Commercial (Count % of Total) (percent)	Commercial Area (feet2)	Commercial Area (acres)	Commercial (Area % of Total) (percent)	Commercial Value (dollars)	Public Government Count	Government (Count % of Total) (percent)	Government Area (feet2)	Government Area (acres)	Government (Area % of Total) (percent)	Government Value (dollars)	All Land Count	(Count % of Total) (percent)	Area (feet2)	Total Area (acres)	(Area % of Total) (percent)	Value (dollars)
Airport	0	0.00%	0	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00
Central City (CENT)	24	3.77%	305046.3438	$16,230,738.79	23	1.26%	7.8788	0.78%		$22,708,546.67	5	1.52%	49299	1.1316	0.00%	$341,223.00	52	1.86%	697540	16.0133	0.53%	$39,370,508.46
Central Northeast Neighborhoods (CNN)	31	0.20%	281865.1168	$3,070,830.55	0	0.00%	7.8788	0.78%		$0.00	3	1.13%	456644	10.4831	0.42%	$129,039.28	34	0.21%	738509	16.9538	0.25%	$3,205,869.83
East Portland Neighborhood Office (EPNO)	5	0.01%	283321.4636	$191,970.75	2	0.11%	68380	1.5698	0.05%	$199,046.32	3	0.32%	50419	1.1575	0.02%	$0.00	10	0.03%	402120	9.2314	0.05%	$391,017.07
Neighbors West/Northwest (NWNW)	1142	18.92%	22463804.47	$286,822,661.98	28	3.08%	869772	19.9672	1.03%	$17,277,260.69	130	26.10%	39682639	910.9881	13.38%	$15,617,358.91	1300	17.47%	63016215	1446.6533	11.83%	$319,717,281.58
North Portland Neighborhood Services (NPNS)	0	0.00%	0	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00
Northeast Coalition (NECN)	0	0.00%	0	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00
Southeast Uplift Neighborhood Program (SEUL)	0	0.00%	0	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00	0	0.00%	0	0.0000	0.00%	$0.00
Southwest Neighborhoods, Inc. (SWNI)	969	4.48%	15919901.78	$180,498,439.08	7	1.00%	967039	22.2002	2.86%	$5,224,407.44	113	17.41%	9247664	212.2972	5.21%	$6,300,943.15	1089	4.74%	26128605	599.8303	5.26%	$192,023,789.68
Total (cities + county)	**2171**	**1.31%**	**39247939**	**$486,820,641.15**	**60**	**0.53%**	**2248392**	**51.6160**	**0.31%**	**$45,499,261.13**	**254**	**6.14%**	**49486658**	**1136.0574**	**2.79%**	**$22,388,564.34**	**2485**	**1.37%**	**90962989**	**2088.8821**	**2.27%**	**$554,708,466.62**

Transportation

Communities (Multnomah County)	Freeways, Highways & Major Arterials Length (feet)	Freeways, Highways & Major Arterials Length (miles)	Freeways, Highways & Major Arterials Percent of Total Area (%)	Minor Arterials & Collect/Connectors Length (feet)	Minor Arterials & Collect/Connectors Length (miles)	Minor Arterials & Collect/Connectors Percent of Total (Juris) Area (%)	Local Streets Length (feet)	Local Streets Length (miles)	Local Streets Percent of Total Area %	Total Road Length (feet)	Total Road Length (miles)	Total Road Length %
Fairview	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%	0	0.00000	0.000%
Gresham	0	0.00	0.000%	947	0.18	0.538%	682	0.13	0.052%	1629	0.30857	0.097%
Multnomah County	16612	3.15	134.001%	45474	8.61	259.756%	74849	14.18	7.025%	136936	25.93482	7.652%
Portland	5700	1.09	2.331%	32813	6.21	6.879%	181515	34.38	1.785%	220088	41.68329	1.594%
Troutdale	1973	0.37	3.292%	0	0.00	0.000%	4333	0.82	1.628%	6306	1.19426	1.751%
Wood Village	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%	0	0.00000	0.000%
Total (cities + county)	**24345**	**4.61088**	**1.136%**	**79235**	**15.01**	**2.84%**	**261378**	**49.50345**	**2.008%**	**364959**	**69.12095**	**2.033%**

Neighborhoods (City of Portland)	Freeways, Highways & Major Arterials Length (feet)	Freeways, Highways & Major Arterials Length (miles)	Freeways, Highways & Major Arterials Percent of Total Area (%)	Minor Arterials & Collect/Connectors Length (feet)	Minor Arterials & Collect/Connectors Length (miles)	Minor Arterials & Collect/Connectors Percent of Total (Juris) Area (%)	Local Streets Length (feet)	Local Streets Length (miles)	Local Streets Percent of Total Area %	Total Road Length (feet)	Total Road Length (miles)	Total Road Length %
Airport	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%	0	0.00000	0.000%
Central City (CENT)	0	0.00	0.000%	714	0.14	0.477%	3807	0.72	0.845%	4521	0.85626	0.564%
Central Northeast Neighborhoods (CNN)	0	0.00	0.000%	1425	0.27	1.020%	0	0.00	0.000%	1425	0.26987	0.129%
East Portland Neighborhood Office (EPNO)	0	0.00	0.000%	0	0.00	0.000%	916	0.17	0.047%	916	0.17343	0.034%
Neighbors West/Northwest (NWNW)	437	0.08	0.442%	16856	3.19	8.342%	132727	25.14	15.569%	150019	28.41272	13.000%
North Portland Neighborhood Services (NPNS)	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%	0	0.00000	0.000%
Northeast Coalition (NECN)	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%	0	0.00000	0.000%
Southeast Uplift Neighborhood Program (SEUL)	0	0.00	0.000%	0	0.00	0.000%	0	0.00	0.000%	0	0.00000	0.000%
Southwest Neighborhoods, Inc. (SWNI)	5285	1.00	2.314%	13533	2.56	3.810%	44420	8.41	3.409%	63237	11.97680	3.353%
Total (cities + county)	**5722**	**1.08**	**0.359%**	**32528**	**6.16**	**1.587%**	**181869**	**34.44**	**1.787%**	**220118**	**42**	**1.593%**

Critical Facilities: Buildings

Communities (Multnomah County)	School Buildings Count	School Buildings (Count % of Total) (percent)	Fire Buildings (count)	Fire Buildings (Count % of Total) (percent)	Police Buildings (count)	Police Buildings (Count % of Total) (percent)	Hospital Buildings (count)	Hospital Buildings (Count % of Total) (percent)	All Critical Buildings Total Count	Percent Total (Count % of Total) (percent)
Fairview	0	0.000%	0	0.000%	0	0.000%	0	0.000%	0	0.00%
Gresham	0	0.000%	0	0.000%	0	0.000%	0	0.000%	0	0.00%
Multnomah County	1	0.621%	1	3.226%	0	0.000%	0	0.000%	2	0.91%
Portland	0	0.000%	0	0.000%	0	0.000%	0	0.000%	0	0.00%
Troutdale	0	0.000%	0	0.000%	0	0.000%	0	0.000%	0	0.00%
Wood Village	0	0.000%	0	0.000%	0	0.000%	0	0.000%	0	0.00%
Total (cities + county)	**1**	**0.392%**	**1**	**2.44%**	**0**	**0.00%**	**0**	**0.00%**	**2**	**0.61%**

Neighborhoods (City of Portland)	School Buildings Count	School Buildings (Count % of Total) (percent)	Fire Buildings (count)	Fire Buildings (Count % of Total) (percent)	Police Buildings (count)	Police Buildings (Count % of Total) (percent)	Hospital Buildings (count)	Hospital Buildings (Count % of Total) (percent)	All Critical Buildings Total Count	Percent Total (Count % of Total) (percent)
Airport	0	0.000%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Central City (CENT)	0	0.000%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Central Northeast Neighborhoods (CNN)	0	0.000%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
East Portland Neighborhood Office (EPNO)	0	0.000%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Neighbors West/Northwest (NWNW)	0	0.000%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
North Portland Neighborhood Services (NPNS)	0	0.000%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Northeast Coalition (NECN)	0	0.000%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Southeast Uplift Neighborhood Program (SEUL)	0	0.000%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Southwest Neighborhoods, Inc. (SWNI)	1	4.167%	1	25.00%	0	0.00%	0	0.00%	2	6.67%
Total (cities + county)	**1**	**0.595%**	**1**	**3.226%**	**0**	**0.000%**	**0**	**0.000%**	**2**	**0.88%**

Social

Communities (Multnomah County)	Population Count	Population Exposed % of Total
Fairview	0	0.00%
Gresham	14	0.01%
Multnomah County	1117	28.82%
Portland	6728	43.01%
Troutdale	42	0.27%
Wood Village	0	0.00%
Total (cities + county)	**7901**	**1.09%**

Neighborhoods (City of Portland)	Population Count	Population Exposed % of Total
Airport	0	0.00%
Central City (CENT)	601	0.40%
Central Northeast Neighborhoods	41	0.16%
East Portland Neighborhood Office (EPNO)	0	0.00%
Neighbors West/Northwest (NWNW)	4168	7.33%
North Portland Neighborhood Services (NPNS)	0	0.00%
Northeast Coalition (NECN)	0	0.00%
Southeast Uplift Neighborhood Program (SEUL)	0	0.00%
Southwest Neighborhoods, Inc. (SWNI)	1967	6.51%
Total (cities + county)	**6777**	**1.18%**

Hazus-MH: Earthquake Event Report

PHF6_8_sl_no_cb

Region Name:

Earthquake Scenario: PHF6_8_sl_no_cb

Print Date: February 16, 2017

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

Earthquake Event Summary Report

Table of Contents

General Description of the Region

Hazus is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences.   The primary purpose of Hazus is to provide a methodology and software application to develop earthquake losses at a regional scale.   These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Oregon

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 465.48 square miles and contains   171 census tracts.   There are over   304   thousand households in the region which has a total population of 735,334 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 248 thousand buildings in the region with a total building replacement value (excluding contents) of 86,281 (millions of dollars).   Approximately 90.00 % of the buildings (and 73.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 21,993 and 1,587   (millions of dollars) , respectively.

Earthquake Event Summary Report

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 248 thousand buildings in the region which have an aggregate total replacement value of 86,281 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 86% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 10 hospitals in the region with a total bed capacity of 2,172 beds. There are 255 schools, 4 fire stations, 15 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 0 dams identified within the region. Of these, 0 of the dams are classified as 'high hazard'. The inventory also includes 252 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 23,580.00 (millions of dollars). This inventory includes over 459 kilometers of highways, 397 bridges, 58,309 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	397	17,896.90
	Segments	381	3,102.80
	Tunnels	7	16.20
	Subtotal		**21,015.90**
Railways	Bridges	8	4.90
	Facilities	26	69.20
	Segments	197	243.10
	Tunnels	0	0.00
	Subtotal		**317.20**
Light Rail	Bridges	3	1.30
	Facilities	88	234.30
	Segments	101	59.20
	Tunnels	0	0.00
	Subtotal		**294.80**
Bus	Facilities	2	2.50
	Subtotal		**2.50**
Ferry	Facilities	0	0.00
	Subtotal		**0.00**
Port	Facilities	95	189.70
	Subtotal		**189.70**
Airport	Facilities	2	21.30
	Runways	4	151.90
	Subtotal		**173.20**
	Total		**21,993.20**

Earthquake Event Summary Report

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	583.10
	Facilities	1	37.60
	Pipelines	0	0.00
	Subtotal		**620.70**
Waste Water	Distribution Lines	NA	349.90
	Facilities	4	301.00
	Pipelines	0	0.00
	Subtotal		**650.90**
Natural Gas	Distribution Lines	NA	233.20
	Facilities	1	1.20
	Pipelines	0	0.00
	Subtotal		**234.50**
Oil Systems	Facilities	4	0.50
	Pipelines	0	0.00
	Subtotal		**0.50**
Electrical Power	Facilities	10	1,243.00
	Subtotal		**1,243.00**
Communication	Facilities	38	4.30
	Subtotal		**4.30**
	Total		**2,753.80**

Earthquake Event Summary Report

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	PHF6_8_sl_no_cb
Type of Earthquake	Source
Fault Name	Portland Hills fault
Historical Epicenter ID #	819
Probabilistic Return Period	NA
Longitude of Epicenter	-122.70
Latitude of Epicenter	45.52
Earthquake Magnitude	6.80
Depth (Km)	0.00
Rupture Length (Km)	26.55
Rupture Orientation (degrees)	0.00
Attenuation Function	West US, Extensional 2008 - Reverse

Building Damage

Building Damage

Hazus estimates that about 100,719 buildings will be at least moderately damaged. This is over 41.00 % of the buildings in the region. There are an estimated 16,594 buildings that will be damaged beyond repair. The definition of   the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	117	0.16	98	0.13	120	0.20	98	0.42	133	0.80
Commercial	1,195	1.60	1,449	1.99	3,622	5.97	4,432	18.86	7,334	44.19
Education	75	0.10	77	0.11	124	0.20	130	0.55	185	1.11
Government	26	0.03	22	0.03	57	0.09	105	0.45	396	2.39
Industrial	332	0.44	349	0.48	878	1.45	1,106	4.71	1,818	10.95
Other Residential	5,018	6.71	5,263	7.22	6,037	9.96	4,018	17.10	3,557	21.44
Religion	183	0.24	212	0.29	337	0.56	372	1.58	581	3.50
Single Family	67,897	90.72	65,464	89.76	49,454	81.57	13,236	56.33	2,591	15.61
Total	**74,843**		**72,934**		**60,629**		**23,496**		**16,595**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	72,225	96.50	70153	96.19	53,963	89.01	14,935	63.56	3,145	18.95
Steel	322	0.43	260	0.36	861	1.42	1,523	6.48	2,916	17.57
Concrete	388	0.52	404	0.55	1,082	1.78	1,466	6.24	2,288	13.79
Precast	282	0.38	224	0.31	759	1.25	1,204	5.12	2,305	13.89
RM	51	0.07	31	0.04	104	0.17	158	0.67	247	1.49
URM	837	1.12	979	1.34	1,904	3.14	2,136	9.09	3,886	23.41
MH	739	0.99	883	1.21	1,956	3.23	2,074	8.83	1,809	10.90
			72,934							
Total	**74,843**				**60,629**		**23,496**		**16,595**	

*Note:
    RM   Reinforced Masonry
    URM   Unreinforced Masonry
    MH   Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 2,172 hospital beds available for use. On the day of the earthquake, the model estimates that only 221 hospital beds (10.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 28.00% of the beds will be back in service. By 30 days, 64.00% will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
		# Facilities		
Hospitals	10	9	0	0
Schools	255	47	0	65
EOCs	0	0	0	0
PoliceStations	15	8	0	2
FireStations	4	1	0	2

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component	Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 % After Day 1	After Day 7
Highway	Segments	381	0	0	381	381
	Bridges	397	133	45	262	301
	Tunnels	7	0	0	7	7
Railways	Segments	197	0	0	197	197
	Bridges	8	0	0	8	8
	Tunnels	0	0	0	0	0
	Facilities	26	25	0	3	26
Light Rail	Segments	101	0	0	101	101
	Bridges	3	0	0	3	3
	Tunnels	0	0	0	0	0
	Facilities	88	71	0	28	88
Bus	Facilities	2	2	0	1	2
Ferry	Facilities	0	0	0	0	0
Port	Facilities	95	89	0	13	95
Airport	Facilities	2	1	0	2	2
	Runways	4	0	0	4	4

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only.   If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems.   Table 7 provides damage to the utility system facilities.   Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems.   For electric power and potable water, Hazus performs a simplified system performance analysis.   Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	Total #	With at Least Moderate Damage	# of Locations With Complete Damage	with Functionality > 50 % After Day 1	After Day 7
Potable Water	1	0	0	1	1
Waste Water	4	1	0	2	4
Natural Gas	1	0	0	1	1
Oil Systems	4	4	0	0	2
Electrical Power	10	7	0	1	10
Communication	38	34	0	6	38

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	29,155	9821	2455
Waste Water	17,493	7038	1760
Natural Gas	11,662	2019	505
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	304,540	126,450	123,555	117,632	80,419	304
Electric Power		121,026	75,971	32,078	6,429	166

Earthquake Event Summary Report

Induced Earthquake Damage

<u>Debris Generation</u>

Hazus estimates the amount of debris that will be generated by the earthquake.   The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel.   This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 9.29 million tons of debris will be generated.   Of the total amount, Brick/Wood comprises 29.00% of the total, with the remainder being Reinforced Concrete/Steel.   If the debris tonnage is converted to an estimated number of truckloads, it will require 371,400   truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 36,097 households to be displaced due to the earthquake. Of these, 19,644 people (out of a total population of 735,334) will seek temporary shelter in public shelters.

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1:   Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2:   Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3:   Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4:   Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	200	63	10	21
	Commuting	0	0	1	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	194	60	10	20
	Other-Residential	2,953	852	125	245
	Single Family	1,233	218	17	32
	Total	**4,581**	**1,194**	**164**	**317**
2 PM	Commercial	11,045	3,461	579	1,140
	Commuting	3	4	7	1
	Educational	2,801	880	149	291
	Hotels	0	0	0	0
	Industrial	1,433	446	73	143
	Other-Residential	538	156	23	44
	Single Family	223	40	4	6
	Total	**16,044**	**4,988**	**836**	**1,626**
5 PM	Commercial	7,623	2,388	401	780
	Commuting	56	75	127	24
	Educational	502	160	27	53
	Hotels	0	0	0	0
	Industrial	896	279	46	89
	Other-Residential	1,149	334	50	95
	Single Family	487	88	8	13
	Total	**10,714**	**3,324**	**659**	**1,056**

Earthquake Event Summary Report

Economic Loss

The total economic loss estimated for the earthquake is 36,260.67 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses.   The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents.   The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake.   Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were   32,781.24 (millions of dollars);   16 % of the estimated losses were related to the business interruption of the region.   By far, the largest loss was sustained by the residential occupancies which made up over 36 % of the total loss.   Table 11 below provides a summary of the losses associated with the building damage.

Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	68.60	1,138.83	41.63	79.30	1,328.35
	Capital-Related	0.00	29.00	1,069.13	26.18	16.76	1,141.07
	Rental	106.73	339.91	538.65	14.66	54.27	1,054.21
	Relocation	400.64	211.58	806.44	57.54	302.77	1,778.98
	Subtotal	**507.37**	**649.09**	**3,553.06**	**140.01**	**453.10**	**5,302.62**
Capital Stock Losses							
	Structural	824.53	693.34	1,969.31	363.07	397.22	4,247.47
	Non_Structural	3,639.05	3,719.86	6,320.07	1,464.79	1,423.15	16,566.92
	Content	1,066.71	828.66	2,929.71	949.72	651.33	6,426.13
	Inventory	0.00	0.00	73.53	162.31	2.27	238.11
	Subtotal	**5,530.28**	**5,241.86**	**11,292.62**	**2,939.89**	**2,473.97**	**27,478.62**
	Total	**6,037.66**	**5,890.95**	**14,845.68**	**3,079.89**	**2,927.07**	**32,781.24**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Hazus estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	3,102.75	$0.00	0.00
	Bridges	17,896.94	$2708.17	15.13
	Tunnels	16.21	$1.25	7.71
	Subtotal	**21015.90**	**2,709.40**	
Railways	Segments	243.07	$0.00	0.00
	Bridges	4.88	$0.13	2.68
	Tunnels	0.00	$0.00	0.00
	Facilities	69.24	$35.41	51.14
	Subtotal	**317.20**	**35.50**	
Light Rail	Segments	59.19	$0.00	0.00
	Bridges	1.28	$0.05	4.07
	Tunnels	0.00	$0.00	0.00
	Facilities	234.34	$108.81	46.43
	Subtotal	**294.80**	**108.90**	
Bus	Facilities	2.46	$1.17	47.44
	Subtotal	**2.50**	**1.20**	
Ferry	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	189.72	$94.83	49.99
	Subtotal	**189.70**	**94.80**	
Airport	Facilities	21.30	$5.58	26.20
	Runways	151.86	$0.00	0.00
	Subtotal	**173.20**	**5.60**	
	Total	**21993.20**	**2,955.40**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	37.60	$4.59	12.20
	Distribution Lines	583.10	$44.19	7.58
	Subtotal	**620.72**	**$48.78**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	301.00	$37.25	12.37
	Distribution Lines	349.90	$31.67	9.05
	Subtotal	**650.89**	**$68.92**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	1.20	$0.07	5.65
	Distribution Lines	233.20	$9.08	3.89
	Subtotal	**234.47**	**$9.15**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.50	$0.15	34.14
	Subtotal	**0.45**	**$0.15**	
Electrical Power	Facilities	1,243.00	$395.56	31.82
	Subtotal	**1,243.00**	**$395.56**	
Communication	Facilities	4.30	$1.44	33.61
	Subtotal	**4.29**	**$1.44**	
	Total	**2,753.82**	**$524.01**	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of $)

LOSS	Total	%

Appendix A: County Listing for the Region

Multnomah,OR

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Oregon					
	Multnomah	735,334	62,709	23,571	86,281
Total State		**735,334**	**62,709**	**23,571**	**86,281**
Total Region		**735,334**	**62,709**	**23,571**	**86,281**

Hazus-MH: Earthquake Event Report

Region Name: PHF6_8_sl_dry_cb

Earthquake Scenario: PHF6_8_soils_dry_lssus_cb

Print Date: February 17, 2017

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

Table of Contents

General Description of the Region

Hazus is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences.   The primary purpose of Hazus is to provide a methodology and software application to develop earthquake losses at a regional scale.   These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Oregon

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 465.48 square miles and contains   171 census tracts.   There are over   304   thousand households in the region which has a total population of 735,334 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 248 thousand buildings in the region with a total building replacement value (excluding contents) of 86,281 (millions of dollars).   Approximately 90.00 % of the buildings (and 73.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 21,993 and 1,587   (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 248 thousand buildings in the region which have an aggregate total replacement value of 86,281 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 86% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 10 hospitals in the region with a total bed capacity of 2,172 beds. There are 255 schools, 4 fire stations, 15 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 0 dams identified within the region. Of these, 0 of the dams are classified as 'high hazard'. The inventory also includes 252 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 23,580.00 (millions of dollars). This inventory includes over 459 kilometers of highways, 397 bridges, 58,309 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	397	17,896.90
	Segments	381	3,102.80
	Tunnels	7	16.20
	Subtotal		**21,015.90**
Railways	Bridges	8	4.90
	Facilities	26	69.20
	Segments	197	243.10
	Tunnels	0	0.00
	Subtotal		**317.20**
Light Rail	Bridges	3	1.30
	Facilities	88	234.30
	Segments	101	59.20
	Tunnels	0	0.00
	Subtotal		**294.80**
Bus	Facilities	2	2.50
	Subtotal		**2.50**
Ferry	Facilities	0	0.00
	Subtotal		**0.00**
Port	Facilities	95	189.70
	Subtotal		**189.70**
Airport	Facilities	2	21.30
	Runways	4	151.90
	Subtotal		**173.20**
	Total		**21,993.20**

Earthquake Event Summary Report

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	583.10
	Facilities	1	37.60
	Pipelines	0	0.00
	Subtotal		**620.70**
Waste Water	Distribution Lines	NA	349.90
	Facilities	4	301.00
	Pipelines	0	0.00
	Subtotal		**650.90**
Natural Gas	Distribution Lines	NA	233.20
	Facilities	1	1.20
	Pipelines	0	0.00
	Subtotal		**234.50**
Oil Systems	Facilities	4	0.50
	Pipelines	0	0.00
	Subtotal		**0.50**
Electrical Power	Facilities	10	1,243.00
	Subtotal		**1,243.00**
Communication	Facilities	38	4.30
	Subtotal		**4.30**
	Total		**2,753.80**

Earthquake Event Summary Report

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	PHF6_8_soils_dry_lssus_cb
Type of Earthquake	Source
Fault Name	Portland Hills fault
Historical Epicenter ID #	819
Probabilistic Return Period	NA
Longitude of Epicenter	-122.70
Latitude of Epicenter	45.53
Earthquake Magnitude	6.80
Depth (Km)	0.00
Rupture Length (Km)	26.55
Rupture Orientation (degrees)	0.00
Attenuation Function	West US, Extensional 2008 - Reverse

Building Damage

Building Damage

Hazus estimates that about 100,944 buildings will be at least moderately damaged. This is over 41.00 % of the buildings in the region. There are an estimated 16,689 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	117	0.16	98	0.13	119	0.20	99	0.42	133	0.80
Commercial	1,195	1.60	1,447	1.99	3,611	5.97	4,437	18.67	7,342	43.99
Education	75	0.10	76	0.11	124	0.20	130	0.55	185	1.11
Government	26	0.03	22	0.03	56	0.09	105	0.44	397	2.38
Industrial	332	0.44	349	0.48	876	1.45	1,107	4.66	1,820	10.90
Other Residential	5,013	6.70	5,248	7.21	6,023	9.96	4,042	17.01	3,567	21.37
Religion	182	0.24	211	0.29	336	0.56	374	1.57	582	3.49
Single Family	67,842	90.72	65,321	89.76	49,342	81.57	13,474	56.69	2,664	15.96
Total	**74,780**		**72,771**		**60,487**		**23,767**		**16,690**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	72,162	96.50	69993	96.18	53,833	89.00	15,202	63.96	3,229	19.35
Steel	322	0.43	260	0.36	860	1.42	1,522	6.41	2,918	17.48
Concrete	388	0.52	403	0.55	1,080	1.78	1,467	6.17	2,290	13.72
Precast	282	0.38	223	0.31	757	1.25	1,205	5.07	2,306	13.82
RM	51	0.07	31	0.04	104	0.17	158	0.67	247	1.48
URM	837	1.12	977	1.34	1,899	3.14	2,139	9.00	3,889	23.30
MH	738	0.99	883	1.21	1,954	3.23	2,074	8.73	1,811	10.85
Total	**74,780**		**72,771**		**60,487**		**23,767**		**16,690**	

*Note:
RM   Reinforced Masonry
URM   Unreinforced Masonry
MH   Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 2,172 hospital beds available for use.   On the day of the earthquake, the model estimates that only 218 hospital beds (10.00%) are available for use by patients already in the hospital and those injured by the earthquake.   After one week, 28.00% of the beds will be back in service.   By 30 days, 63.00% will be operational.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**At Least Moderate Damage > 50%**	**Complete Damage > 50%**	**With Functionality > 50% on day 1**
Hospitals	10	9	0	0
Schools	255	47	0	65
EOCs	0	0	0	0
PoliceStations	15	8	0	2
FireStations	4	1	0	2

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component	Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 % After Day 1	After Day 7
Highway	Segments	381	0	0	381	381
	Bridges	397	133	45	262	301
	Tunnels	7	2	0	7	7
Railways	Segments	197	0	0	197	197
	Bridges	8	0	0	8	8
	Tunnels	0	0	0	0	0
	Facilities	26	25	0	3	26
Light Rail	Segments	101	0	0	101	101
	Bridges	3	0	0	3	3
	Tunnels	0	0	0	0	0
	Facilities	88	71	0	28	88
Bus	Facilities	2	2	0	1	2
Ferry	Facilities	0	0	0	0	0
Port	Facilities	95	89	0	13	95
Airport	Facilities	2	1	0	2	2
	Runways	4	0	0	4	4

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only.   If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems.   Table 7 provides damage to the utility system facilities.   Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems.   For electric power and potable water, Hazus performs a simplified system performance analysis.   Table 9 provides a summary of the system performance information.

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Table 7 : Expected Utility System Facility Damage

System	Total #	With at Least Moderate Damage	# of Locations With Complete Damage	with Functionality > 50 % After Day 1	After Day 7
Potable Water	1	0	0	1	1
Waste Water	4	1	0	2	4
Natural Gas	1	0	0	1	1
Oil Systems	4	4	0	0	2
Electrical Power	10	7	0	1	10
Communication	38	34	0	6	38

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	29,155	9821	2455
Waste Water	17,493	7038	1760
Natural Gas	11,662	2019	505
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	304,540	126,454	123,558	117,635	80,423	304
Electric Power		121,053	76,037	32,176	6,495	166

Earthquake Event Summary Report

Induced Earthquake Damage

<u>Debris Generation</u>

Hazus estimates the amount of debris that will be generated by the earthquake.   The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel.   This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 9.31 million tons of debris will be generated.   Of the total amount, Brick/Wood comprises 29.00% of the total, with the remainder being Reinforced Concrete/Steel.   If the debris tonnage is converted to an estimated number of truckloads, it will require 372,400   truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters.   The model estimates 36,646 households to be displaced due to the earthquake. Of these,   19,909 people (out of a total population of 735,334) will seek temporary shelter in public shelters.

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake.   The casualties are broken down into four (4) severity levels that describe the extent of the injuries.   The levels are described as follows;

- Severity Level 1:   Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2:   Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3:   Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4:   Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM.   These times represent the periods of the day that different sectors of the community are at their peak occupancy loads.   The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	200	63	11	21
	Commuting	0	0	1	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	194	60	10	20
	Other-Residential	2,968	855	126	245
	Single Family	1,249	221	17	32
	Total	**4,612**	**1,200**	**164**	**318**
2 PM	Commercial	11,052	3,463	580	1,141
	Commuting	3	4	7	1
	Educational	2,803	881	149	291
	Hotels	0	0	0	0
	Industrial	1,434	446	73	143
	Other-Residential	542	157	23	44
	Single Family	226	41	4	6
	Total	**16,060**	**4,992**	**836**	**1,627**
5 PM	Commercial	7,628	2,389	402	781
	Commuting	56	75	126	24
	Educational	503	160	27	53
	Hotels	0	0	0	0
	Industrial	896	279	46	89
	Other-Residential	1,155	335	50	95
	Single Family	493	89	8	13
	Total	**10,732**	**3,328**	**659**	**1,056**

Earthquake Event Summary Report

Economic Loss

The total economic loss estimated for the earthquake is 36,436.98 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 32,956.79 (millions of dollars); 16 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 37 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	69.03	1,140.02	41.67	79.48	1,330.19
	Capital-Related	0.00	29.18	1,070.36	26.20	16.79	1,142.54
	Rental	107.91	343.56	539.31	14.68	54.37	1,059.83
	Relocation	404.50	213.62	807.35	57.59	303.33	1,786.39
	Subtotal	**512.41**	**655.40**	**3,557.04**	**140.13**	**453.97**	**5,318.95**
Capital Stock Losses							
	Structural	838.00	700.34	1,972.12	363.47	398.02	4,271.95
	Non_Structural	3,675.92	3,754.82	6,336.50	1,469.24	1,427.54	16,664.03
	Content	1,076.29	837.28	2,941.49	953.44	654.25	6,462.74
	Inventory	0.00	0.00	73.83	163.00	2.28	239.12
	Subtotal	**5,590.21**	**5,292.44**	**11,323.94**	**2,949.16**	**2,482.09**	**27,637.84**
	Total	**6,102.62**	**5,947.84**	**14,880.98**	**3,089.29**	**2,936.06**	**32,956.79**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only.   There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Hazus estimates the long-term economic impacts to the region for 15 years after the earthquake.   The model quantifies this information in terms of income and employment changes within the region.   Table 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	3,102.75	$0.00	0.00
	Bridges	17,896.94	$2708.17	15.13
	Tunnels	16.21	$1.48	9.11
	Subtotal	**21015.90**	**2,709.60**	
Railways	Segments	243.07	$0.00	0.00
	Bridges	4.88	$0.13	2.68
	Tunnels	0.00	$0.00	0.00
	Facilities	69.24	$35.51	51.28
	Subtotal	**317.20**	**35.60**	
Light Rail	Segments	59.19	$0.00	0.00
	Bridges	1.28	$0.05	4.07
	Tunnels	0.00	$0.00	0.00
	Facilities	234.34	$108.93	46.48
	Subtotal	**294.80**	**109.00**	
Bus	Facilities	2.46	$1.17	47.45
	Subtotal	**2.50**	**1.20**	
Ferry	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	189.72	$95.14	50.15
	Subtotal	**189.70**	**95.10**	
Airport	Facilities	21.30	$5.58	26.20
	Runways	151.86	$0.00	0.00
	Subtotal	**173.20**	**5.60**	
	Total	**21993.20**	**2,956.20**	

Earthquake Event Summary Report

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	37.60	$4.59	12.20
	Distribution Lines	583.10	$44.19	7.58
	Subtotal	**620.72**	**$48.79**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	301.00	$37.27	12.38
	Distribution Lines	349.90	$31.67	9.05
	Subtotal	**650.89**	**$68.94**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	1.20	$0.07	5.65
	Distribution Lines	233.20	$9.08	3.89
	Subtotal	**234.47**	**$9.15**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.50	$0.15	34.23
	Subtotal	**0.45**	**$0.15**	
Electrical Power	Facilities	1,243.00	$395.56	31.82
	Subtotal	**1,243.00**	**$395.56**	
Communication	Facilities	4.30	$1.44	33.61
	Subtotal	**4.29**	**$1.44**	
	Total	**2,753.82**	**$524.03**	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of $)

LOSS	Total	%

Appendix A: County Listing for the Region

Multnomah,OR

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Oregon					
	Multnomah	735,334	62,709	23,571	86,281
Total State		**735,334**	**62,709**	**23,571**	**86,281**
Total Region		**735,334**	**62,709**	**23,571**	**86,281**

Hazus-MH: Earthquake Event Report

Region Name:

PHF6_8_sl_wet_cb2

Earthquake Scenario: PHF6_8_sl_wet_cb_run2

Print Date: February 17, 2017

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

Earthquake Event Summary Report

Table of Contents

General Description of the Region

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The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Oregon

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 465.48 square miles and contains   171 census tracts.   There are over   304   thousand households in the region which has a total population of 735,334 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 248 thousand buildings in the region with a total building replacement value (excluding contents) of 86,281 (millions of dollars).   Approximately 90.00 % of the buildings (and 73.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 21,993 and 1,587   (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 248 thousand buildings in the region which have an aggregate total replacement value of 86,281 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 86% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 10 hospitals in the region with a total bed capacity of 2,172 beds. There are 255 schools, 4 fire stations, 15 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 0 dams identified within the region. Of these, 0 of the dams are classified as 'high hazard'. The inventory also includes 252 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 23,580.00 (millions of dollars). This inventory includes over 459 kilometers of highways, 397 bridges, 58,309 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	397	17,896.90
	Segments	381	3,102.80
	Tunnels	7	16.20
	Subtotal		**21,015.90**
Railways	Bridges	8	4.90
	Facilities	26	69.20
	Segments	197	243.10
	Tunnels	0	0.00
	Subtotal		**317.20**
Light Rail	Bridges	3	1.30
	Facilities	88	234.30
	Segments	101	59.20
	Tunnels	0	0.00
	Subtotal		**294.80**
Bus	Facilities	2	2.50
	Subtotal		**2.50**
Ferry	Facilities	0	0.00
	Subtotal		**0.00**
Port	Facilities	95	189.70
	Subtotal		**189.70**
Airport	Facilities	2	21.30
	Runways	4	151.90
	Subtotal		**173.20**
	Total		**21,993.20**

Earthquake Event Summary Report

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	583.10
	Facilities	1	37.60
	Pipelines	0	0.00
	Subtotal		**620.70**
Waste Water	Distribution Lines	NA	349.90
	Facilities	4	301.00
	Pipelines	0	0.00
	Subtotal		**650.90**
Natural Gas	Distribution Lines	NA	233.20
	Facilities	1	1.20
	Pipelines	0	0.00
	Subtotal		**234.50**
Oil Systems	Facilities	4	0.50
	Pipelines	0	0.00
	Subtotal		**0.50**
Electrical Power	Facilities	10	1,243.00
	Subtotal		**1,243.00**
Communication	Facilities	38	4.30
	Subtotal		**4.30**
	Total		**2,753.80**

Earthquake Event Summary Report

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	PHF6_8_sl_wet_cb_run2
Type of Earthquake	Source
Fault Name	Portland Hills fault
Historical Epicenter ID #	819
Probabilistic Return Period	NA
Longitude of Epicenter	-122.70
Latitude of Epicenter	45.52
Earthquake Magnitude	6.80
Depth (Km)	0.00
Rupture Length (Km)	26.55
Rupture Orientation (degrees)	0.00
Attenuation Function	West US, Extensional 2008 - Reverse

Earthquake Event Summary Report

Building Damage

Building Damage

Hazus estimates that about 105,711 buildings will be at least moderately damaged. This is over 43.00 % of the buildings in the region. There are an estimated 18,280 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	114	0.16	93	0.13	115	0.20	108	0.37	137	0.75
Commercial	1,179	1.61	1,410	2.02	3,492	5.97	4,530	15.67	7,421	40.59
Education	73	0.10	73	0.10	119	0.20	137	0.47	188	1.03
Government	26	0.03	21	0.03	54	0.09	106	0.37	400	2.19
Industrial	328	0.45	341	0.49	851	1.45	1,125	3.89	1,837	10.05
Other Residential	4,921	6.74	5,061	7.26	5,861	10.01	4,367	15.11	3,683	20.14
Religion	178	0.24	202	0.29	325	0.56	390	1.35	591	3.23
Single Family	66,220	90.66	62,546	89.68	47,706	81.52	18,146	62.77	4,025	22.02
Total	**73,038**		**69,746**		**58,522**		**28,909**		**18,281**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	70,443	96.45	67017	96.09	52,018	88.89	20,233	69.99	4,710	25.76
Steel	319	0.44	256	0.37	842	1.44	1,529	5.29	2,937	16.07
Concrete	383	0.52	395	0.57	1,050	1.79	1,488	5.15	2,312	12.65
Precast	278	0.38	219	0.31	737	1.26	1,218	4.21	2,321	12.70
RM	50	0.07	30	0.04	101	0.17	161	0.56	249	1.36
URM	828	1.13	954	1.37	1,842	3.15	2,191	7.58	3,927	21.48
MH	737	1.01	876	1.26	1,933	3.30	2,089	7.23	1,825	9.98
			69,746							
Total	**73,038**				**58,522**		**28,909**		**18,281**	

*Note:
   RM   Reinforced Masonry
   URM   Unreinforced Masonry
   MH   Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 2,172 hospital beds available for use.   On the day of the earthquake, the model estimates that only 205 hospital beds (9.00%) are available for use by patients already in the hospital and those injured by the earthquake.   After one week, 26.00% of the beds will be back in service.   By 30 days, 59.00% will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	10	9	0	0
Schools	255	65	0	64
EOCs	0	0	0	0
PoliceStations	15	8	0	2
FireStations	4	1	0	2

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 % After Day 1	After Day 7
Highway	Segments	381	0	0	381	381
	Bridges	397	133	45	262	301
	Tunnels	7	2	0	7	7
Railways	Segments	197	0	0	197	197
	Bridges	8	0	0	8	8
	Tunnels	0	0	0	0	0
	Facilities	26	25	0	3	26
Light Rail	Segments	101	0	0	101	101
	Bridges	3	0	0	3	3
	Tunnels	0	0	0	0	0
	Facilities	88	71	0	28	88
Bus	Facilities	2	2	0	1	2
Ferry	Facilities	0	0	0	0	0
Port	Facilities	95	89	0	11	93
Airport	Facilities	2	1	0	2	2
	Runways	4	0	0	4	4

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only.   If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems.   Table 7 provides damage to the utility system facilities.   Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems.   For electric power and potable water, Hazus performs a simplified system performance analysis.   Table 9 provides a summary of the system performance information.

Earthquake Event Summary Report

Table 7 : Expected Utility System Facility Damage

System	Total #	With at Least Moderate Damage	# of Locations With Complete Damage	with Functionality > 50 % After Day 1	After Day 7
Potable Water	1	0	0	1	1
Waste Water	4	1	0	2	4
Natural Gas	1	0	0	1	1
Oil Systems	4	4	0	0	2
Electrical Power	10	7	0	1	10
Communication	38	34	0	6	38

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	29,155	9821	2455
Waste Water	17,493	7038	1760
Natural Gas	11,662	2019	505
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	304,540	126,452	123,556	117,633	80,421	304
Electric Power		121,683	77,492	34,448	7,979	166

Earthquake Event Summary Report

Induced Earthquake Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake.   The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel.   This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 9.59 million tons of debris will be generated.   Of the total amount, Brick/Wood comprises 30.00% of the total, with the remainder being Reinforced Concrete/Steel.   If the debris tonnage is converted to an estimated number of truckloads, it will require 383,680   truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

<u>Shelter Requirement</u>

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters.   The model estimates 41,652 households to be displaced due to the earthquake. Of these,   22,405 people (out of a total population of 735,334) will seek temporary shelter in public shelters.

<u>Casualties</u>

Hazus estimates the number of people that will be injured and killed by the earthquake.   The casualties are broken down into four (4) severity levels that describe the extent of the injuries.   The levels are described as follows;

· Severity Level 1:   Injuries will require medical attention but hospitalization is not needed.
· Severity Level 2:   Injuries will require hospitalization but are not considered life-threatening
· Severity Level 3:   Injuries will require hospitalization and can become life threatening if not
                                         promptly treated.
· Severity Level 4:   Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM.   These times represent the periods of the day that different sectors of the community are at their peak occupancy loads.   The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	203	64	11	21
	Commuting	0	0	1	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	196	61	10	20
	Other-Residential	3,082	881	128	249
	Single Family	1,545	283	21	38
	Total	**5,027**	**1,289**	**170**	**327**
2 PM	Commercial	11,177	3,500	585	1,152
	Commuting	3	4	7	1
	Educational	2,844	893	151	294
	Hotels	0	0	0	0
	Industrial	1,448	450	74	144
	Other-Residential	563	161	24	45
	Single Family	282	52	4	7
	Total	**16,317**	**5,061**	**846**	**1,644**
5 PM	Commercial	7,715	2,415	406	788
	Commuting	56	75	127	24
	Educational	511	163	28	54
	Hotels	0	0	0	0
	Industrial	905	281	46	90
	Other-Residential	1,201	346	51	96
	Single Family	613	114	10	15
	Total	**11,001**	**3,393**	**667**	**1,069**

Earthquake Event Summary Report

Economic Loss

The total economic loss estimated for the earthquake is 38,287.84 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses.   The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents.   The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake.   Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were   34,798.67 (millions of dollars);   16 % of the estimated losses were related to the business interruption of the region.   By far, the largest loss was sustained by the residential occupancies which made up over 39 % of the total loss.   Table 11 below provides a summary of the losses associated with the building damage.

Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	72.42	1,151.43	41.97	80.60	1,346.42
	Capital-Related	0.00	30.62	1,081.10	26.39	17.15	1,155.26
	Rental	129.49	368.63	545.04	14.76	54.99	1,112.90
	Relocation	475.96	227.82	815.68	57.87	308.34	1,885.67
	Subtotal	**605.44**	**699.48**	**3,593.26**	**141.00**	**461.08**	**5,500.26**
Capital Stock Losses							
	Structural	1,055.61	746.79	1,993.84	366.30	404.97	4,567.52
	Non_Structural	4,278.24	3,991.98	6,454.65	1,495.45	1,459.94	17,680.26
	Content	1,232.53	897.42	3,025.33	975.14	675.63	6,806.05
	Inventory	0.00	0.00	75.48	166.69	2.42	244.59
	Subtotal	**6,566.38**	**5,636.19**	**11,549.30**	**3,003.58**	**2,542.96**	**29,298.42**
	Total	**7,171.82**	**6,335.67**	**15,142.56**	**3,144.59**	**3,004.04**	**34,798.67**

<u>Transportation and Utility Lifeline Losses</u>

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only.   There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Hazus estimates the long-term economic impacts to the region for 15 years after the earthquake.   The model quantifies this information in terms of income and employment changes within the region.   Table 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	3,102.75	$0.00	0.00
	Bridges	17,896.94	$2708.36	15.13
	Tunnels	16.21	$2.71	16.72
	Subtotal	**21015.90**	**2,711.10**	
Railways	Segments	243.07	$0.00	0.00
	Bridges	4.88	$0.13	2.68
	Tunnels	0.00	$0.00	0.00
	Facilities	69.24	$36.20	52.29
	Subtotal	**317.20**	**36.30**	
Light Rail	Segments	59.19	$0.00	0.00
	Bridges	1.28	$0.05	4.07
	Tunnels	0.00	$0.00	0.00
	Facilities	234.34	$109.96	46.92
	Subtotal	**294.80**	**110.00**	
Bus	Facilities	2.46	$1.18	47.88
	Subtotal	**2.50**	**1.20**	
Ferry	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	189.72	$96.70	50.97
	Subtotal	**189.70**	**96.70**	
Airport	Facilities	21.30	$5.61	26.32
	Runways	151.86	$0.00	0.00
	Subtotal	**173.20**	**5.60**	
	Total	**21993.20**	**2,960.90**	

Earthquake Event Summary Report

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	37.60	$4.59	12.20
	Distribution Lines	583.10	$44.19	7.58
	Subtotal	**620.72**	**$48.78**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	301.00	$41.48	13.78
	Distribution Lines	349.90	$31.67	9.05
	Subtotal	**650.89**	**$73.16**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	1.20	$0.07	5.65
	Distribution Lines	233.20	$9.08	3.89
	Subtotal	**234.47**	**$9.15**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.50	$0.16	34.96
	Subtotal	**0.45**	**$0.16**	
Electrical Power	Facilities	1,243.00	$395.56	31.82
	Subtotal	**1,243.00**	**$395.56**	
Communication	Facilities	4.30	$1.45	33.68
	Subtotal	**4.29**	**$1.45**	
	Total	**2,753.82**	**$528.26**	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of $)

LOSS	Total	%

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Total State		**735,334**	**62,709**	**23,571**	**86,281**
Total Region		**735,334**	**62,709**	**23,571**	**86,281**

Hazus-MH: Earthquake Event Report

Region Name:

Cascadia9_0_no

Earthquake Scenario:

Cascadia9_0_no_lssus

Print Date:

February 16, 2017

Disclaimer:
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Earthquake Event Summary Report

Building and Lifeline Inventory

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Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 23,580.00 (millions of dollars). This inventory includes over 459 kilometers of highways, 397 bridges, 58,309 kilometers of pipes.

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	Facilities	26	69.20
	Segments	197	243.10
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Light Rail	Bridges	3	1.30
	Facilities	88	234.30
	Segments	101	59.20
	Tunnels	0	0.00
	Subtotal		**294.80**
Bus	Facilities	2	2.50
	Subtotal		**2.50**
Ferry	Facilities	0	0.00
	Subtotal		**0.00**
Port	Facilities	95	189.70
	Subtotal		**189.70**
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	Runways	4	151.90
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	Total		**21,993.20**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	583.10
	Facilities	1	37.60
	Pipelines	0	0.00
	Subtotal		**620.70**
Waste Water	Distribution Lines	NA	349.90
	Facilities	4	301.00
	Pipelines	0	0.00
	Subtotal		**650.90**
Natural Gas	Distribution Lines	NA	233.20
	Facilities	1	1.20
	Pipelines	0	0.00
	Subtotal		**234.50**
Oil Systems	Facilities	4	0.50
	Pipelines	0	0.00
	Subtotal		**0.50**
Electrical Power	Facilities	10	1,243.00
	Subtotal		**1,243.00**
Communication	Facilities	38	4.30
	Subtotal		**4.30**
	Total		**2,753.80**

Earthquake Event Summary Report

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Cascadia9_0_no_lssus
Type of Earthquake	User-defined
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	NA
Latitude of Epicenter	NA
Earthquake Magnitude	9.00
Depth (Km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Building Damage

Building Damage

Hazus estimates that about 26,896 buildings will be at least moderately damaged. This is over 11.00 % of the buildings in the region. There are an estimated 2,967 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	233	0.13	89	0.22	102	0.72	101	1.03	41	1.37
Commercial	2,603	1.44	3,751	9.31	6,154	43.56	4,185	42.70	1,338	45.08
Education	184	0.10	103	0.26	151	1.07	119	1.22	32	1.08
Government	45	0.02	47	0.12	121	0.85	195	1.99	198	6.68
Industrial	552	0.30	746	1.85	1,501	10.62	1,277	13.02	406	13.68
Other Residential	11,773	6.49	4,191	10.40	3,635	25.73	3,473	35.43	821	27.67
Religion	480	0.26	284	0.71	432	3.05	378	3.86	111	3.74
Single Family	165,417	91.25	31,099	77.15	2,032	14.39	74	0.75	21	0.70
Total	**181,288**		**40,311**		**14,127**		**9,802**		**2,967**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	175,989	97.08	34083	84.55	3,939	27.88	364	3.71	45	1.50
Steel	291	0.16	357	0.89	1,708	12.09	2,541	25.92	984	33.15
Concrete	381	0.21	692	1.72	2,250	15.93	1,843	18.80	461	15.55
Precast	423	0.23	422	1.05	1,467	10.38	1,870	19.08	590	19.88
RM	65	0.04	58	0.14	223	1.58	207	2.12	38	1.30
URM	3,318	1.83	3313	8.22	2,288	16.19	529	5.39	295	9.94
MH	821	0.45	1386	3.44	2,252	15.94	2,448	24.97	554	18.68
			40,311							
Total	**181,288**				**14,127**		**9,802**		**2,967**	

*Note:
    RM   Reinforced Masonry
    URM   Unreinforced Masonry
    MH   Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 2,172 hospital beds available for use.   On the day of the earthquake, the model estimates that only 554 hospital beds (26.00%) are available for use by patients already in the hospital and those injured by the earthquake.   After one week, 53.00% of the beds will be back in service.   By 30 days, 96.00% will be operational.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**At Least Moderate Damage > 50%**	**Complete Damage > 50%**	**With Functionality > 50% on day 1**
Hospitals	10	7	0	3
Schools	255	0	0	249
EOCs	0	0	0	0
PoliceStations	15	0	0	13
FireStations	4	0	0	3

Earthquake Event Summary Report

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component	Locations/ Segments	Number of Locations		With Functionality > 50 %	
			With at Least Mod. Damage	With Complete Damage	After Day 1	After Day 7
Highway	Segments	381	0	0	381	381
	Bridges	397	19	0	380	388
	Tunnels	7	0	0	7	7
Railways	Segments	197	0	0	197	197
	Bridges	8	0	0	8	8
	Tunnels	0	0	0	0	0
	Facilities	26	0	0	26	26
Light Rail	Segments	101	0	0	101	101
	Bridges	3	0	0	3	3
	Tunnels	0	0	0	0	0
	Facilities	88	0	0	88	88
Bus	Facilities	2	0	0	2	2
Ferry	Facilities	0	0	0	0	0
Port	Facilities	95	0	0	95	95
Airport	Facilities	2	0	0	2	2
	Runways	4	0	0	4	4

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only.   If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems.   Table 7 provides damage to the utility system facilities.   Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems.   For electric power and potable water, Hazus performs a simplified system performance analysis.   Table 9 provides a summary of the system performance information.

Earthquake Event Summary Report

Table 7 : Expected Utility System Facility Damage

System	Total #	With at Least Moderate Damage	# of Locations With Complete Damage	with Functionality > 50 % After Day 1	with Functionality > 50 % After Day 7
Potable Water	1	0	0	1	1
Waste Water	4	0	0	3	4
Natural Gas	1	0	0	1	1
Oil Systems	4	1	0	2	4
Electrical Power	10	0	0	9	10
Communication	38	0	0	38	38

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	29,155	2860	715
Waste Water	17,493	2050	512
Natural Gas	11,662	588	147
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	304,540	13,731	11,362	7,228	0	0
Electric Power		0	0	0	0	0

Earthquake Event Summary Report

Induced Earthquake Damage

<u>Debris Generation</u>

Hazus estimates the amount of debris that will be generated by the earthquake.   The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel.   This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 3.39 million tons of debris will be generated.   Of the total amount, Brick/Wood comprises 20.00% of the total, with the remainder being Reinforced Concrete/Steel.   If the debris tonnage is converted to an estimated number of truckloads, it will require 135,640   truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

<u>Shelter Requirement</u>

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters.   The model estimates 12,632 households to be displaced due to the earthquake. Of these,   7,221 people (out of a total population of 735,334) will seek temporary shelter in public shelters.

<u>Casualties</u>

Hazus estimates the number of people that will be injured and killed by the earthquake.   The casualties are broken down into four (4) severity levels that describe the extent of the injuries.   The levels are described as follows;

- · Severity Level 1:   Injuries will require medical attention but hospitalization is not needed.
- · Severity Level 2:   Injuries will require hospitalization but are not considered life-threatening
- · Severity Level 3:   Injuries will require hospitalization and can become life threatening if not promptly treated.
- · Severity Level 4:   Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM.   These times represent the periods of the day that different sectors of the community are at their peak occupancy loads.   The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Earthquake Event Summary Report

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	43	11	2	3
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	60	15	2	4
	Other-Residential	719	169	21	41
	Single Family	65	5	0	1
	Total	**888**	**199**	**26**	**49**
2 PM	Commercial	2,396	590	88	172
	Commuting	1	1	1	0
	Educational	622	150	22	43
	Hotels	0	0	0	0
	Industrial	439	109	15	30
	Other-Residential	140	34	4	8
	Single Family	12	1	0	0
	Total	**3,609**	**884**	**131**	**254**
5 PM	Commercial	1,647	405	60	117
	Commuting	9	11	20	4
	Educational	89	21	3	6
	Hotels	0	0	0	0
	Industrial	275	68	10	19
	Other-Residential	271	64	8	15
	Single Family	24	2	0	0
	Total	**2,315**	**571**	**102**	**162**

Earthquake Event Summary Report

Economic Loss

The total economic loss estimated for the earthquake is 10,761.79 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses.   The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents.   The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake.   Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were   9,736.40 (millions of dollars);   24 % of the estimated losses were related to the business interruption of the region.   By far, the largest loss was sustained by the residential occupancies which made up over 24 % of the total loss.   Table 11 below provides a summary of the losses associated with the building damage.

Table 11: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	22.60	527.01	22.54	48.11	620.26
	Capital-Related	0.00	9.69	500.77	14.17	7.48	532.12
	Rental	3.68	118.96	280.66	8.66	33.97	445.93
	Relocation	10.12	77.66	427.08	37.41	157.43	709.71
	Subtotal	**13.80**	**228.91**	**1,735.52**	**82.78**	**247.00**	**2,308.01**
Capital Stock Losses							
	Structural	48.96	253.46	835.03	176.57	197.03	1,511.05
	Non_Structural	433.94	973.18	1,902.63	428.20	512.27	4,250.23
	Content	226.13	195.67	726.15	256.13	196.96	1,601.04
	Inventory	0.00	0.00	17.97	47.30	0.81	66.08
	Subtotal	**709.03**	**1,422.31**	**3,481.79**	**908.20**	**907.07**	**7,428.39**
	Total	**722.83**	**1,651.22**	**5,217.31**	**990.97**	**1,154.06**	**9,736.40**

Earthquake Event Summary Report

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Hazus estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	3,102.75	$0.00	0.00
	Bridges	17,896.94	$791.58	4.42
	Tunnels	16.21	$0.06	0.38
	Subtotal	**21015.90**	**791.60**	
Railways	Segments	243.07	$0.00	0.00
	Bridges	4.88	$0.02	0.41
	Tunnels	0.00	$0.00	0.00
	Facilities	69.24	$15.17	21.91
	Subtotal	**317.20**	**15.20**	
Light Rail	Segments	59.19	$0.00	0.00
	Bridges	1.28	$0.01	0.44
	Tunnels	0.00	$0.00	0.00
	Facilities	234.34	$40.15	17.13
	Subtotal	**294.80**	**40.20**	
Bus	Facilities	2.46	$0.49	19.89
	Subtotal	**2.50**	**0.50**	
Ferry	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	189.72	$31.75	16.74
	Subtotal	**189.70**	**31.80**	
Airport	Facilities	21.30	$3.85	18.06
	Runways	151.86	$0.00	0.00
	Subtotal	**173.20**	**3.80**	
	Total	**21993.20**	**883.10**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	37.60	$2.41	6.41
	Distribution Lines	583.10	$12.87	2.21
	Subtotal	**620.72**	**$15.28**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	301.00	$15.84	5.26
	Distribution Lines	349.90	$9.22	2.64
	Subtotal	**650.89**	**$25.06**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	1.20	$0.05	4.34
	Distribution Lines	233.20	$2.65	1.13
	Subtotal	**234.47**	**$2.70**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.50	$0.05	10.64
	Subtotal	**0.45**	**$0.05**	
Electrical Power	Facilities	1,243.00	$98.89	7.96
	Subtotal	**1,243.00**	**$98.89**	
Communication	Facilities	4.30	$0.31	7.32
	Subtotal	**4.29**	**$0.31**	
	Total	**2,753.82**	**$142.30**	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of $)

LOSS	Total	%

Appendix A: County Listing for the Region

Multnomah,OR

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Oregon					
	Multnomah	735,334	62,709	23,571	86,281
Total State		**735,334**	**62,709**	**23,571**	**86,281**
Total Region		**735,334**	**62,709**	**23,571**	**86,281**

Hazus-MH: Earthquake Event Report

Region Name: Cascadia9_0_dry_cb

Earthquake Scenario: Cascadia9_0_wet_lssus_added

Print Date: February 16, 2017

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

Table of Contents

General Description of the Region

Hazus is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Oregon

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 465.48 square miles and contains 171 census tracts. There are over 304 thousand households in the region which has a total population of 735,334 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 248 thousand buildings in the region with a total building replacement value (excluding contents) of 86,281 (millions of dollars). Approximately 90.00 % of the buildings (and 73.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 21,993 and 1,587 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 248 thousand buildings in the region which have an aggregate total replacement value of 86,281 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 86% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 10 hospitals in the region with a total bed capacity of 2,172 beds. There are 255 schools, 4 fire stations, 15 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 0 dams identified within the region. Of these, 0 of the dams are classified as 'high hazard'. The inventory also includes 252 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 23,580.00 (millions of dollars). This inventory includes over 459 kilometers of highways, 397 bridges, 58,309 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	397	17,896.90
	Segments	381	3,102.80
	Tunnels	7	16.20
	Subtotal		**21,015.90**
Railways	Bridges	8	4.90
	Facilities	26	69.20
	Segments	197	243.10
	Tunnels	0	0.00
	Subtotal		**317.20**
Light Rail	Bridges	3	1.30
	Facilities	88	234.30
	Segments	101	59.20
	Tunnels	0	0.00
	Subtotal		**294.80**
Bus	Facilities	2	2.50
	Subtotal		**2.50**
Ferry	Facilities	0	0.00
	Subtotal		**0.00**
Port	Facilities	95	189.70
	Subtotal		**189.70**
Airport	Facilities	2	21.30
	Runways	4	151.90
	Subtotal		**173.20**
	Total		**21,993.20**

Earthquake Event Summary Report

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	583.10
	Facilities	1	37.60
	Pipelines	0	0.00
	Subtotal		**620.70**
Waste Water	Distribution Lines	NA	349.90
	Facilities	4	301.00
	Pipelines	0	0.00
	Subtotal		**650.90**
Natural Gas	Distribution Lines	NA	233.20
	Facilities	1	1.20
	Pipelines	0	0.00
	Subtotal		**234.50**
Oil Systems	Facilities	4	0.50
	Pipelines	0	0.00
	Subtotal		**0.50**
Electrical Power	Facilities	10	1,243.00
	Subtotal		**1,243.00**
Communication	Facilities	38	4.30
	Subtotal		**4.30**
	Total		**2,753.80**

Earthquake Event Summary Report

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Cascadia9_0_wet_lssus_added
Type of Earthquake	User-defined
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	NA
Latitude of Epicenter	NA
Earthquake Magnitude	9.00
Depth (Km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Building Damage

Building Damage

Hazus estimates that about 26,921 buildings will be at least moderately damaged. This is over 11.00 % of the buildings in the region. There are an estimated 2,972 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	233	0.13	89	0.22	102	0.72	101	1.03	41	1.36
Commercial	2,603	1.44	3,751	9.31	6,154	43.55	4,186	42.62	1,338	45.02
Education	184	0.10	103	0.26	151	1.07	119	1.21	32	1.08
Government	45	0.02	47	0.12	121	0.85	195	1.99	198	6.67
Industrial	552	0.30	746	1.85	1,501	10.62	1,277	13.00	406	13.66
Other Residential	11,773	6.49	4,190	10.40	3,635	25.73	3,474	35.37	821	27.63
Religion	480	0.26	284	0.71	432	3.05	378	3.85	111	3.73
Single Family	165,406	91.25	31,086	77.14	2,034	14.40	91	0.93	25	0.85
Total	**181,276**		**40,298**		**14,129**		**9,821**		**2,972**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	175,978	97.08	34070	84.55	3,941	27.90	382	3.89	49	1.66
Steel	291	0.16	357	0.89	1,708	12.09	2,541	25.87	984	33.10
Concrete	381	0.21	692	1.72	2,250	15.93	1,843	18.77	462	15.53
Precast	423	0.23	422	1.05	1,467	10.38	1,870	19.04	590	19.84
RM	65	0.04	58	0.14	223	1.58	207	2.11	38	1.29
URM	3,318	1.83	3313	8.22	2,287	16.19	529	5.39	295	9.93
MH	821	0.45	1386	3.44	2,251	15.94	2,448	24.93	554	18.65
			40,298							
Total	**181,276**				**14,129**		**9,821**		**2,972**	

*Note:
RM   Reinforced Masonry
URM   Unreinforced Masonry
MH   Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 2,172 hospital beds available for use. On the day of the earthquake, the model estimates that only 554 hospital beds (26.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 53.00% of the beds will be back in service. By 30 days, 96.00% will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	10	7	0	3
Schools	255	0	0	249
EOCs	0	0	0	0
PoliceStations	15	0	0	13
FireStations	4	0	0	3

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component	Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 % After Day 1	After Day 7
Highway	Segments	381	0	0	381	381
	Bridges	397	19	0	380	388
	Tunnels	7	0	0	7	7
Railways	Segments	197	0	0	197	197
	Bridges	8	0	0	8	8
	Tunnels	0	0	0	0	0
	Facilities	26	0	0	26	26
Light Rail	Segments	101	0	0	101	101
	Bridges	3	0	0	3	3
	Tunnels	0	0	0	0	0
	Facilities	88	0	0	88	88
Bus	Facilities	2	0	0	2	2
Ferry	Facilities	0	0	0	0	0
Port	Facilities	95	0	0	95	95
Airport	Facilities	2	0	0	2	2
	Runways	4	0	0	4	4

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only.   If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems.   Table 7 provides damage to the utility system facilities.   Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems.   For electric power and potable water, Hazus performs a simplified system performance analysis.   Table 9 provides a summary of the system performance information.

Earthquake Event Summary Report

Table 7 : Expected Utility System Facility Damage

System	Total #	With at Least Moderate Damage	# of Locations With Complete Damage	with Functionality > 50 % After Day 1	After Day 7
Potable Water	1	0	0	1	1
Waste Water	4	0	0	3	4
Natural Gas	1	0	0	1	1
Oil Systems	4	1	0	2	4
Electrical Power	10	0	0	9	10
Communication	38	0	0	38	38

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	29,155	2860	715
Waste Water	17,493	2050	512
Natural Gas	11,662	588	147
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	304,540	13,731	11,362	7,228	0	0
Electric Power		0	0	0	0	0

Earthquake Event Summary Report

Induced Earthquake Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake.   The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel.   This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 3.39 million tons of debris will be generated.   Of the total amount, Brick/Wood comprises 20.00% of the total, with the remainder being Reinforced Concrete/Steel.   If the debris tonnage is converted to an estimated number of truckloads, it will require 135,680   truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters.   The model estimates 12,652 households to be displaced due to the earthquake. Of these,   7,229 people (out of a total population of 735,334) will seek temporary shelter in public shelters.

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake.   The casualties are broken down into four (4) severity levels that describe the extent of the injuries.   The levels are described as follows;

· Severity Level 1:   Injuries will require medical attention but hospitalization is not needed.
· Severity Level 2:   Injuries will require hospitalization but are not considered life-threatening
· Severity Level 3:   Injuries will require hospitalization and can become life threatening if not
                        promptly treated.
· Severity Level 4:   Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM.   These times represent the periods of the day that different sectors of the community are at their peak occupancy loads.   The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	43	11	2	3
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	60	15	2	4
	Other-Residential	720	169	21	41
	Single Family	66	5	0	1
	Total	**889**	**199**	**26**	**49**
2 PM	Commercial	2,397	590	88	172
	Commuting	1	1	1	0
	Educational	622	150	22	43
	Hotels	0	0	0	0
	Industrial	439	109	15	30
	Other-Residential	140	34	4	8
	Single Family	12	1	0	0
	Total	**3,610**	**884**	**131**	**254**
5 PM	Commercial	1,647	405	60	117
	Commuting	9	11	20	4
	Educational	89	21	3	6
	Hotels	0	0	0	0
	Industrial	275	68	10	19
	Other-Residential	271	64	8	15
	Single Family	25	2	0	0
	Total	**2,316**	**572**	**102**	**162**

Economic Loss

The total economic loss estimated for the earthquake is 10,769.65 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 9,744.27 (millions of dollars); 24 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 24 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	22.61	527.04	22.54	48.11	620.29
	Capital-Related	0.00	9.69	500.80	14.17	7.48	532.15
	Rental	3.77	119.06	280.67	8.66	33.97	446.14
	Relocation	10.45	77.73	427.09	37.41	157.44	710.12
	Subtotal	**14.23**	**229.10**	**1,735.60**	**82.78**	**247.01**	**2,308.71**
Capital Stock Losses							
	Structural	50.06	253.65	835.07	176.57	197.04	1,512.39
	Non_Structural	437.09	974.21	1,902.91	428.22	512.31	4,254.74
	Content	226.93	195.93	726.35	256.15	196.99	1,602.36
	Inventory	0.00	0.00	17.98	47.30	0.81	66.08
	Subtotal	**714.08**	**1,423.79**	**3,482.30**	**908.24**	**907.15**	**7,435.56**
	Total	**728.30**	**1,652.89**	**5,217.90**	**991.02**	**1,154.16**	**9,744.27**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Hazus estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	3,102.75	$0.00	0.00
	Bridges	17,896.94	$791.58	4.42
	Tunnels	16.21	$0.06	0.38
	Subtotal	**21015.90**	**791.60**	
Railways	Segments	243.07	$0.00	0.00
	Bridges	4.88	$0.02	0.41
	Tunnels	0.00	$0.00	0.00
	Facilities	69.24	$15.17	21.91
	Subtotal	**317.20**	**15.20**	
Light Rail	Segments	59.19	$0.00	0.00
	Bridges	1.28	$0.01	0.44
	Tunnels	0.00	$0.00	0.00
	Facilities	234.34	$40.15	17.13
	Subtotal	**294.80**	**40.20**	
Bus	Facilities	2.46	$0.49	19.89
	Subtotal	**2.50**	**0.50**	
Ferry	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	189.72	$31.75	16.74
	Subtotal	**189.70**	**31.80**	
Airport	Facilities	21.30	$3.85	18.06
	Runways	151.86	$0.00	0.00
	Subtotal	**173.20**	**3.80**	
	Total	**21993.20**	**883.10**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	37.60	$2.41	6.41
	Distribution Lines	583.10	$12.87	2.21
	Subtotal	**620.72**	**$15.28**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	301.00	$15.84	5.26
	Distribution Lines	349.90	$9.22	2.64
	Subtotal	**650.89**	**$25.06**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	1.20	$0.05	4.34
	Distribution Lines	233.20	$2.65	1.13
	Subtotal	**234.47**	**$2.70**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.50	$0.05	10.64
	Subtotal	**0.45**	**$0.05**	
Electrical Power	Facilities	1,243.00	$98.89	7.96
	Subtotal	**1,243.00**	**$98.89**	
Communication	Facilities	4.30	$0.31	7.32
	Subtotal	**4.29**	**$0.31**	
	Total	**2,753.82**	**$142.30**	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of $)

LOSS	Total	%

Appendix A: County Listing for the Region

Multnomah,OR

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Oregon					
	Multnomah	735,334	62,709	23,571	86,281
Total State		**735,334**	**62,709**	**23,571**	**86,281**
Total Region		**735,334**	**62,709**	**23,571**	**86,281**

Hazus-MH: Earthquake Event Report

Region Name:

Cascadia9_0_wet_cb

Earthquake Scenario: Cascadia9_0_wet_lssus_added

Print Date: February 16, 2017

Disclaimer:

This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

Table of Contents

General Description of the Region

Hazus is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences.   The primary purpose of Hazus is to provide a methodology and software application to develop earthquake losses at a regional scale.   These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Oregon

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 465.48 square miles and contains   171 census tracts.   There are over   304   thousand households in the region which has a total population of 735,334 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 248 thousand buildings in the region with a total building replacement value (excluding contents) of 86,281 (millions of dollars).   Approximately 90.00 % of the buildings (and 73.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 21,993 and 1,587   (millions of dollars) , respectively.

Earthquake Event Summary Report

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 248 thousand buildings in the region which have an aggregate total replacement value of 86,281 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 86% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 10 hospitals in the region with a total bed capacity of 2,172 beds. There are 255 schools, 4 fire stations, 15 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 0 dams identified within the region. Of these, 0 of the dams are classified as 'high hazard'. The inventory also includes 252 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 23,580.00 (millions of dollars). This inventory includes over 459 kilometers of highways, 397 bridges, 58,309 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	397	17,896.90
	Segments	381	3,102.80
	Tunnels	7	16.20
	Subtotal		**21,015.90**
Railways	Bridges	8	4.90
	Facilities	26	69.20
	Segments	197	243.10
	Tunnels	0	0.00
	Subtotal		**317.20**
Light Rail	Bridges	3	1.30
	Facilities	88	234.30
	Segments	101	59.20
	Tunnels	0	0.00
	Subtotal		**294.80**
Bus	Facilities	2	2.50
	Subtotal		**2.50**
Ferry	Facilities	0	0.00
	Subtotal		**0.00**
Port	Facilities	95	189.70
	Subtotal		**189.70**
Airport	Facilities	2	21.30
	Runways	4	151.90
	Subtotal		**173.20**
	Total		**21,993.20**

Earthquake Event Summary Report

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	583.10
	Facilities	1	37.60
	Pipelines	0	0.00
	Subtotal		**620.70**
Waste Water	Distribution Lines	NA	349.90
	Facilities	4	301.00
	Pipelines	0	0.00
	Subtotal		**650.90**
Natural Gas	Distribution Lines	NA	233.20
	Facilities	1	1.20
	Pipelines	0	0.00
	Subtotal		**234.50**
Oil Systems	Facilities	4	0.50
	Pipelines	0	0.00
	Subtotal		**0.50**
Electrical Power	Facilities	10	1,243.00
	Subtotal		**1,243.00**
Communication	Facilities	38	4.30
	Subtotal		**4.30**
	Total		**2,753.80**

Earthquake Event Summary Report

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Cascadia9_0_wet_lssus_added
Type of Earthquake	User-defined
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	NA
Latitude of Epicenter	NA
Earthquake Magnitude	9.00
Depth (Km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Building Damage

Building Damage

Hazus estimates that about 28,240 buildings will be at least moderately damaged. This is over 11.00 % of the buildings in the region. There are an estimated 3,234 buildings that will be damaged beyond repair. The definition of   the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	232	0.13	87	0.22	102	0.72	103	0.96	41	1.28
Commercial	2,584	1.43	3,741	9.40	6,134	43.10	4,216	39.13	1,357	41.95
Education	182	0.10	102	0.26	151	1.06	122	1.13	33	1.02
Government	43	0.02	46	0.12	117	0.82	197	1.83	202	6.24
Industrial	550	0.30	745	1.87	1,497	10.52	1,281	11.89	410	12.67
Other Residential	11,710	6.49	4,167	10.47	3,638	25.56	3,536	32.82	842	26.05
Religion	477	0.26	282	0.71	431	3.03	382	3.54	112	3.48
Single Family	164,677	91.26	30,628	76.96	2,162	15.19	938	8.70	236	7.31
Total	**180,456**		**39,800**		**14,231**		**10,775**		**3,234**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	175,187	97.08	33588	84.39	4,069	28.59	1,297	12.04	280	8.67
Steel	286	0.16	355	0.89	1,706	11.99	2,545	23.62	989	30.57
Concrete	375	0.21	689	1.73	2,246	15.78	1,850	17.17	468	14.46
Precast	420	0.23	421	1.06	1,465	10.29	1,873	17.38	593	18.34
RM	64	0.04	58	0.14	223	1.56	208	1.93	39	1.21
URM	3,304	1.83	3304	8.30	2,277	16.00	551	5.11	306	9.45
MH	819	0.45	1385	3.48	2,246	15.78	2,451	22.74	559	17.29
			39,800							
Total	**180,456**				**14,231**		**10,775**		**3,234**	

*Note:
    RM   Reinforced Masonry
    URM   Unreinforced Masonry
    MH   Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 2,172 hospital beds available for use.   On the day of the earthquake, the model estimates that only 554 hospital beds (26.00%) are available for use by patients already in the hospital and those injured by the earthquake.   After one week, 53.00% of the beds will be back in service.   By 30 days, 96.00% will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	10	7	0	3
Schools	255	0	0	249
EOCs	0	0	0	0
PoliceStations	15	0	0	13
FireStations	4	0	0	3

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

| System | Component | Number of Locations | | | | |
| | | Locations/ Segments | With at Least Mod. Damage | With Complete Damage | With Functionality > 50 % | |
					After Day 1	After Day 7
Highway	Segments	381	0	0	381	381
	Bridges	397	19	0	380	388
	Tunnels	7	0	0	7	7
Railways	Segments	197	0	0	197	197
	Bridges	8	0	0	8	8
	Tunnels	0	0	0	0	0
	Facilities	26	0	0	26	26
Light Rail	Segments	101	0	0	101	101
	Bridges	3	0	0	3	3
	Tunnels	0	0	0	0	0
	Facilities	88	0	0	88	88
Bus	Facilities	2	0	0	2	2
Ferry	Facilities	0	0	0	0	0
Port	Facilities	95	0	0	95	95
Airport	Facilities	2	0	0	2	2
	Runways	4	0	0	4	4

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Earthquake Event Summary Report

Table 7 : Expected Utility System Facility Damage

System	Total #	With at Least Moderate Damage	# of Locations With Complete Damage	with Functionality > 50 % After Day 1	After Day 7
Potable Water	1	0	0	1	1
Waste Water	4	0	0	3	4
Natural Gas	1	0	0	1	1
Oil Systems	4	1	0	2	4
Electrical Power	10	0	0	9	10
Communication	38	0	0	38	38

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	29,155	2860	715
Waste Water	17,493	2050	512
Natural Gas	11,662	588	147
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	304,540	13,731	11,362	7,228	0	0
Electric Power		0	0	0	0	0

Earthquake Event Summary Report

Induced Earthquake Damage

<u>Debris Generation</u>

Hazus estimates the amount of debris that will be generated by the earthquake.   The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel.   This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 3.47 million tons of debris will be generated.   Of the total amount, Brick/Wood comprises 21.00% of the total, with the remainder being Reinforced Concrete/Steel.   If the debris tonnage is converted to an estimated number of truckloads, it will require 138,680   truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

<u>Shelter Requirement</u>

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters.   The model estimates 13,796 households to be displaced due to the earthquake. Of these,   7,768 people (out of a total population of 735,334) will seek temporary shelter in public shelters.

<u>Casualties</u>

Hazus estimates the number of people that will be injured and killed by the earthquake.   The casualties are broken down into four (4) severity levels that describe the extent of the injuries.   The levels are described as follows;

· Severity Level 1:   Injuries will require medical attention but hospitalization is not needed.
· Severity Level 2:   Injuries will require hospitalization but are not considered life-threatening
· Severity Level 3:   Injuries will require hospitalization and can become life threatening if not
                              promptly treated.
· Severity Level 4:   Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM.   These times represent the periods of the day that different sectors of the community are at their peak occupancy loads.   The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	44	11	2	3
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	60	15	2	4
	Other-Residential	749	175	22	42
	Single Family	118	15	1	2
	Total	**970**	**216**	**27**	**51**
2 PM	Commercial	2,427	599	89	175
	Commuting	1	1	1	0
	Educational	631	152	22	44
	Hotels	0	0	0	0
	Industrial	442	110	16	30
	Other-Residential	146	35	4	8
	Single Family	22	3	0	0
	Total	**3,670**	**900**	**133**	**258**
5 PM	Commercial	1,668	411	61	119
	Commuting	9	11	20	4
	Educational	91	22	3	6
	Hotels	0	0	0	0
	Industrial	277	69	10	19
	Other-Residential	283	67	8	16
	Single Family	45	6	0	1
	Total	**2,373**	**585**	**103**	**165**

Economic Loss

The total economic loss estimated for the earthquake is 11,281.29 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses.   The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents.   The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake.   Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were   10,255.91 (millions of dollars);   23 % of the estimated losses were related to the business interruption of the region.   By far, the largest loss was sustained by the residential occupancies which made up over 27 % of the total loss.   Table 11 below provides a summary of the losses associated with the building damage.

Table 11: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	23.22	532.72	22.64	49.03	627.61
	Capital-Related	0.00	9.96	505.36	14.23	7.70	537.25
	Rental	8.25	126.22	282.96	8.69	34.56	460.68
	Relocation	25.79	82.10	431.05	37.51	160.71	737.16
	Subtotal	**34.03**	**241.51**	**1,752.10**	**83.07**	**251.99**	**2,362.70**
Capital Stock Losses							
	Structural	97.94	267.19	843.16	177.39	200.44	1,586.12
	Non_Structural	575.54	1,047.36	1,944.03	435.81	531.23	4,533.97
	Content	262.82	214.76	755.16	262.85	209.50	1,705.08
	Inventory	0.00	0.00	18.45	48.74	0.86	68.05
	Subtotal	**936.30**	**1,529.31**	**3,560.79**	**924.80**	**942.02**	**7,893.21**
	Total	**970.33**	**1,770.81**	**5,312.89**	**1,007.87**	**1,194.01**	**10,255.91**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Hazus estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	3,102.75	$0.00	0.00
	Bridges	17,896.94	$791.58	4.42
	Tunnels	16.21	$0.06	0.38
	Subtotal	**21015.90**	**791.60**	
Railways	Segments	243.07	$0.00	0.00
	Bridges	4.88	$0.02	0.41
	Tunnels	0.00	$0.00	0.00
	Facilities	69.24	$15.17	21.91
	Subtotal	**317.20**	**15.20**	
Light Rail	Segments	59.19	$0.00	0.00
	Bridges	1.28	$0.01	0.44
	Tunnels	0.00	$0.00	0.00
	Facilities	234.34	$40.15	17.13
	Subtotal	**294.80**	**40.20**	
Bus	Facilities	2.46	$0.49	19.89
	Subtotal	**2.50**	**0.50**	
Ferry	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	189.72	$31.75	16.74
	Subtotal	**189.70**	**31.80**	
Airport	Facilities	21.30	$3.85	18.06
	Runways	151.86	$0.00	0.00
	Subtotal	**173.20**	**3.80**	
	Total	**21993.20**	**883.10**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	37.60	$2.41	6.41
	Distribution Lines	583.10	$12.87	2.21
	Subtotal	**620.72**	**$15.28**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	301.00	$15.84	5.26
	Distribution Lines	349.90	$9.22	2.64
	Subtotal	**650.89**	**$25.06**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	1.20	$0.05	4.34
	Distribution Lines	233.20	$2.65	1.13
	Subtotal	**234.47**	**$2.70**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.50	$0.05	10.64
	Subtotal	**0.45**	**$0.05**	
Electrical Power	Facilities	1,243.00	$98.89	7.96
	Subtotal	**1,243.00**	**$98.89**	
Communication	Facilities	4.30	$0.31	7.32
	Subtotal	**4.29**	**$0.31**	
	Total	**2,753.82**	**$142.30**	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of $)

LOSS	Total	%

Appendix A: County Listing for the Region

Multnomah,OR

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Oregon					
	Multnomah	735,334	62,709	23,571	86,281
Total State		**735,334**	**62,709**	**23,571**	**86,281**
Total Region		**735,334**	**62,709**	**23,571**	**86,281**