

Volume II Hazard Annex

Earthquakes

Causes and Characteristics of Earthquakes

Seismic events were once thought to pose little or no threat to Oregon communities. However, recent earthquakes and scientific evidence indicate that the risk to people and property is much greater than previously thought. Oregon and the Pacific Northwest in general are susceptible to earthquakes from three sources: 1) shallow crustal events within the North American Plate; 2) deep intra-plate events within the subducting Juan de Fuca Plate; and 3) the off-shore Cascadian Subduction Zone.

Crustal Fault Earthquakes

Crustal fault earthquakes are the most common types of earthquakes and occur at relatively shallow depths of six to twelve miles below the surface. While most crustal fault earthquakes are smaller than magnitude 4.0 and generally create little or no damage, they can produce earthquakes of magnitudes 7.0 and higher and cause extensive damage. The Mount Angel Fault, a crustal fault located within the county, produced a 5.7 magnitude quake in 1993.⁹²

Deep Intraplate Earthquakes

Occurring at depths from 25 to 40 miles below the earth's surface in the subducting oceanic crust, deep intraplate earthquakes can reach magnitude 7.5.⁹³ The February 28, 2001 earthquake in Washington State was a deep intraplate earthquake. It produced a rolling motion that was felt from Vancouver, British Columbia to Coos Bay, Oregon and east to Salt Lake City, Utah. A 1965 magnitude 6.5-intraplate earthquake centered south of Seattle-Tacoma International Airport caused seven deaths.⁹⁴

Subduction Zone Earthquakes

The Pacific Northwest is located at a convergent plate boundary, where the Juan de Fuca and North American tectonic plates meet. The two plates are converging at a rate of about one to two inches

⁹² Wong, Ivan G and Jacqueline D.J. Bott. November 1995. "A Look Back at Oregon's Earthquake History, 1841- 1994." *Oregon Geology* 57 (6): 125.

⁹³ Ibid.

⁹⁴ Hill, Richard. "Geo Watch Warning Quake Shook Portland 40 Years Ago." *The Oregonian*. October 30, 2002.

per year. This boundary is called the Cascadia Subduction Zone (see Figure 1.0). It extends from British Columbia to northern California. Subduction zone earthquakes are caused by the abrupt release of slowly accumulated stress.

While all three types of earthquakes have the potential to cause major damage, subduction zone earthquakes pose the greatest danger. A major CSZ event could generate an earthquake with a magnitude of 9.0 or greater resulting in devastating damage and loss of life. Such earthquakes may cause great damage to the coastal area of Oregon as well as inland areas in western Oregon including Marion County. It is estimated that shaking from a large subduction zone earthquake could last up to five minutes.⁹⁵

Subduction zones similar to the Cascadia Subduction Zone have produced earthquakes with magnitudes of 8.0 or larger. Historic subduction zone earthquakes include the 1960 Chile (magnitude 9.5) and the 1964 southern Alaska (magnitude 9.2) earthquakes. Geologic evidence shows that the Cascadia Subduction Zone has generated great earthquakes, most recently about 300 years ago.

Figure 1. Cascadia Subduction Zone



Source: Oregon Department of Land Conservation and Development

⁹⁵ UO Community Planning Workshop. 2002.

The specific hazards associated with an earthquake include the following:

Ground Shaking

Ground shaking is defined as the motion or seismic waves felt on the Earth's surface caused by an earthquake. Ground shaking is the primary cause of earthquake damage.

Ground Shaking Amplification

Ground shaking amplification refers to the soils and soft sedimentary rocks near the surface that can modify ground shaking from an earthquake. Such factors can increase or decrease the amplification (i.e., strength) as well as the frequency of the shaking.

Surface Faulting

Surface faulting are planes or surfaces in Earth materials along which failure occurs. Such faults can be found deep within the earth or on the surface. Earthquakes occurring from deep lying faults usually create only ground shaking.

Earthquake-Induced Landslides

These landslides are secondary hazards that occur from ground shaking.

Liquefaction

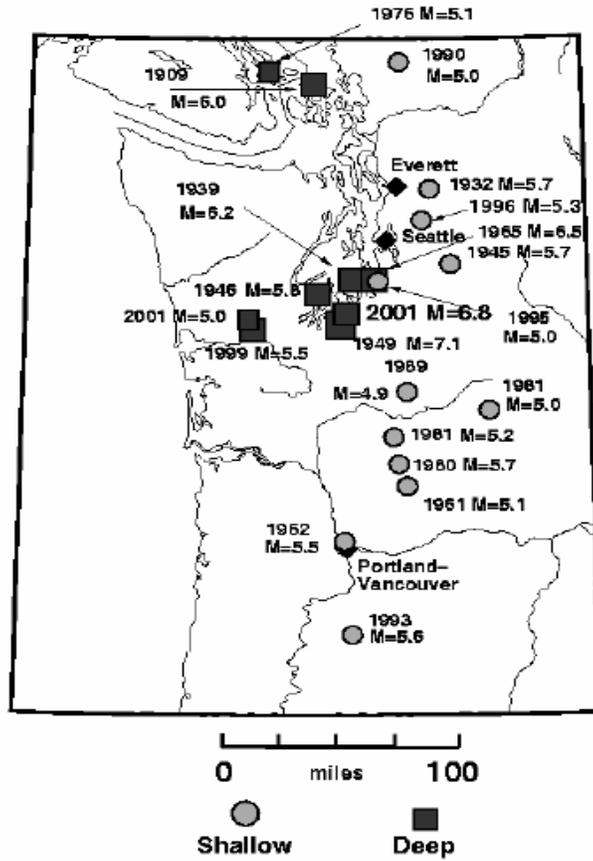
Liquefaction takes place when ground shaking causes granular soils to turn from a solid into a liquid state. This in turn causes soils to lose their strength and their ability to support weight.

The severity of an earthquake is dependent upon a number of factors including: 1) the distance from the quake's source (or epicenter); 2) the ability of the soil and rock to conduct the quake's seismic energy; 3) the degree (i.e., angle) of slope materials; 4) the composition of slope materials; 5) the magnitude of the earthquake; and 6) the type of earthquake.

History of Earthquakes in Marion County

Figure 2 shows the location and size of all damaging earthquakes in the Pacific Northwest. It shows that no high concentrations of earthquakes exist in northern Oregon, and all major quakes in northwest Oregon have been shallow.

Figure 2. Selected Pacific Northwest Earthquakes Since 1872



Source: Pacific Northwest Seismograph Network

Historical Earthquake Events

Marion County has experienced multiple earthquakes of an estimated magnitude of four and greater, with major earthquakes felt in 1941 (magnitude 7.1), 1962 (magnitude 5.2), and 2001 (magnitude 6.8). Figure 2 shows the location of selected Pacific Northwest earthquakes that have occurred since 1872. Detailed descriptions of major recent earthquakes that affected Marion County are listed below.

April 13, 1949, Olympia, Washington- Magnitude 7.1

On April 13, 1949, Marion County residents felt an earthquake that was centered near Olympia, Washington. In Washington, this quake caused eight deaths. While Marion County was shaken by the quake, damage was minimal, and no deaths occurred.

The quake rocked northwestern Oregon, extending as far south as Eugene, Coos Bay, and Reedsport, and as far east as Prineville and La Grande.⁹⁶ In downtown Salem and West Salem and in outlying areas buildings

⁹⁶ Statesman Journal. April 13, 1949.

trembled, light-fixtures swayed, dishes rattle in cupboards. Most of those who were outside at the time reported no shock. Workers in the Marion County courthouse said that filing cabinets rocked back and forth.⁹⁷

November 16, 1957, Salem, Oregon – Magnitude 5.0

A quake struck near Salem in late 1957, with damage intensity estimated at 5.0. Most reports indicated only one sharp jolt or a few seconds of shaking. The earthquake caused slight damage in Salem, including cracked walls and plaster in West Salem, and furnishings shifting around. Residents also reported temporary outages to TV and electricity. This earthquake was also felt in Portland and all the way to the Oregon Coast.⁹⁸

April 18, 1961, Albany, Oregon – Magnitude 4.5

A quake in April of 1961 caused little damage to the county, but startled many residents. The quake was centered just south of Salem, and registered 4.6 on the Richter scale. Described by most as a double shock, it shook houses and rattled dishes, but damage was very limited. Albany reported some cracked plaster.⁹⁹

November 5, 1962, Vancouver, Washington- Magnitude 5.2

Three and a half weeks after the devastating Columbus Day Storm, an earthquake that measured approximately 5.2 on the Richter scale shook the Portland area. It was the largest quake to be generated by a fault under Portland and Vancouver.¹⁰⁰ The Oregon Statesman reported little damage, although much of Marion County was shaken up. A resident in North Salem said it felt as if somebody was “shaking the house vigorously.”¹⁰¹ Another resident said, “Our table began shaking just like I was in a boat.” The quake was felt over a wide area of Oregon and Washington. Reports of the earthquake came from Eugene, 110 miles south of Portland, and from Seattle, 135 miles to the north. The heaviest damage report came from Tillamook on the Oregon coast where the quake, lasting only a few seconds, cracked open barn walls and broke out windows at a local ranch.¹⁰²

March 7, 1963, Salem, Oregon – Magnitude 4.6

On March 7, 1963, a quake measuring 4.6 on the Richter scale shook Marion County. Despite the low magnitude of the quake, damage still occurred – especially to older masonry buildings. A porch was loosened from its house south of Salem, and three instances of cracked plaster were

⁹⁷ Ibid.

⁹⁸Braze, Rutlage and William Cloud. “United States Earthquakes, 1957.” U.S. Department of Commerce. http://www.pnsn.org/HIST_CAT/1957.html

⁹⁹ Ibid.

¹⁰⁰ Hill, Richard. “Geo Watch Warning Quake Shook Portland 40 Years Ago.” The Oregonian, October 30, 2002

¹⁰¹ Oregon Statesman. November 6, 1962.

¹⁰² Ibid.

reported.¹⁰³ A tremor was felt on the third floor of the Marion County Courthouse. An employee at Boise Cascade noted, the “office building shook and rattled.”¹⁰⁴

March 25, 1993, Scotts Mills Earthquake- Magnitude 5.7

The Scotts Mills Earthquake (also known as the “Spring Break Quake”) was centered in Marion County, near Woodburn and Scotts Mills. The quake originated about two miles south of Scotts Mills and twelve to thirteen miles underground. Because of its locality to Marion County, damage was more severe in the county than the Nisqually quake. In Salem, the rotunda of the state Capitol cracked, and the Golden Pioneer statue nearly rocked off its base.¹⁰⁵ In Mount Angel, authorities closed the historic St. Mary Catholic Church for fear its 200-foot bell tower could collapse. Chunks of plaster fell from the walls at the Queen of Angels Monastery. Woodburn felt the strongest effects of the quake. Officials shut down four century-old brick and mortar buildings that began to crumble. At the Wal-Mart store, fumes overcame several employees when pesticides, paints and car batteries mixed.¹⁰⁶

February 28, 2001, Nisqually Earthquake- Magnitude 6.8

The most recent earthquake to be felt in Marion County was the Nisqually earthquake, on February 28, 2001. The earthquake hit at 10:54 a.m. and was centered 35 miles southwest of Seattle.¹⁰⁷ The quake registered 6.8 on the Richter Scale. In the Puget Sound area, this quake caused 400 injuries, one quake-related death, and about \$2 billion dollars in damage.¹⁰⁸ While the quake caused little damage in Marion County, it did temporarily close businesses and schools to assess potential damage. About 300 Salem City Hall employees went outside after the quake. About 1,000 employees evacuated the state Department of Human Services building after an employee pulled a fire alarm.¹⁰⁹ Tremors were also felt in the upper floors of the Oregon State Capitol, and legislators and staff said they could feel the building swaying.¹¹⁰ Schools in Marion County also felt the Nisqually Earthquake, although county school districts found little damage. The local schools that reported the strongest tremors were mostly in northern Marion County.¹¹¹ St. Paul and North Marion High Schools, both north of Woodburn, briefly evacuated students.¹¹² Even though the quake amounted to billions of dollars in damage in Washington, the cost there

¹⁰³ Oregon Statesman. March 8, 1963.

¹⁰⁴ Ibid.

¹⁰⁵ Statesman Journal. March 26, 1993.

¹⁰⁶ Ibid.

¹⁰⁷ Statesman Journal. March 1, 2001.

¹⁰⁸ Ibid.

¹⁰⁹ Ibid.

¹¹⁰ Ibid.

¹¹¹ Ibid.

¹¹² Ibid.

could have been much higher if not for seismic retrofitting of buildings and highways.¹¹³

Risk Assessment

How are Hazard Areas Identified?

The Department of Geology and Mineral Industries (DOGAMI), in partnership with other state and federal agencies, has identified seismic hazards and risks in Marion County. Among other data, DOGAMI has created maps that identify areas in selected Oregon communities that will suffer more damage, relative to other areas, during a damaging earthquake. These include maps identifying primary geologic hazards and maps showing earthquake and landslide risk for each county. Primary earthquake hazards include ground shaking amplification, liquefaction, and earthquake-induced landslides. The areas most susceptible to ground amplification and liquefaction have young, soft alluvial sediments, found in most of the Willamette Valley and along stream channels. Landslides are most likely in high, steep, mountainous terrain and at the base of steep canyons.¹¹⁴

The extent of the damage to structures and injury and death to people will depend upon the type of earthquake, proximity to the epicenter and the magnitude and duration of the event.

The earthquake hazard maps (Figures 3 to 7 below) show areas of relatively higher or lower potential risk to these earthquake hazards. They are intended to guide planners in determining areas for future site-specific earthquake mitigation actions.¹¹⁵

- Figure 3 shows the areas in and around Marion County where ground shaking is especially amplified during earthquakes. Higher areas of amplification are shown in pink and dark purple, and lower areas of amplification are shown in light purple and blue.
- Figure 4 shows areas ranked from rare to very high based on their likelihood of liquefying (where the ground has the consistency of a liquid) during a major earthquake.
- Figure 5 shows areas in the county that are especially prone to landslides induced by earthquakes.
- Figure 6 shows areas in the state where the peak ground acceleration would be greatest. It clearly shows that areas closer to the coast have

¹¹³ Ibid.

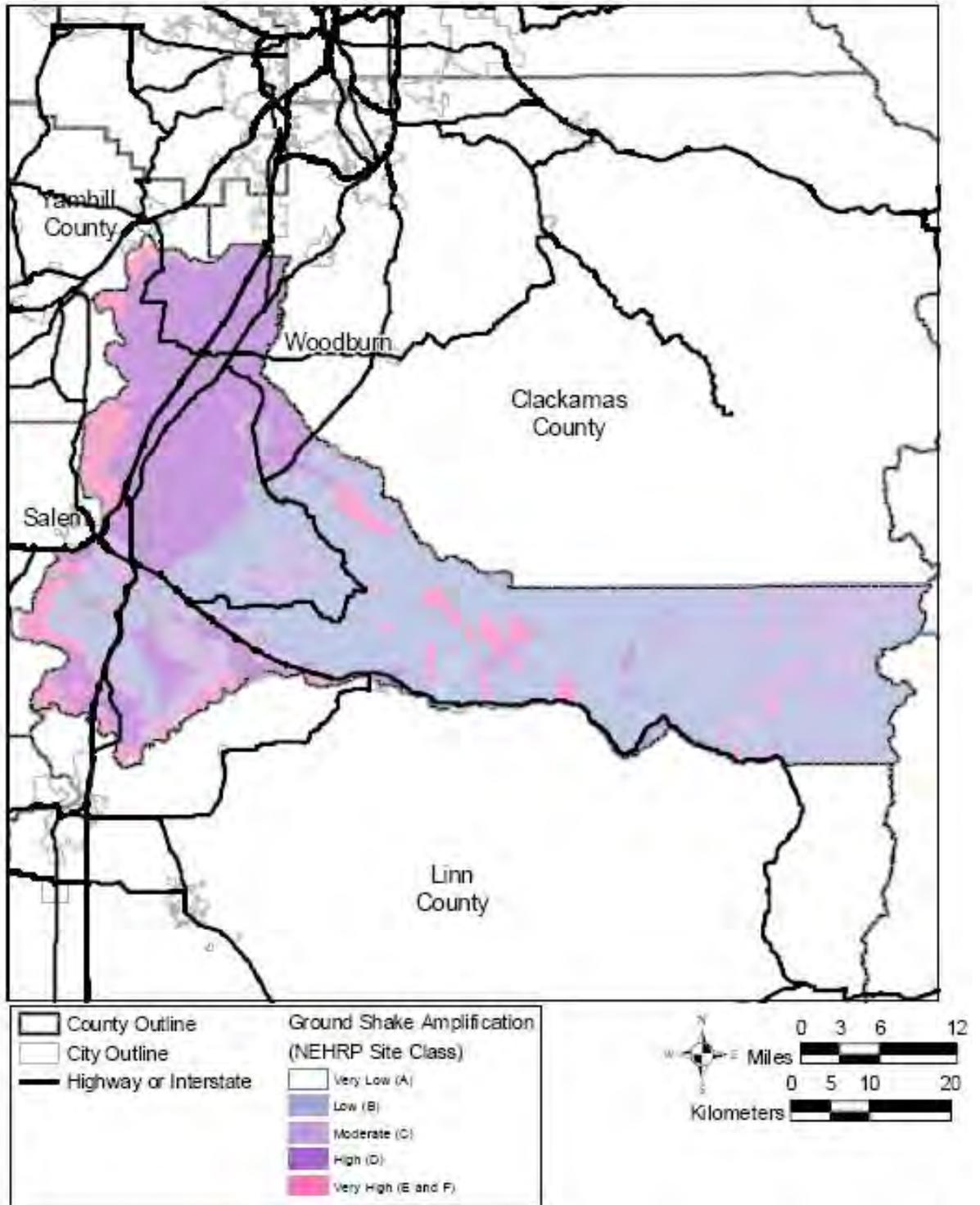
¹¹⁴ Burns, William, John Hofmeister and Yumei Wang. "Geologic Hazards, Earthquake and Landslide Hazard Maps, and Future Earthquake Damage Estimates for Six Counties in the Mid/Southern Willamette Valley Including Yamhill, Marion, Polk, Benton, Linn, and Lane Counties, and the City of Albany, Oregon." Oregon Department of Geology and Mineral Industries, 2008

¹¹⁵ Ibid.

a much higher chance of exceeding their peak ground acceleration than areas further away.

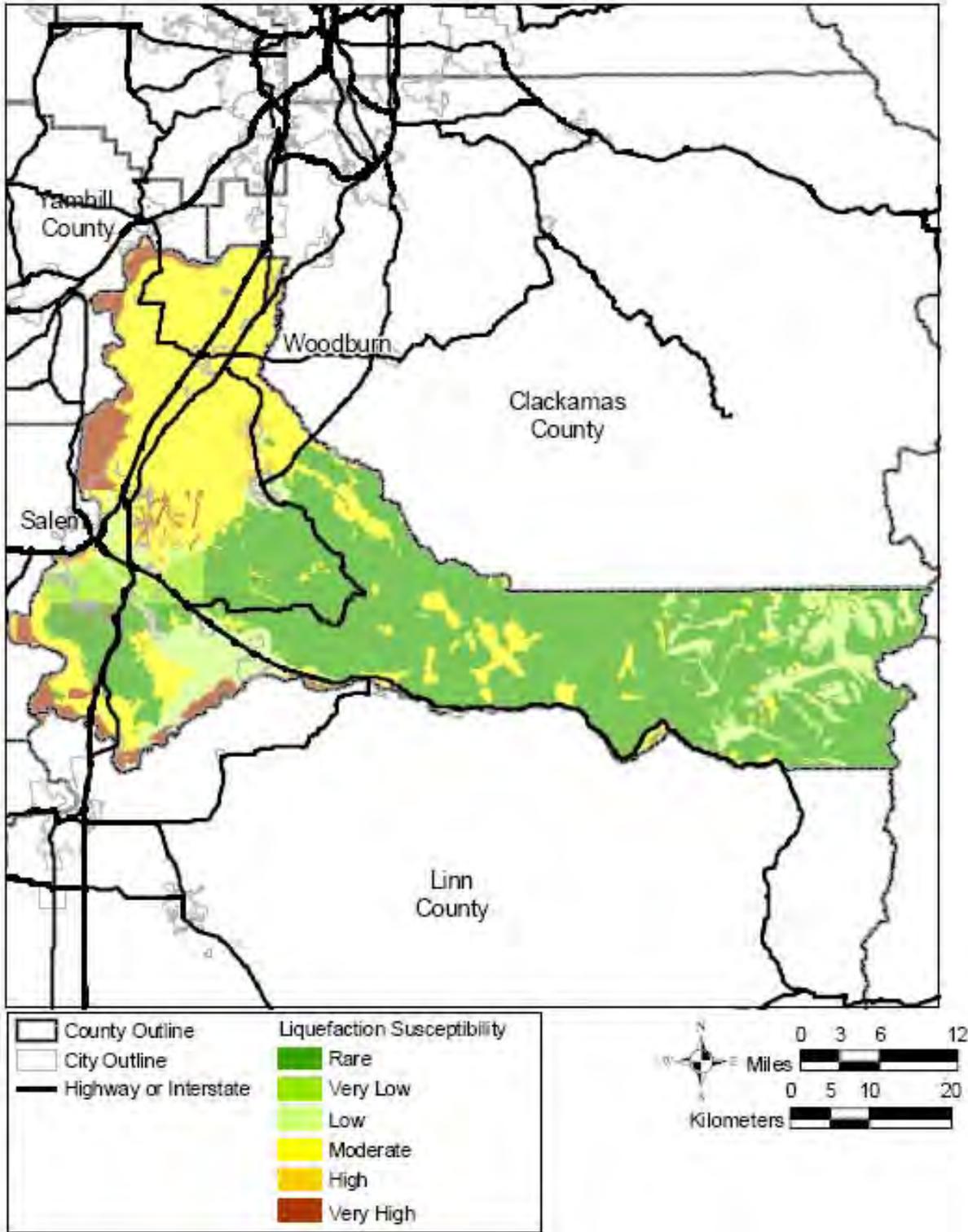
- Figure 7 shows all known faults and land folds in Marion County.

Figure 3 Amplification Susceptibility for Marion County



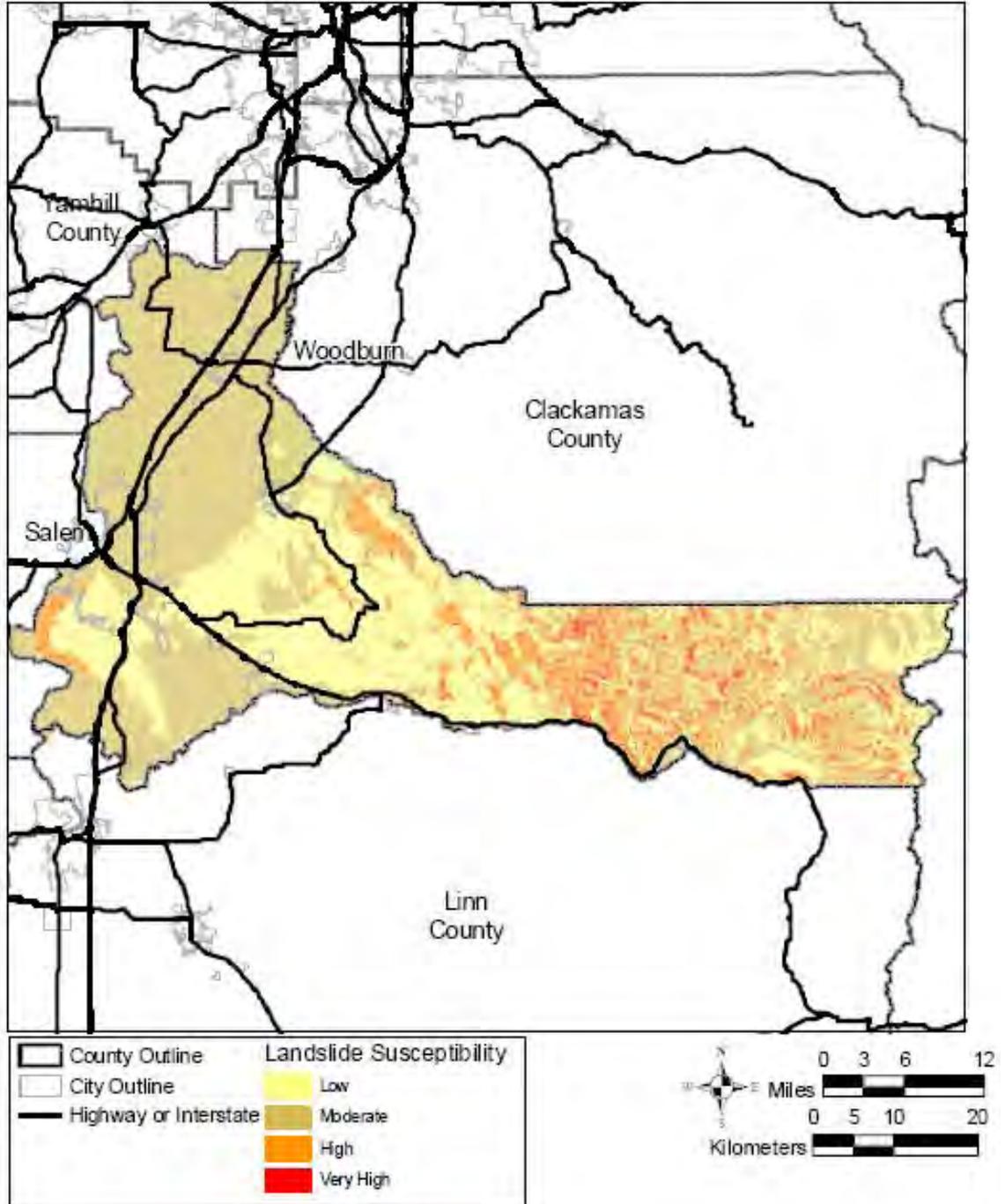
Source: IMS-24, Geologic Hazards, Earthquake and Landslide Hazard Maps, and Future Earthquake Damage Estimates for Six Counties in the Mid/Southern Willamette Valley Including Yamhill, Marion, Polk, Benton, Linn, and Lane Counties, and the City of Albany, Oregon, by William J. Burns, R. Jon Hofmeister, and Yumei Wang.

Figure 4 Relative Liquefaction Hazard for Marion County



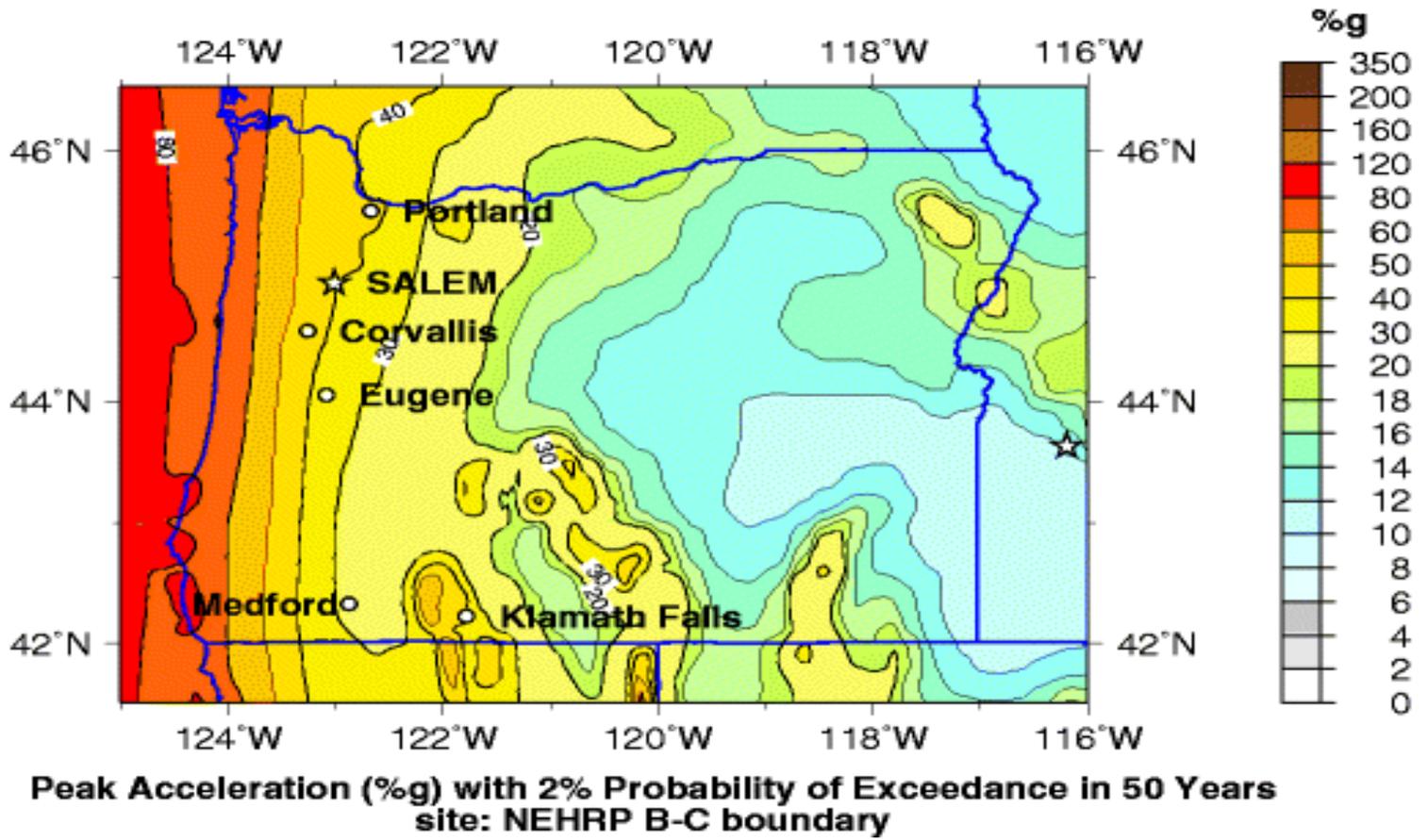
Source: IMS-24, Geologic Hazards, Earthquake and Landslide Hazard Maps, and Future Earthquake Damage Estimates for Six Counties in the Mid/Southern Willamette Valley Including Yamhill, Marion, Polk, Benton, Linn, and Lane Counties, and the City of Albany, Oregon, by William J. Burns, R. Jon Hofmeister, and Yumei Wang.

Figure 5 Earthquake Induced Landslide Hazards for Marion County



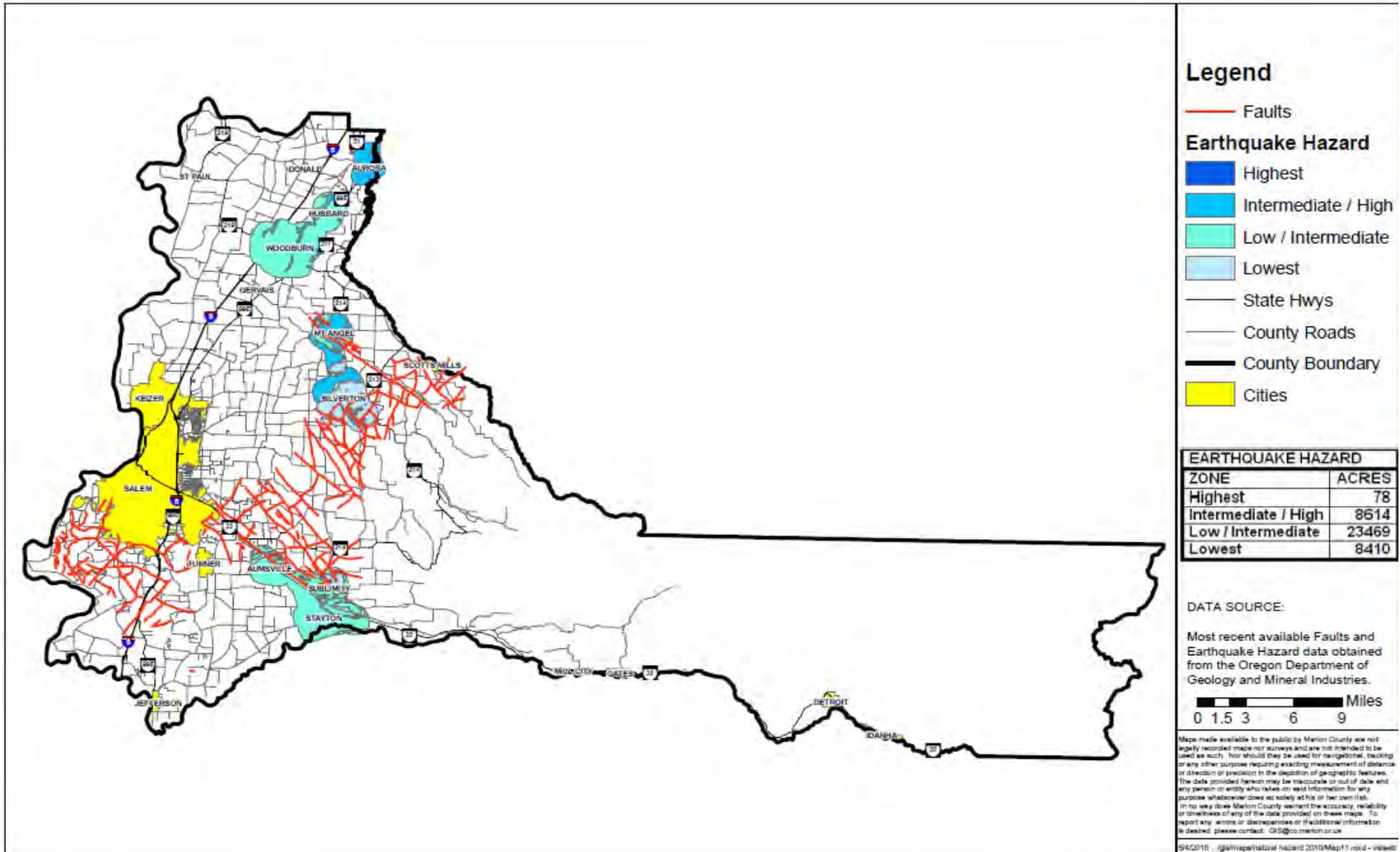
Source: IMS-24, Geologic Hazards, Earthquake and Landslide Hazard Maps, and Future Earthquake Damage Estimates for Six Counties in the Mid/Southern Willamette Valley Including Yamhill, Marion, Polk, Benton, Linn, and Lane Counties, and the City of Albany, Oregon, by William J. Burns, R. Jon Hofmeister, and Yumei Wang.

Figure 6 Peak Ground Acceleration in Marion County



Source: National Seismic Hazard Mapping Project (2008), USGS

Figure 7 Comprehensive Earthquake Hazards in Marion County



Source: Marion County GIS

Probability of Future Occurrence

Scientists estimate the chance in the next 50 years of a large subduction zone earthquake is between 10 and 20 percent, assuming that the recurrence is on the order of 400 +/- 200 years.¹¹⁶ Establishing a probability for crustal earthquakes is more difficult. There have been five earthquakes above magnitude 4 centered in the mid-Willamette Valley, of which the 1993 Scotts Mills earthquake was the largest. Oregon's seismic record is short and the number of earthquakes above a magnitude 4 centered in the mid-Willamette Valley is small. Therefore, any kind of prediction would be questionable. Earthquakes generated by volcanic activity in Oregon's Cascade Range are possible, but likewise unpredictable.

The "Previous Occurrences" section above details seven damaging earthquakes affecting Marion County in the last 61 years, ranging from 4.5 to 7.1 in magnitude. This averages out to one damaging earthquake every nine years. Given this recurrence interval, the Marion County steering committee rated the probability of an earthquake occurring as **high**, meaning that it is likely Marion County will be affected by a damaging earthquake within a 10-35 year period. The high ranking is consistent with the 2006 Marion County Hazard Analysis.

Vulnerability Assessment

The effects of earthquakes span a large area. The degree to which earthquakes are felt, however, and the damages associated with them may vary. At risk from earthquake damage are unreinforced masonry buildings, bridges built before earthquake standards were incorporated into building codes, many "high tech" and hazardous material facilities, extensive sewer, water, and natural gas pipelines, petroleum pipelines, and other critical facilities and private property located within the county. The areas that are particularly vulnerable to potential earthquakes in the county have been identified as those areas near the crustal fault lines.

The Marion County Steering Committee determined that the county's vulnerability to earthquakes **high**, meaning that more than 10% of the population and the regional assets would be impacted by an earthquake. The high ranking is consistent with the 2006 Marion County Hazard Analysis.

Risk Analysis

Marion County's human and physical assets are highly at risk from earthquake hazards in the next 35 years. The hazard profile above shows that several moderate earthquakes have occurred over the last 60 years in Marion County, and two over 6.5 in magnitude have caused damage in the county.

¹¹⁶ *Oregon Geology*, Volume 64, No. 1, Spring 2002.

In 2007, DOGAMI completed a rapid visual screening (RVS) of educational and emergency facilities in communities across Oregon, as directed by the Oregon Legislature in Senate Bill 2 (2005). RVS is a technique used by the Federal Emergency Management Agency (FEMA), known as FEMA 154, to identify, inventory, and rank buildings that are potentially vulnerable to seismic events. DOGAMI surveyed buildings in Marion County and gave them a 'low,' 'moderate,' 'high,' or 'very high' potential of collapse in the event of an earthquake. It is important to note that these rankings represent a probability of collapse based on limited observed and analytical data and are therefore approximate rankings.¹¹⁷ To fully assess a building's potential of collapse, a more detailed engineering study completed by a qualified professional is required, but the RVS study can help to prioritize which buildings to survey.

Table 1 Marion County Buildings Collapse Potential

Level of Collapse Potential in Marion County			
Low (<1%)	Moderate (>1%)	High (>10%)	Very High (100%)
94	34	88	30

Source: DOGAMI 2007. Open File Report 07-02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment

The Oregon Department of Geology and Mineral Industries (DOGAMI) has also developed two earthquake loss models for Oregon based on the two most likely sources of seismic scenarios: (1) the Cascadia Subduction Zone (CSZ), and (2) M6.5 arbitrary crustal earthquake. Both models are based on HAZUS-MH software currently used by the Federal Emergency Management Agency (FEMA) as a means of determining potential losses from earthquakes.

The CSZ event is based on a potential 9.0 earthquake generated off the Oregon coast. The M6.9 arbitrary crustal earthquake scenario does not look at a single earthquake (as in the CSZ model); it encompasses many faults, each with a 2% chance of producing an earthquake in the next 50 years. The model assumes that each fault will produce a single "average" earthquake during this time.

DOGAMI investigators caution that the models contain a high degree of uncertainty and should be used only for general planning purposes. Despite their limitations, the models do provide some approximate estimates of damage. Results are found in Tables 2-4.

¹¹⁷ State of Oregon Department of Geologic and Mineral Industries, *Implementation of 2005 Senate Bill 2 Relating to Public Safety, Seismic Safety and Seismic Rehabilitation of Public Building*, May 22, 2007, iv.

Table 2. Estimated Losses from M9 CSZ and Local Crustal Event

Building Value (Billions)	Total Building-Related Losses From a 9.0 CSZ Event (Billions)	Total Building-Related Losses From a Crustal Earthquake (Billions)
\$15.86	\$2.6	\$3.9

Source: DOGAMI, Geologic Hazards, Earthquake and Landslide Hazard Maps, and Future Earthquake Damage Estimates, 2008

Table 3. Estimated Losses Associated with an Arbitrary M 6.5-6.9 Crustal Event

Categories	Losses
Injuries (5 pm time period)	2,492
Deaths (5 pm time period)	157
Displaced Households	5,787
Economic Losses for Buildings	\$2,604 million
Operational After Day 1:	
Fire Station	100%
Police Station	100%
Schools	99%
Bridges	89%
Economic Loss to Infrastructure:	
Highways	\$127.7 million
Airports	\$13 million
Communications	\$0.03 million
Debris Generated (thousands of tons)	1,000

Source: GOGAMI, Geologic Hazards, Earthquake and Landslide Hazard Maps, and Future Earthquake Damage Estimates, 2008.

Table 4 Estimated Losses Associated with a Magnitude 8.5-9.0 Subduction Event

Categories	Losses
Injuries (5 pm time period)	3,249
Deaths (5 pm time period)	189
Displaced Households	10,701
Economic Losses for Buildings	\$3980 million
Operational After Day 1:	
Fire Station	61%
Police Station	65%
Schools	74%
Bridges	86%
Economic Loss to Infrastructure:	
Highways	\$271.5 million
Airports	\$38 million
Communications	\$0.18 million
Debris Generated (thousands of tons)	1,000

Source: GOGAMI, Geologic Hazards, Earthquake and Landslide Hazard Maps, and Future Earthquake Damage Estimates, 2008.

Community Hazard Issues

What is susceptible to damage during a hazard event?

The degree of damage to structures and injury and death to people will depend upon the type of earthquake, proximity to the epicenter and the magnitude and duration of the event. The Marion County steering committee identified a number of community assets that are vulnerable to earthquake hazards. These include populations, communities, infrastructure, critical facilities, cultural and natural resources, and the economy.

Population

Several population groups found in Marion County are vulnerable to earthquakes. The retirement homes at the multi-story Mt. Angel Retirement Facility and Woodburn Senior Estates mobile home park are particularly vulnerable because they were designed before strict building codes were introduced. Medically impaired populations found throughout the county are also vulnerable to earthquake-related hazards because of their reliance on medical services and roads. To address vulnerabilities with this population, the city of Salem has a computerized database of all medically impaired individuals in the city.

Finally, non-native English speaking residents are vulnerable because they may be more difficult to reach in times when emergency information needs to be quickly disseminated. In Marion County, non-native English speaking residents can be found in communities along the Santiam River, and in Woodburn and Gervais.

Communities

The steering committee identified several bedroom communities, particularly Silverton and Stayton, as being highly vulnerable to earthquakes should roads be damaged. Residents in these communities depend on automobile transport to go to school and places of employment. If an earthquake damages local roads, residents will be isolated from their jobs and from schools. Other communities in Marion County that are experiencing increasing development include Sublimity, the South Salem Hills, Elkhorn and Breitenbush.

Critical Facilities

The steering committee identified many critical facilities as being vulnerable to earthquakes. These include the hospitals in Salem, Silverton and Stayton. A major landfill along the Willamette River in Salem is particularly vulnerable to earthquake events.

Economy

Earthquakes pose a threat to government offices in Salem largely due to Salem's soil type being prone to liquefaction (see Figure 4). The greatest impact on trade, transportation or retail (the biggest economic sectors in Marion County) would be any blockage to I-5 or Highway 22. In addition, agriculture, of critical importance to Marion County, has major service areas located in areas such as Woodburn, Silverton, and in the Sublimity area. Limited access to these areas could cause economic harm. Damage to routes accessing these agriculture service businesses could also cause economic harm for individual employees.

Cultural Assets

The Marion County steering committee identified several cultural and natural assets that are vulnerable to earthquakes. The historic districts in downtown Salem, Silverton, and Aurora are all prominent tourist sites that are constructed of unreinforced masonry buildings, which are highly vulnerable to collapse in even a moderate earthquake. Damage to these districts can have a negative impact on the community's local economy and cultural identity.

Infrastructure

Roads and bridges in Marion County are highly vulnerable to earthquake hazards. Damage to roads and bridges can disconnect people from work, school, food, and leisure, and separates businesses from their employees, customers, and suppliers. Because bridges vary in size, materials, siting, and design, any given earthquake will affect them differently. Bridges built before the mid-1970s have a significantly higher risk of suffering structural damage during a moderate to large earthquake compared with those built after 1980, which contain structural improvements.¹¹⁸ It is appropriate to note here that much of the interstate highway system was built in the mid to late 1960's. The Oregon Department of Transportation lists Salem among the heavily populated areas with bridges that are especially at risk of collapse, due to having soil profiles that are highly prone to liquefaction in the event of a major earthquake.¹¹⁹ Principal roads in Marion County include Interstate 5 and Highways 22 and Highway 99E. Damage to bridges and roadways on these routes can significantly limit access to communities in the county. The Marion County steering committee also identified North Fork Rd. in Elkhorn and roads in the South Salem Hills as particularly vulnerable to earthquake-induced landslides.

¹¹⁸ "Seismic Vulnerability of Oregon State Highway Bridges: Mitigation Strategies to Reduce Major Mobility Risks." Oregon Department of Transportation, 2009. ftp://odot.state.or.us/bridge/bridge_website_chittirat/2009_seismic_vulnerability_final.pdf

¹¹⁹ Ibid

Other infrastructure vulnerable to earthquakes includes water and gas lines, electricity, and communication networks. Ground shaking and amplification can cause pipes to break, power lines to fall, roads and railways to crack or move, and radio and telephone communication to cease. All lifelines need to be usable after an earthquake to allow for rescue, recovery, and rebuilding efforts and to relay important information to the public.

Existing Mitigation Activities

Building Codes

Marion County has adopted the International Building Code which includes regulations that address seismic hazards.

The Oregon State Building Codes Division adopts statewide standards for building construction that are administered by the state, cities and counties throughout Oregon. The codes apply to new construction and to the alteration of, or addition to, existing structures. Within these standards are six levels of design and engineering specifications that are applied to areas according to the expected degree of ground motion and site conditions that a given area could experience during an earthquake. The Structural Code requires a site-specific seismic hazard report for projects including critical facilities such as hospitals, fire and police stations, emergency response facilities, and special occupancy structures, such as large schools and prisons.

The seismic hazard report required by the Structural Code for essential facilities and special occupancy structures considers factors such as the seismic zone, soil characteristics including amplification and liquefaction potential, any known faults, and potential landslides. The findings of the seismic hazard report must be considered in the design of the building. The Dwelling Code incorporates prescriptive requirements for foundation reinforcement and framing connections based on the applicable seismic zone for the area. The cost of these requirements is rarely more than a small percentage of the overall cost for a new building.

Requirements for existing buildings vary depending on the type and size of the alteration and whether there is a change in the use of the building that is considered more hazardous. Oregon State Building Codes recognize the difficulty of meeting new construction standards in existing buildings and allow some exception to the general seismic standards. Upgrading existing buildings to resist earthquake forces is more expensive than meeting code requirements for new construction. The state code only requires seismic upgrades when there is significant structural alteration to the building or where there is a change in use that puts building occupants and the community at greater risk.

Local building officials are responsible for enforcing these codes. Although there is no statewide building code for substandard structures, local communities have the option of adopting a local building code to mitigate hazards in existing buildings. Oregon Revised Statutes allow municipalities to create local programs to require seismic retrofitting of existing buildings within their communities. The building codes do not regulate public utilities or facilities constructed in public right-of-way, such as bridges.

Earthquake Preparedness

Marion County provides information to the public about earthquake hazards and preparedness measures on its website.

Earthquake Mitigation Action Items

The following actions have been identified by the Marion County steering committee, and are recommended for mitigating the potential effects of earthquakes in Marion County. Please see full action item worksheets in Appendix A.

EQ1: Develop and publicize structural and nonstructural retrofit activities that county residents can implement to reduce their risk to seismic events.

EQ2: Regularly inspect county facilities for earthquake hazards (to check for compliance with state building codes).

EQ3: Identify the most seismically vulnerable bridges county roads, conduct a seismic assessment on them, and take steps to bring those that are out of compliance up to code.

EQ4: Promote earthquake awareness month activities for schools and large employers (e.g. employers with 250 or more employees).

