Methodology for State Facility Loss Estimation 2013

State facilities data

The inventory of state-owned and leased facilities by state agencies represents a significant financial investment by the citizens of Washington State. As a result, Revised Code of Washington (RCW) 43.82.150 requires an annual inventory of state-owned and leased facilities. This report is commonly referred to as the Facilities Inventory System (FIS). The FIS report is one of several sources of information that support OFM's responsibilities for leased and owned facilities. Other examples include capital and operating budget development, six-year strategic facilities planning, and various facilities oversight analysis and reporting functions. The FIS report serves as Washington State's primary facilities database. Annual FIS reports summarizing the information contained in the inventory will be published by October 1st of each year, beginning in 2010. These reports are submitted to the appropriate fiscal committees of the Legislature. Below is a list of the reports. The data includes latitude and longitude coordinates to allow creation of a GIS layer that can be superimposed onto a hazard map to determine facilities at risk to hazards.

2012 Facilities Inventory
2012 Facilities Inventory System Report
2012 Facilities Inventory (Excel)

Facilities Inventory System Replacement
Facilities Inventory Data Quality Grant

2011 Facilities Inventory
2011 Facilities Inventory System Report
2011 Facilities Inventory (Excel)

2010 Facilities Inventory
2010 Facilities Inventory System Report
2010 Facilities Inventory (Excel)

2009 Facilities Inventory
2009 Facilities Inventory System Report
2009 Facilities Inventory (Excel)

Other documents
2008 Facility Inventory System Report: Recommendations for System Improvement

2013 Risk Assessment Methodology (State Facilities at Risk):

For the 2013 SHMP update, the contractor took the OFM facility data, updated the risk assessment for the four hazards of greatest concern (Earthquake, Fire, Flood, and Severe Storm), and superimposed the facility data against the hazard maps to determine state facilities at risk to these hazards.

Earthquake
A Hazus-MH 2.1 analysis was employed to model building losses for state-owned and state-leased facilities utilizing the Washington State Office of Financial Managements 2012 dataset of state facilities. A total of 9,975 state facilities were analyzed. These buildings have an estimated replacement value of $13,363,228,000. The combined area of the state buildings is estimated at 105,060,000 square feet. Of these buildings, 8,893 were reported as owned and 1,082 were reported as leased. Owned buildings have a combined exposure (building replacement value) of $11,858,700,000, and leased buildings have a combined value of $1,504,528,000. Owned buildings have a combined area of 93,425,000square feet, and leased buildings have a combined area of 11,635,000 square feet.

The OFM data did contain data gaps that needed to be addressed in order to perform the Hazus-MH analysis. Most critically, building type and building replacement value needed attention. For building type, it was assumed that all structures were one story and constructed of wood. Regarding building replacement value, there were both missing and erroneous data in the OFM data. Therefore, 2012 R.S. Means Facilities Construction Cost data was used to determine building replacement value using a combination of the building occupancy (Hazus classification of Government buildings (GOV1)), existing building square footage, year built and the assumed building type. From this updated building inventory, the Advanced Engineering Building Module (AEBM) was used to model each building.

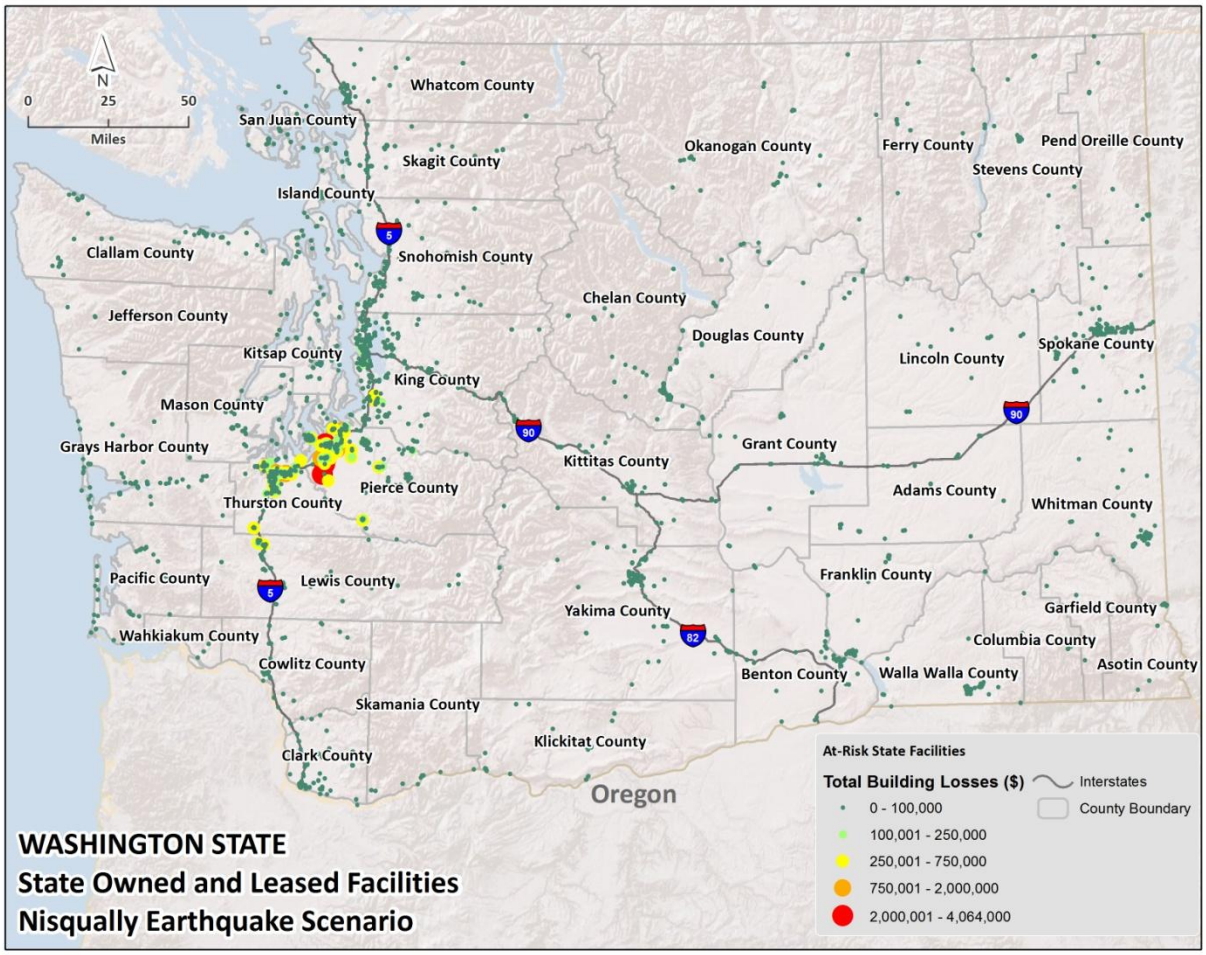
The AEBM is a Hazus-MH component that performs a detailed earthquake analysis and facilitates a site-specific building loss estimation analysis for damages and losses for each building in an inventory. There are many advanced functions, including the ability to input user-specified hazard maps, override the default building fragility curves or create your own building profiles. In this case, an AEBM inventory was developed outside of Hazus using the 2012 OFM dataset of state leased and owned facilities. This dataset was then defined in Hazus as the AEBM Inventory. A set of AEBM Profiles were then entered in Hazus for all possible building occupancies, types and earthquake design level combinations. The AEBM Profiles describe an extensive set of building performance characteristics, including damage and loss function parameters. Each building in the AEBM Inventory is then linked to one of the created AEBM Profiles.

After the AEBM Inventory and Profiles were developed, the Hazus Earthquake model was employed to generate building losses based on certain scenario earthquakes, or an earthquake with a specified magnitude and location. The resulting loss estimate generally will describe the scale and extent of damage that may result from a potential earthquake. Quantitative estimates of losses were then reported in terms of direct costs for repair and replacement of damaged buildings.

The first scenario earthquake (deterministic hazard) that was run was the February 28, 2001, Nisqually earthquake event which a Magnitude 6.8. Similar to the methodology employed for Average Annualized Losses above, two user-supplied data layers for liquefaction and soil class were added to Hazus-MH to

more accurately model the effects of the earthquake at each site-specific state facility. These maps allow Hazus-MH to model the conditions present at each of the building sites.

The Nisqually M6.8 earthquake resulted in $122,589,000 potential total building losses to the 9,975 state owned facilities. Of this $90,719,000 were total building losses to the 8,893 state owned buildings and $31,871,000 were total building losses to 1,082 state leased facilities. As a percentage this represents a loss ratio of 0.91 percent of total state facility exposure (including .68 percent for state owned buildings and 0.24 percent for state leased buildings).



Flood

A Hazus-MH 2.1 analysis was employed to model potential building losses due to flooding for state-owned and state-leased facilities utilizing the Washington State Office of Financial Managements 2012 dataset of state operated facilities.

The analysis for the state owned facilities utilized the 1.0-percent annual chance riverine floodplain data used to determine 1.0-percent annual chance losses (as described above in the Hazus-MH 2.1 Flood Methodology and Results section). State operated facilities were run as Hazus User Defined Facilities.

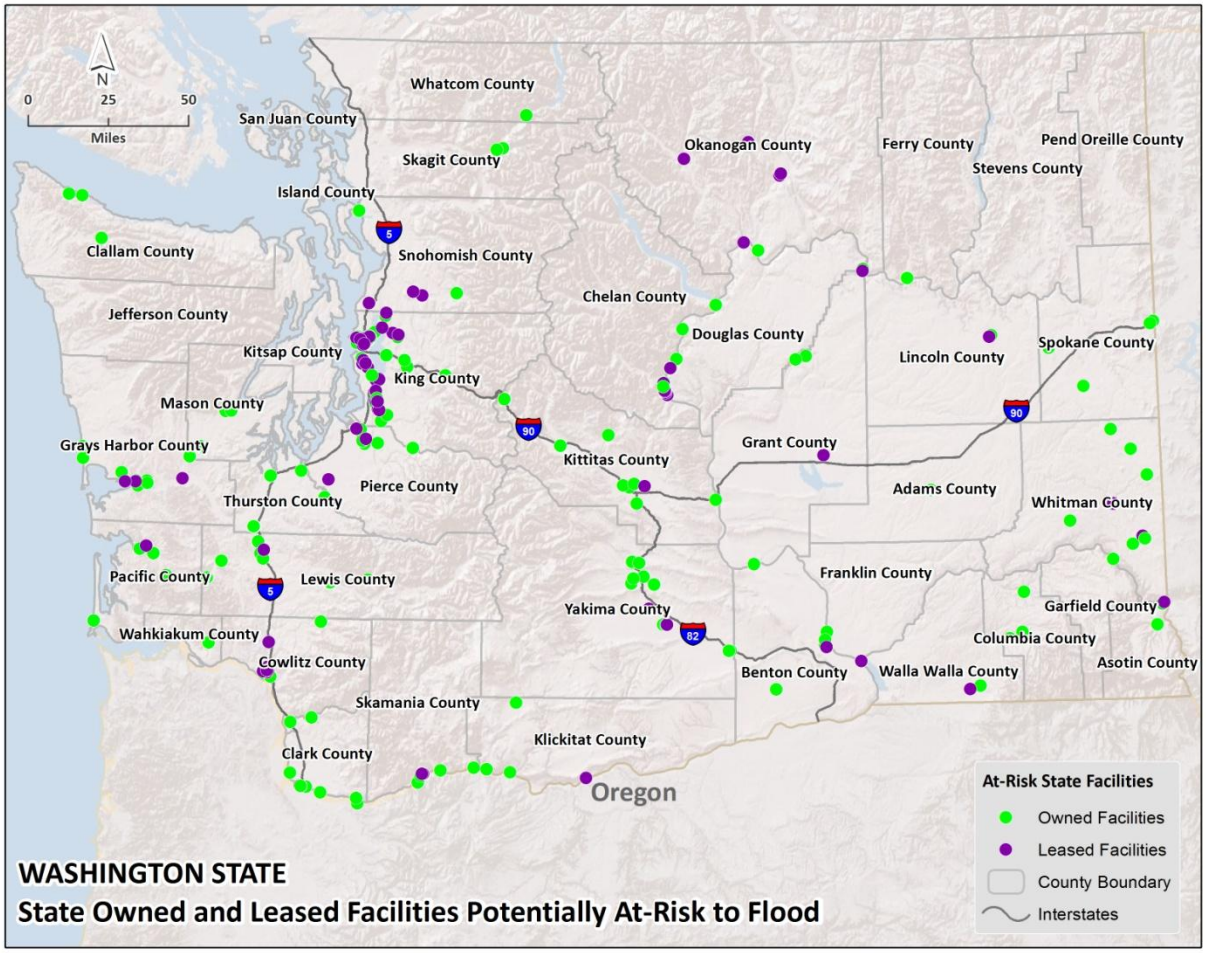
Hazus User Defined Facilities are represented as a point at a specific latitude/longitude location and not as the entire footprint of the building on the ground. Data specific to each building such as elevation, value, area, number of floors, and construction type were utilized in the analysis for each building within Hazus-MH 2.1.

Assumptions were made to the OFM data in order to be used by Hazus as User Defined Facilities. Most critically, building type and building replacement value needed attention. For building type, it was assumed that all structures were one story and constructed of wood. It should be noted that this is not the true building construction of all buildings modeled but was a necessary assumption to analyze the large number of buildings with limited available data. Regarding building replacement value, there were both missing and erroneous data in the OFM data. Therefore, 2012 R.S. Means Facilities Construction Cost data was used to determine building replacement cost using a combination of the building occupancy (Hazus classification of Government buildings (GOV1)), existing building square footage, year built and the assumed building type. Content values were determined based on guidance in the Hazus Technical Manual, which states that GOV1 occupancies have a content value that is equal to the building replacement value. Lastly, it was assumed that each building had an elevation of one foot above the ground (indicating flood level would have to exceed one foot damages).

A total of 9,975 state facilities were analyzed in the state based on Washington State Office of Financial Management (OFM) 2012 dataset of state leased and owned facilities. Their combined estimated replacement value and area was determined to be $13,363,228,000 and 105,060,000 square feet, respectively. Of these buildings, 8,893 were reported as owned and 1,082 were reported as leased. State owned buildings have a combined exposure (building replacement value) of $11,858,700,000 and leased buildings have a combined replacement value of $1,504,528,000. State owned buildings have a combined area of 93,425,000 square feet, and leased buildings have a combined area of 11,635,000 square feet.

Hazus-MH 2.1 was run for the 1.0-percent annual chance riverine floodplain. This analysis found over 1,000 state owned and leased facilities that are potentially at-risk to flooding throughout the state. A majority, 851, are state-owned properties. The state owned facilities have an estimated building loss of approximately $400,208,000 and approximated contents loss of $953,000,000. This results in a loss ratio for building and contents of 10 percent. Leased facilities may experience an estimated building loss of $24,844,000 and content losses of $79,956,000, representing a loss ratio of about 1 percent of the total state operated facilities.

As could be expected, many of these facilities reside in the most vulnerable jurisdictions located in the western portion of the state along the Puget Sound. Additional concentrations are located in southeastern portion of the state, especially Whitman County, and in the middle of the state within Douglas, Kittitas, and Yakima counties. A complete list of the at-risk facilities, including potential damage to the building and contents, is in WA EMD's possession. A map of those facilities found to be potentially at-risk to the 1.0-percent annual chance flood is depicted in the map below.

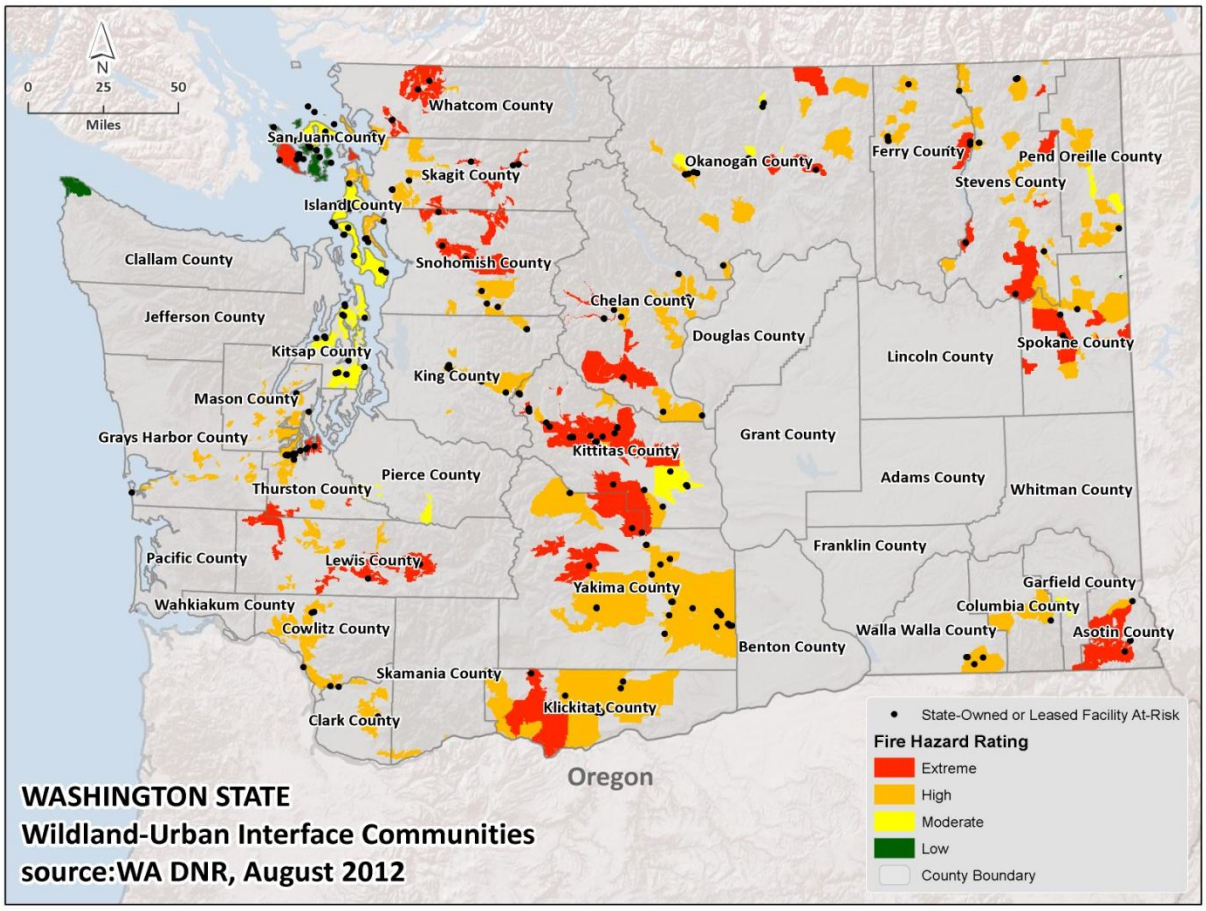


Severe Storm

This profile will not attempt to estimate potential losses to state facilities due to severe storm. The state does not have data on which to base a determination of which facilities might be most vulnerable to either high winds or winter storm events. However, all facilities are considered vulnerable to this hazard.

Wildfire

The contractor provided a GIS overlay of the DNR derived Wildland-Urban Interface Communities with the geospatial referenced facilities from the OFM FIS data.



2010 Risk Assessment Methodology (State Facilities at Risk):

Various geo-spatial datasets for hazard zones were used in combination with geo-referenced facility information from the OFM database to determine the state facility projected loss information. The dataset(s) used for each hazard are described in detail below.

Earthquake – The analysis of state owned and leased facilities vulnerable to earthquakes used the 2008 National Seismic Hazard Map - 2% Probability of Exceedance in 50 Years, developed by the USGS. To determine the state facilities that were considered at risk to earthquake hazards, a spatial query was performed to determine the leased and owned facilities that were within areas with a percent gravity (%g) greater than or equal to 18%. Based on the Mercalli Index of VII (≥18%g) this percent gravity produces strong shaking and building damage to structures that would require repair after the event. This Mercalli Index threshold was recommended by the State's Chief Hazards Geologist, Tim Walsh. Spatial data for this analysis was downloaded from the USGS website at http://gldims.cr.usgs.gov/website/nshmp2008/viewer.htm. Spatial analysis was performed using ArcGIS Desktop – ArcInfo software.

Flood – For the analysis of state owned and leased facilities vulnerable to flood the Q3 digital flood dataset available from the Department of Ecology was used. The Q3 digital flood data was derived from the Flood Insurance Rate Maps (FIRMs) published by the Federal Emergency Management Agency (FEMA). This dataset contains digital DFIRMs dated either 1996 or 1998 depending on the each specific county. While some newer digital flood data is available for select counties, this layer is the most current statewide layer available to determine vulnerability to flood hazards. The state owned and leased facilities vulnerable to flood were determined by performing a spatial query of those facilities that were located within the special flood hazard area indicated within the Q3 digital flood dataset. Spatial analysis for this hazard was performed using ArcGIS Desktop – ArcInfo software.

Tsunami – The analysis used digitized tsunami inundation maps developed by DNR based on tsunami modeling performed by NOAA and feedback from local jurisdictions. The communities covered by these maps include coastal counties, the inland waters of the Puget Sound, and the Strait of Juan de Fuca. The inundation areas for coastal counties were based on a tsunami generated by a M9.1 earthquake on the Cascadia Subduction Zone. The inundation areas for the inland waters of the Puget Sound were based in a tsunami generated by a M7.3 earthquake on the Seattle Fault and a tsunami generated by a M7.1 earthquake on the Tacoma Fault. State owned and leased facilities determined to be at risk to tsunamis were determined based on a spatial query performed for those state facilities that were located within the tsunami inundation zones. The spatial analysis was performed using ArcGIS Desktop – ArcInfo software.

Landslide – The Landslides (24K scale) spatial dataset developed by the Washington State Department of Natural Resources in April 2009 was used to determine the state owned and leased facilities vulnerable to landslides. State owned and leased facilities within 500 feet of a landslide were considered at risk to future landslide activity. The threshold of 500 feet was considered reasonable for determining risk, as a landslide within this distance could block road access or use of essential functions of a state facility. Spatial analysis was performed using ArcGIS Desktop software. The landslide dataset used for this analysis is available in GIS format from the DNR GIS Data Center at:
www.dnr.wa.gov/ResearchScience/Topics/GeosciencesData/Pages/gis_data.aspx

Volcano – To determine the vulnerability of state facilities to volcano hazards, the lahar and pyroclastic flow hazard zones developed by the USGS Cascades Volcano Observatory in 1996 and 2004 were used. To following zones were used for each volcano: Mt. Baker (1996) – Case 1 and Case M zones, Mount St. Helens (2004) – Zones VEI 2-3 (1M m^3, 3M m^3 , 10M m^3, 30M m^3, and 100M m^3 flow volumes) and Zones VEI 4-5 (1M m^3, 3M m^3 , 10M m^3, and 30M m^3 eruption flow volumes), Mount Rainier (1996) – Case 1 lahar zone only, Mount Adams (1996) – lahar zone, and Glacier Peak (1996) – lahar zone. A spatial query was performed to determine which state owned and leased facilities were located in each of these hazard zones. Facilities located within the volcano hazard zone indicated, were considered at risk to a potential volcanic event.

Wildland Fire – The September 2004 Wildland-Urban Interface (WUI) High Risk Communities dataset developed by the Washington State Department of Natural Resources was used to determine the state owned and leased facilities at risk to a potential wildfire. Using this data, a spatial query was performed to determine which state owner and leased facilities were located within these WUI High Risk Communities. Those facilities located within a WUI boundary were considered at risk to a potential

wildland fire event. This data is the most currently available dataset for the designation of wildland-urban interface communities in Washington State.

2013 Hazard Profile Analysis (data utilized to determine counties at risk):

Earthquake - Hazus-MH is a geographic information system (GIS) based earthquake loss estimation tool developed by the Federal Emergency Management Agency (FEMA) in cooperation with the National Institute of Building Sciences (NIBS). Hazus-MH 2.1 was used to calculate the Average Annualized Loss (AAL) and the Average Annualized Loss Ratios (AALR) for the State of Washington. In order to increase the reliability of the results, enhanced hazard data and inventory was utilized. Two user-supplied data layers for liquefaction and soil class were added to Hazus-MH to more accurately model the effects of the earthquake at each site-specific state facility. These data maps were supplied by the Washington Department of Natural Resources in their June 2010 Ground Response file geodatabase containing GIS data. The two datasets used in this scenario were: liquefaction susceptibility, which contain GIS polygons that provide information regarding the relative liquefaction potential for Washington State; and seismic site class, which contains polygons that provide NEHRP (National Earthquake Hazards Reduction Program) soil data information for Washington State. In addition, enhanced inventory data was provided for five counties courtesy of the Washington Hazus Users Group.

The Average Annualized Loss addresses two key components of seismic risk: the probability of ground motion in terms of physical damage and economic loss. Average Annualized Loss also takes into account the regional variations in seismic risk. Average Annualized Loss annualizes expected losses by averaging losses per return period (100; 250; 500; 750; 1,000; 1,500; 2,000; and 2,500 years), which factors in historic patterns of smaller but more frequent earthquakes with those that are larger in magnitude but are infrequent in nature. This methodology enables the comparison of risk to occur between two geographic areas, such as Skagit County and Asotin County.

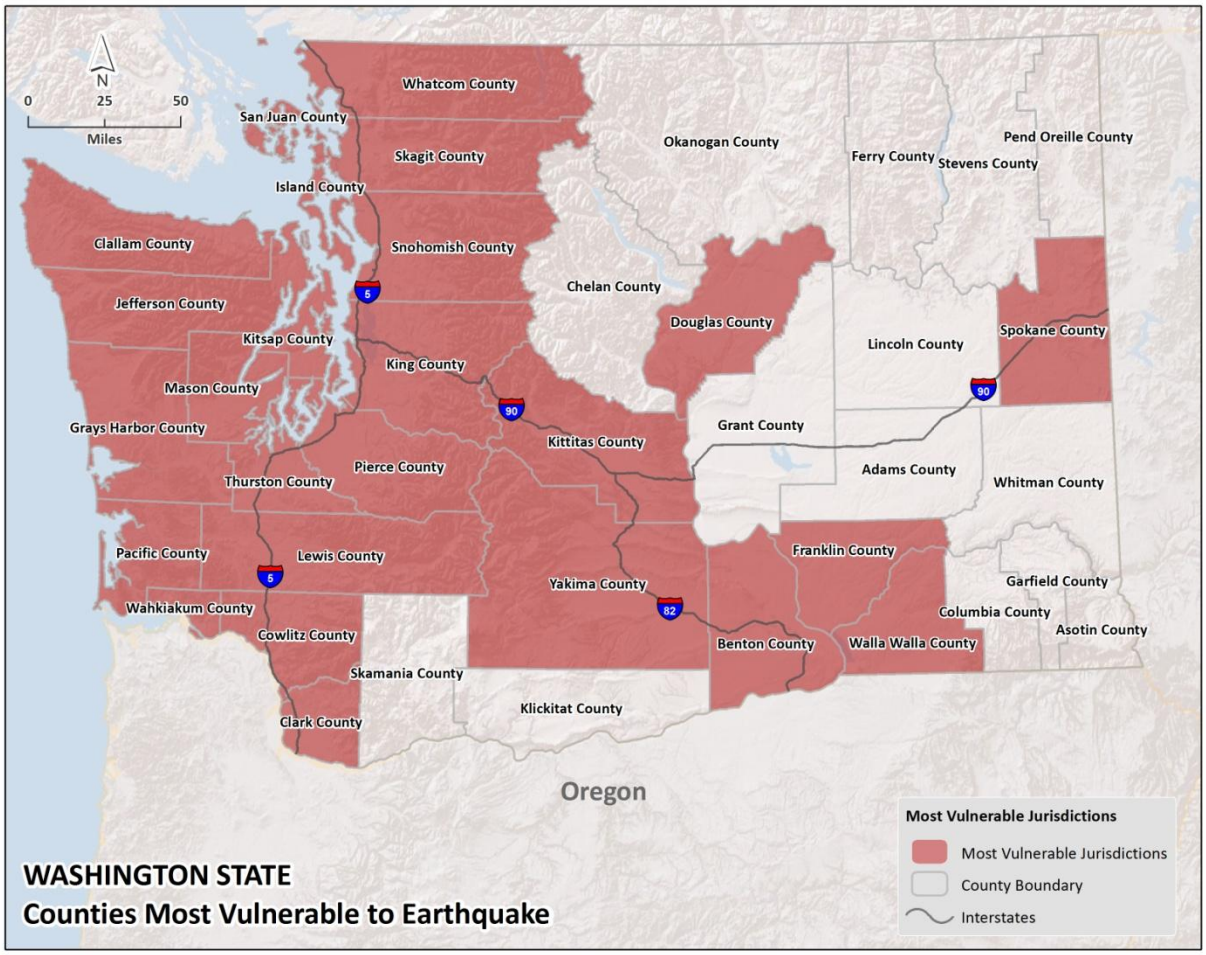
The Average Annualized Loss Ratio is the Average Annualized Loss presented as a fraction of the replacement value of the building inventory and is used for comparing the relative risk of a seismic event. Therefore, the annualized loss ratio allows for the relationship between the AAL and the building replacement values to be evaluated. This ratio can be used as a measure of relative risk between regions and within a state, since it is normalized by replacement value, allowing for the direct comparison across metropolitan areas, counties, and even between states.

In addition to the Hazus-MH Average Annualized Loss analysis, inflation was accounted for in order to estimate approximate 2012 value of losses. The Consumer Price Index (CPI) is a common measure of inflation and was used herein. State CPI's are not determined but national and metropolitan-level (with populations over 1.5 million) values are calculated. According to the Washington Office of Financial Management, the Seattle Metropolitan Statistical Area CPI (including Seattle, Tacoma, and Bremerton) is the closest representative to a state CPI. It should also be noted that the CPI at the metropolitan level is subject to measurement errors and can be more volatile given the smaller area. According to the Seattle CPI, the cumulative rate of inflation between 2000 and 2012 was calculated to be 29.9 percent. In other words, $1.00 in 2000 is equivalent to $1.29 in 2012. For comparison purposes, the national rate of inflation during this time was 33.3 percent.

The Average Annualized Loss Ratio is the Average Annualized Loss presented as a fraction of the replacement value of the building inventory and is used for comparing the relative risk of a seismic event. Therefore, the annualized loss ratio allows for the relationship between the AAL and the building

replacement values to be evaluated. This ratio can be used as a measure of relative risk between regions and within a state, since it is normalized by replacement value, allowing for the direct comparison across metropolitan areas, counties, and even between states.

The Average Annualized Loss and Ratios calculated using Hazus-MH for each county in Washington State are not to be seen as determinations of total risk since not all aspects of earthquake are addressed. The value presented in Table 5.4-7 only represent the direct economic loss to buildings, and do not factor in such things as damage to lifelines and critical facilities and the indirect economic losses that can be sustained by communities and as a result of a seismic event. The Hazus-MH estimates annualized loss and annualized loss ratios were calculated using default inventory data for each county. As noted above, counties considered most at risk are those with an Annualized Earthquake Loss of at least $1 million or with an Annualized Earthquake Loss Ratio equal or greater than the state's ratio of 0.02. Twenty-five counties meet one of these two criteria.



Flood - The factors used to determine which counties are most vulnerable to future flooding are:

- Frequency of flooding that causes major damage, based on the number of Presidential Disaster Declarations since 1956 as an indicator of how often serious, damaging flood events occur (top 20 counties). An approximated reoccurrence interval was also estimated using this data.
- Percentage of the County in Floodplain (land area only minus water bodies) (2 percent of more of the area of the county) – a measure of the size of the area within a county at-risk to flooding.
- Counties with the top 20 highest total General Building Stock Losses in Hazus-MH 2.1 from the 1.0-percent annual chance flood scenario.
- Number of Flood Insurance Policies Currently in Effect (top 20 counties) – a measure of the built environment in the floodplain.
- Number of Flood Insurance Claims Paid Since 1978 (top 20 counties) – another measure of the built environment in the floodplain.
- Number of Repetitive Flood Loss Properties (measured by county) – a measure of how often serious, damaging flood events occur.
- Number of Severe Repetitive Loss Properties (measured by county) – a measure of how often serious, damaging flood events occur.

Based on these factors, the following counties are at ten with the greatest risk and most vulnerable to flooding:

Jurisdictions Most Vulnerable to Flooding	
• Clark	• Pierce
• Cowlitz	• Skagit
• Grays Harbor	• Snohomish
• King	• Thurston
• Lewis	• Whatcom

Severe Storm - For the State Hazard Mitigation Plan, factors used to determine which counties are most vulnerable to a future non-flood, severe storm are:

- Counties most vulnerable to the non-flood meteorological criteria below, as determined by the Warning Coordination Meteorologist s from the National Weather Service whose offices oversee areas within Washington State.
- How often severe storm events occur, expressed as a percentage of recurrence per year. The percentage used to differentiate jurisdictions most vulnerable differs by storm type and is explained below.

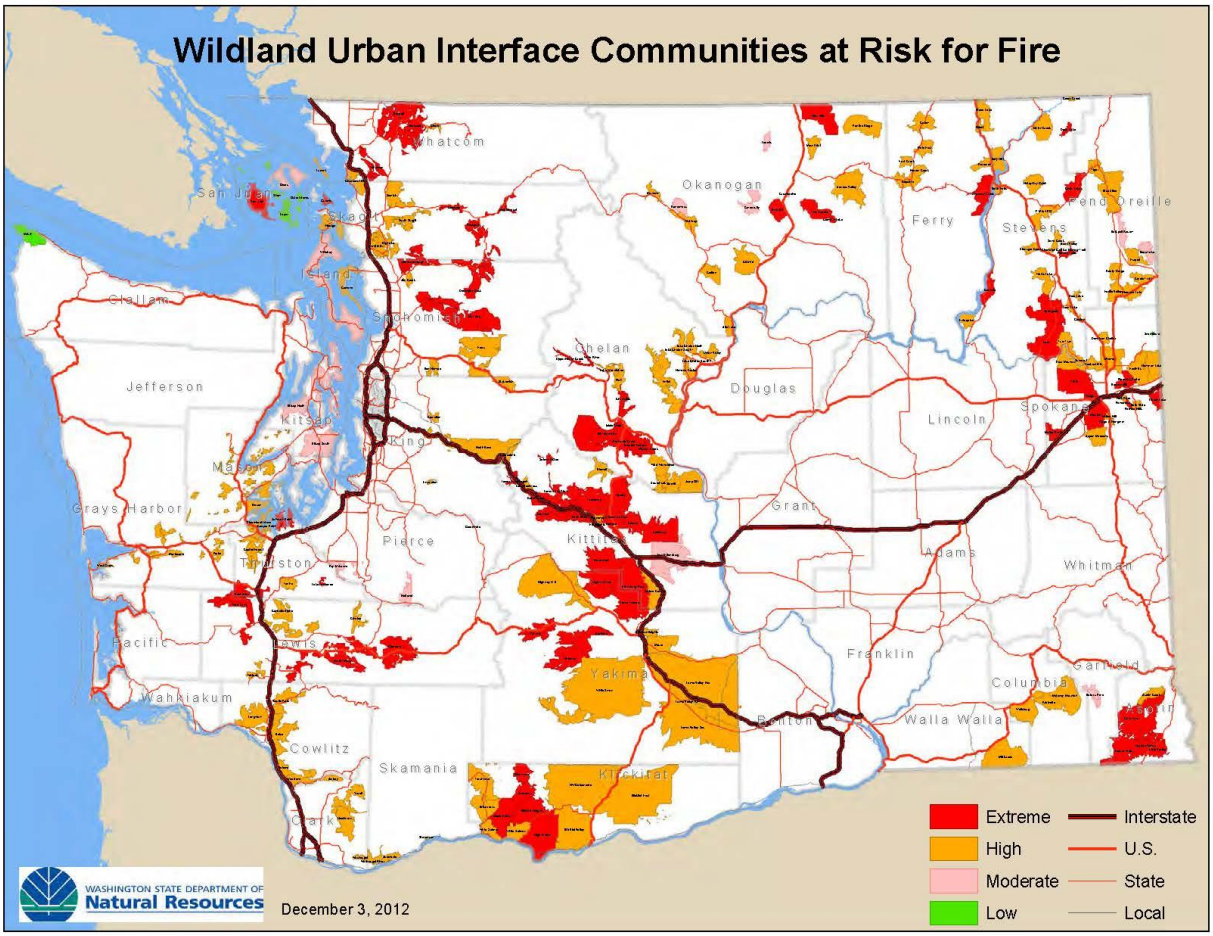
Data for frequency of severe storm events was obtained from the Special Hazard Events and Losses Database for the United States (SHELDUS, beta version), developed by the Hazard Research Lab at the University of South Carolina, and from the National Climatic Data Center of the National Oceanic and Atmospheric Administration. SHELDUS uses a variety of NOAA data sources. It covers severe weather events from 1960 through 2009 that caused more than $50,000 in property and/or crop damage. Data obtained from the National Climatic Data Center covered weather events causing more than $100,000 in property and/or crop damage from 1993 through 2012 (except June and July 1993, for which data is not available), with the following exceptions: Tornado information is from 1950 to 1992 and Thunderstorm

wind and hail information is from 1955 to 1992. Analysis of the data sets eliminated duplicate entries between the SHELDUS and National Climatic Data Center data. Figure 5.7-6 shows the hazard losses from 1960 to 2009.

Table 5.7-1	Counties Most Vulnerable to High Winds (shade indicates most vulnerable)		Counties Most Vulnerable to Winter Storm (shade indicates most vulnerable)	
Counties (shaded for most vulnerable)	Vulnerable to Meteorological Conditions	Recurrence Rate (>100% – At least 1 occurrence per year)	Vulnerable to Meteorological Conditions	Recurrence Chance / Year (>50% – At least one occurrence every two years)
Adams	YES	70%, Included by NWS	NO	35%
Asotin	NO	70%	YES	23%
Benton	YES	140%	NO	48%
Chelan	YES, East Slopes of Cascades	Included by NWS	YES	Included by NWS
Clallam	YES, Pacific Coast	118%	YES	48%
Clark	YES	130%	YES, East County	85%
Columbia	YES	120%	YES	38%
Cowlitz	YES	113%	YES	60%
Douglas	NO	80%	YES	143%
Ferry	YES, Higher Elevations	65%	YES	23%
Franklin	YES	80%, Included by NWS	NO	33%
Garfield	YES	70% Included by NWS,	YES	73%
Grant	YES	93%, Included by NWS	NO	60%
Grays Harbor	YES	170%	NO	40%
Island	YES	148%	NO	43%
Jefferson	YES, Pacific Coast	125%	YES	43%
King	YES	133%	YES	70%
Kitsap	YES	125%	YES	35%, Included by NWS
Kittitas	YES	110%	YES	110%
Klickitat	YES	73%, Included by NWS	YES	38%
Lewis	YES	123%	YES	33% Included by NWS,
Lincoln	YES	75%	YES	25%
Mason	YES	165%	YES	60%
Okanogan	YES	83%	YES	128%
Pacific	YES, Pacific Coast	213%	NO	33%
Pend Oreille	YES	73%	YES	Included by NWS
Pierce	YES	165%	YES	60%
San Juan	YES, Western Half	173%	YES	48%, Included by NWS
Skagit	YES	188%	YES	58%, Included by NWS
Skamania	YES	95%	YES	88%
Snohomish	YES, Western Half	175%	YES	58%
Spokane	YES	105%	YES	55%
Stevens	YES, Higher Elevations	83%	YES	Included by NWS
Thurston	YES	175%	YES	50%

Wahkiakum	YES	118%	NO	35%
Walla Walla	YES	90%	YES	98%
Whatcom	YES, Western Half	190%	YES	65%, Included by NWS
Whitman	YES	93%, Included by NWS	YES	30%
Yakima	YES	103%	YES	73%

Wildfire - The Washington Department of Natural Resources and its federal and local partners determined the listed communities were at high risk after evaluating them for fire behavior potential, fire protection capability, and risk to social, cultural and community resources. Risk factors included area fire history, type and density of vegetative fuels, extreme weather conditions, topography, number and density of structures and their distance from fuels, location of municipal watershed, and likely loss of housing or business. The evaluation used the criteria in the wildfire hazard severity analysis of the NFPA 299 Standard for Protection of Life and Property from Wildfire. Consequently, Washington's State Forester (DNR) designated 221 Wildfire-Urban Interface Communities are high risk to wildfire. Those communities were geo-referenced by zip code onto a county map of Washington State.



2010 Hazard Profile Analysis (data utilized to determine counties at risk):

Earthquake – The analysis of vulnerability to earthquakes used the 2008 National Seismic Hazard Map - 2% Probability of Exceedance in 50 Years, developed by the USGS (Open File Report 2008-1128). The National Seismic Hazard Map (2008) displays earthquake ground motions for various probability levels across the United States and is applied in seismic provisions of building codes, insurance rate structures, risk assessments, and other public policy. This update of the map (previous releases were in 1996 and 2002) incorporates new findings on earthquake ground shaking, faults, seismicity, and geodesy. The resulting maps are derived from seismic hazard curves calculated on a grid of sites across the United States that describe the frequency of exceeding a set of ground motions. The USGS National Seismic Hazard Mapping Project developed these maps by incorporating information on potential earthquakes and associated ground shaking obtained from interaction in science and engineering workshops involving hundreds of participants, review by several science organizations and State surveys, and advice from two expert panels. The National Seismic Hazard Maps represent the assessment of the "best available science" in earthquake hazards estimation for the United States. The spatial data and full report can be accessed online at the following USGS websites: http://pubs.usgs.gov/of/2008/1128/ and http://earthquake.usgs.gov/hazards/products/conterminous/.

Flood – For the analysis of vulnerability to floods, the Q3 digital flood dataset available from the Department of Ecology was used. Digital Q3 flood dataset was derived from Flood Insurance Rate Maps (FIRMs) published by the Federal Emergency Management Agency (FEMA) for each county in Washington State. The FIRM is the basis for floodplain management, mitigation, and insurance activities for the National Flood Insurance Program (NFIP). This dataset contains digital DFIRMs dated either 1996 or 1998 depending on the specific county. The spatial data and metadata for each county's Q3 Flood Data can be downloaded from the Department of Ecology's website at: http://www.ecy.wa.gov/services/gis/data/flood/flood.htm.

Tsunami – For the analysis of vulnerability to tsunamis, the tsunami inundation maps developed by DNR based on tsunami modeling performed by NOAA and feedback from local jurisdictions were used. The communities covered by these maps include coastal counties, the inland waters of the Puget Sound, and the Strait of Juan de Fuca. The inundation areas for coastal counties were based on a tsunami generated by a M9.1 earthquake on the Cascadia Subduction Zone. The inundation areas for the inland waters of the Puget Sound were based in a tsunami generated by a M7.3 earthquake on the Seattle Fault and a tsunami generated by a M7.1 earthquake on the Tacoma Fault.

Volcano – To determine the vulnerability to volcano hazards, the lahar and pyroclastic flow hazard zones developed by the USGS- Cascade Volcano Observatory in 1996 and 2004 were used. To following zones were used for each volcano: Mt. Baker (1996) – Case 1 and Case M zones, Mount St. Helens (2004) – Zones VEI 2-3 (1M m^3, 3M m^3 , 10M m^3, 30M m^3, and 100M m^3 flow volumes) and Zones VEI 4-5 (1M m^3, 3M m^3 , 10M m^3, and 30M m^3 eruption flow volumes), Mount Rainier (1996) – Case 1 lahar zone only, Mount Adams (1996) – lahar zone, and Glacier Peak (1996) – lahar zone. Digital datasets for each of Washington's active volcanoes can be downloaded from the USGS's website at: http://vulcan.wr.usgs.gov/Volcanoes/Cascades/Publications/OFR96-178/framework.html.

Wildland fire – The September 2004 Wildland-Urban Interface (WUI) High Risk Communities dataset developed by the Washington State Department of Natural Resources was used to determine

vulnerability to a potential wildfire. This data is the most currently available statewide dataset designating the location of wildland-urban interface communities. The digital data for WUI High Risk Communities can be downloaded from the DNR website at: http://fortress.wa.gov/dnr/app1/dataweb/dmmatrix.html.

2013 Cost and Area Calculations for State Facilities:

A Hazus-MH 2.1 analysis was employed to model building losses for state-owned and state-leased facilities utilizing the Washington State Office of Financial Managements 2012 dataset of state facilities. A total of 9,975 state facilities were analyzed. These buildings have an estimated replacement value of $13,363,228,000. The combined area of the state buildings is estimated at 105,060,000 square feet. Of these buildings, 8,893 were reported as owned and 1,082 were reported as leased. Owned buildings have a combined exposure (building replacement value) of $11,858,700,000, and leased buildings have a combined value of $1,504,528,000. Owned buildings have a combined area of 93,425,000square feet, and leased buildings have a combined area of 11,635,000 square feet.

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2010 Cost and Area Calculations for State Facilities:

Total and average original cost and area (square footage, ft^2) was calculated for all state facilities that were determined to be at risk to each of the six natural hazards included in this plan. The original cost value for each owned structure was used to determine approximate value of state facilities at risk, as an assessed or replacement value was not collected by OFM during the 2009 data update of state owned and leased facilities. The monthly rental value for each of the leased state facilities was used to determine approximate revenue that is generated by those leased state facilities at risk to each hazard. As with the owned state facilities, the leased state facilities dataset did not include an assessed or replacement value to determine the approximate value of leased facilities at risk to hazards. The number of leased and owned facilities that did not report the monthly rent or original cost for each structure was 8.3% and 40.9%. Therefore, the average original cost and average monthly rental values should be considered an underestimate of the true value of structures and rental income at risk to state facilities.