

Places to Stay Away From During the Next 50 Years:

Earthquake Vulnerability Analysis in Washington State

Introduction

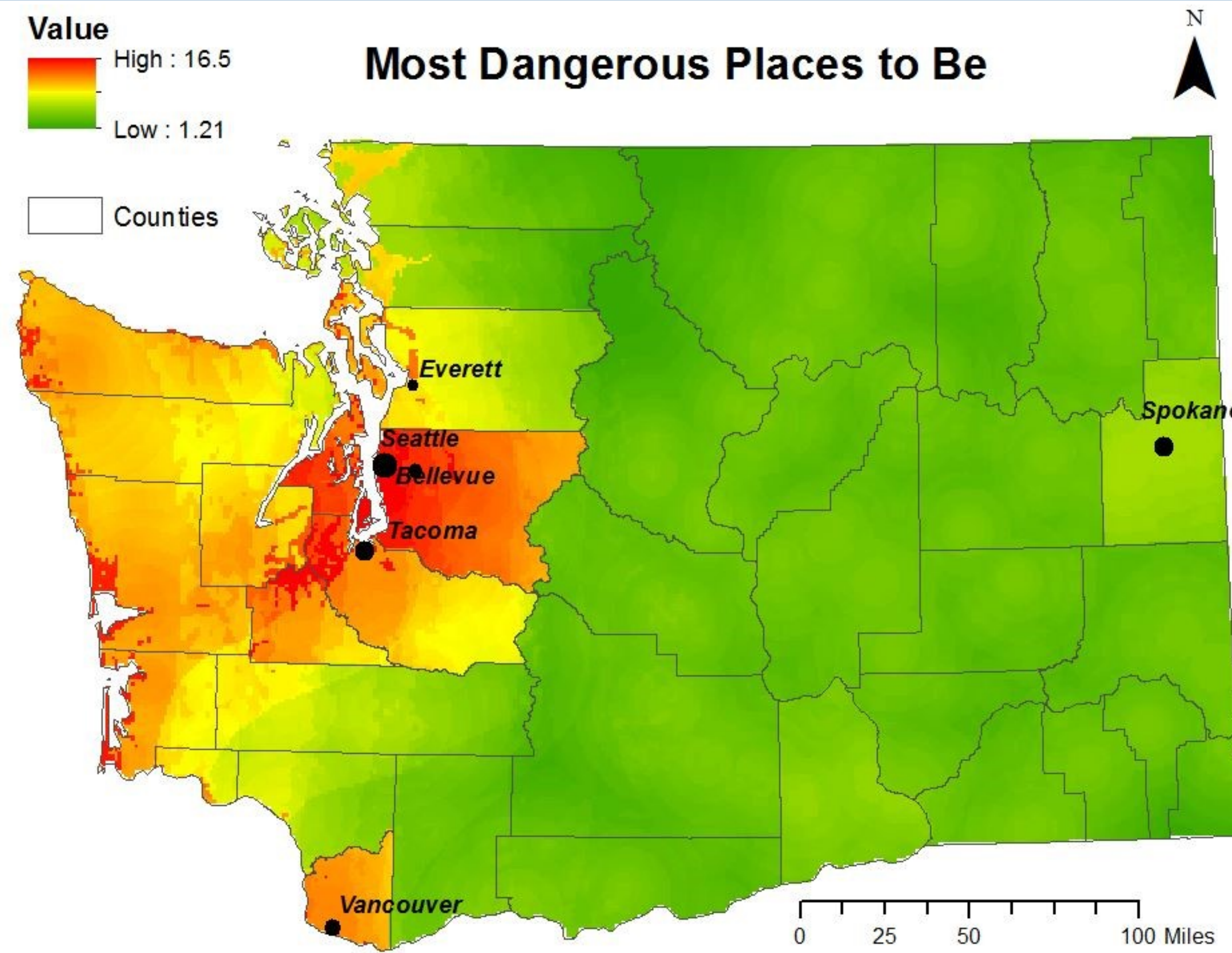
According to recent studies, Washington State is 200 years overdue for a 9.7 magnitude earthquake. Experts suggest that this earthquake will occur at the Cascadia subduction zone at some point within the next 50 years. This earthquake is also expected to trigger a 100 foot tall tsunami. The fact that Washington State has not seen an earthquake/tsunami this large in recent history poses a significant danger to the people living there. The purpose of this study is to evaluate which regions are the most dangerous places to be in so that people can prepare accordingly.

Methodology

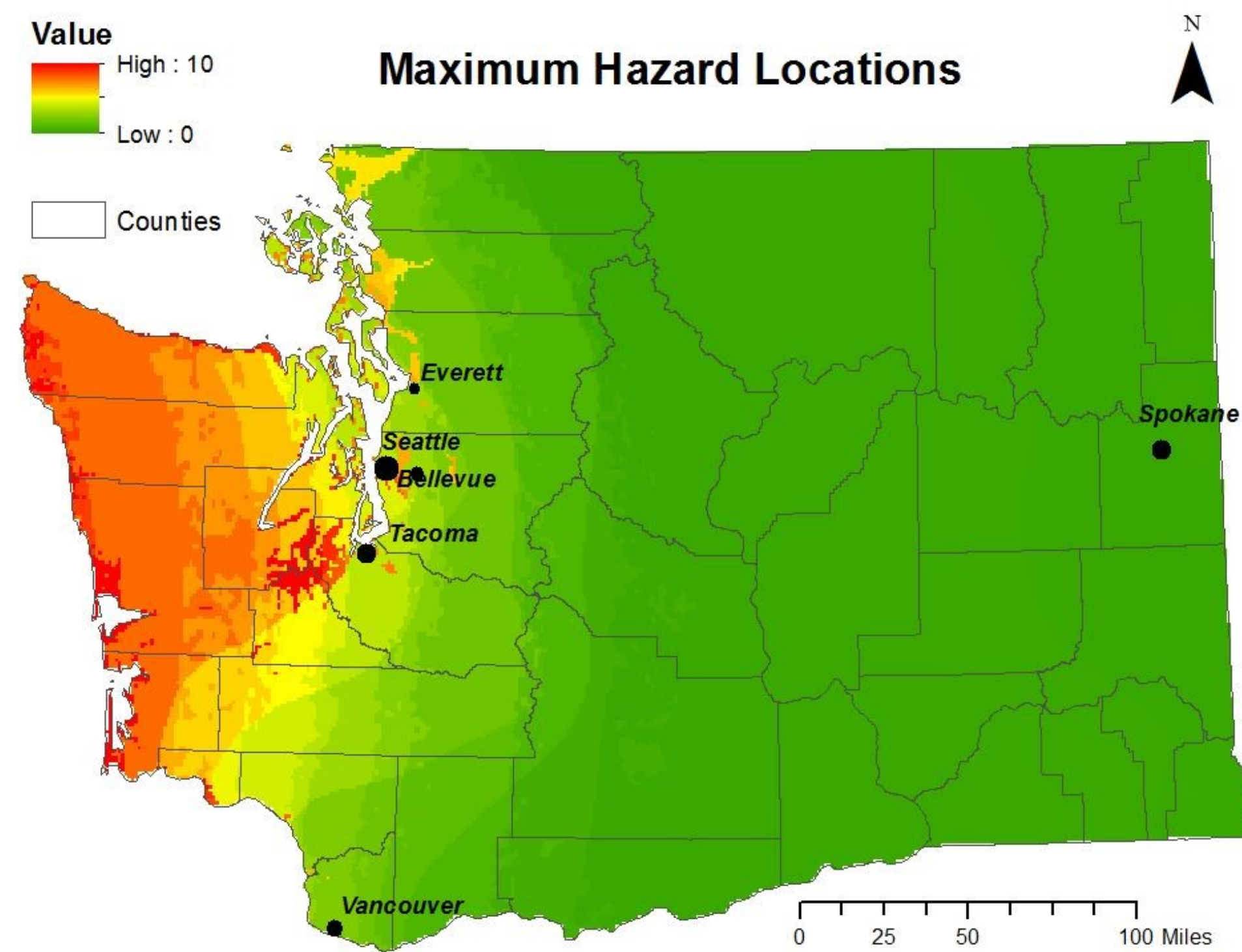
This study was performed by combining 2 factors that influence where the most danger lies. These 2 factors are maximum hazard locations (the locations where the earthquake/tsunami will hit the hardest) and most vulnerable locations (the locations that are most at risk in the event of an earthquake/tsunami disaster). Each of these 2 factors was created by further breaking down the variables involved. The maximum hazard factor was created by combining 3 variables: the predicted percent ground acceleration due to a 9.7 magnitude earthquake, the susceptibility of various soils to shaking, and the vulnerability of various locations to a tsunami flood. In addition, the vulnerability factor was created by combining 3 variables: population density, proximity to hospitals, and proximity to fire stations. Various spatial analysis tools were used including: Euclidian Distance, Raster Calculator, and Reclassify.

Conclusions

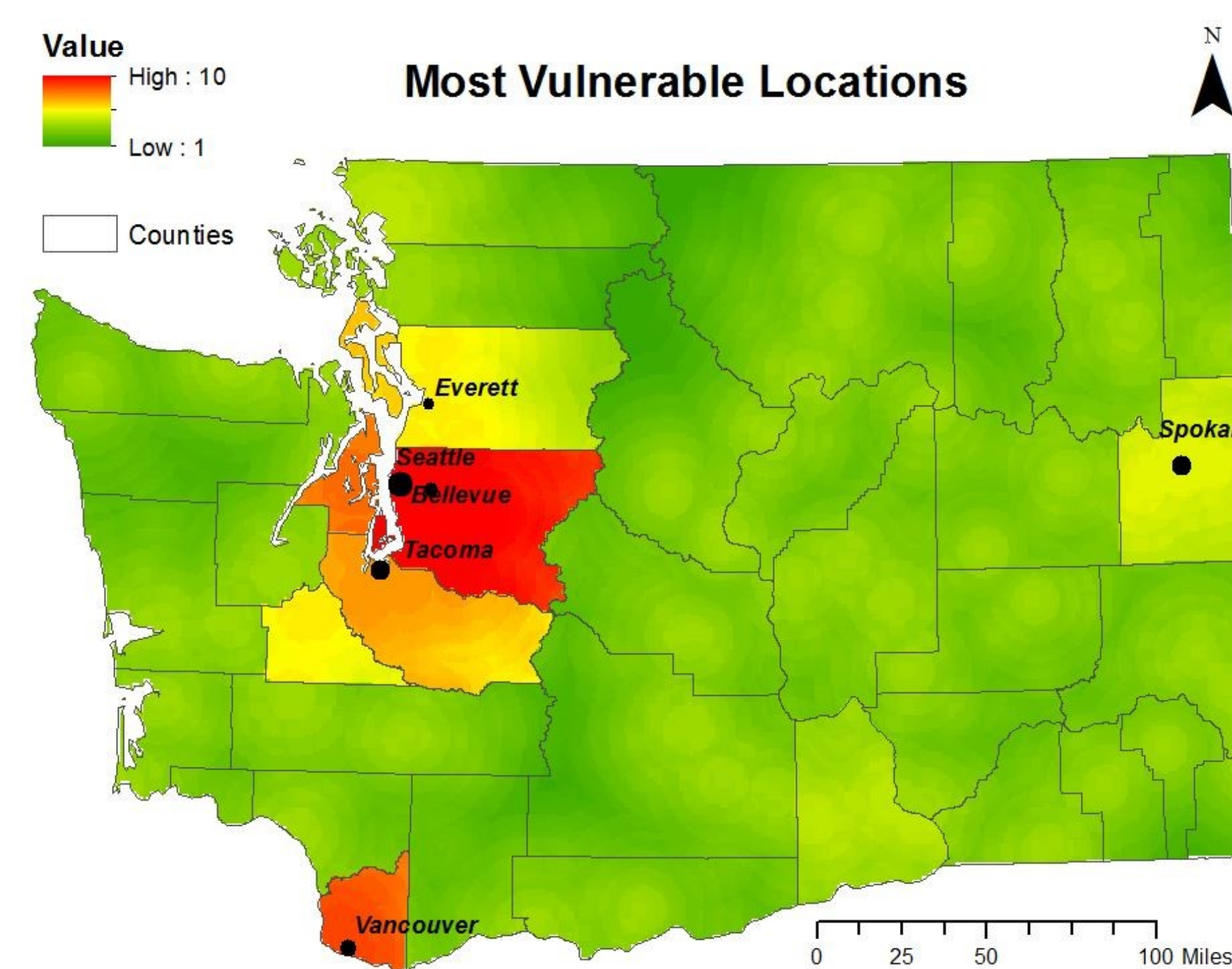
The results of this study are that there are pockets of Washington which are in the most danger. The first pocket is the locations along the west coast that have elevations smaller than 100 feet. These locations will likely all be underwater if a tsunami hits. The second pocket is the majority of the western region of the state. This whole region will see the largest effects of the earthquake and will likely see the most building and infrastructure damage. The third pocket is King county. This is by far the most populated county in the state and it contains many of the largest cities. Because of the large population and because it is expected to be hit by the earthquake relatively hard, it is in a significant amount of danger. It is recommended that these 3 locations take caution and prepare by implementing emergency protocols, incorporating seismic effects into all future infrastructure design, and renovating old infrastructure with seismic considerations.



This map shows which regions are the most dangerous to be in during the next 50 years. It was created by combining the vulnerability and the hazard maps found below. The equation used to create the map was: Danger = Maximum Hazard Locations + Most Vulnerable Locations



This map shows which regions will see the most damage due to the expected earthquake and resulting tsunami. This map was created by combining the 3 maps below. It was created using the weighted average shown in the following equation: Hazard = ((PGA)*(Soil Shaking Susceptibility)*.07) + (Tsunami Vulnerability)*.3



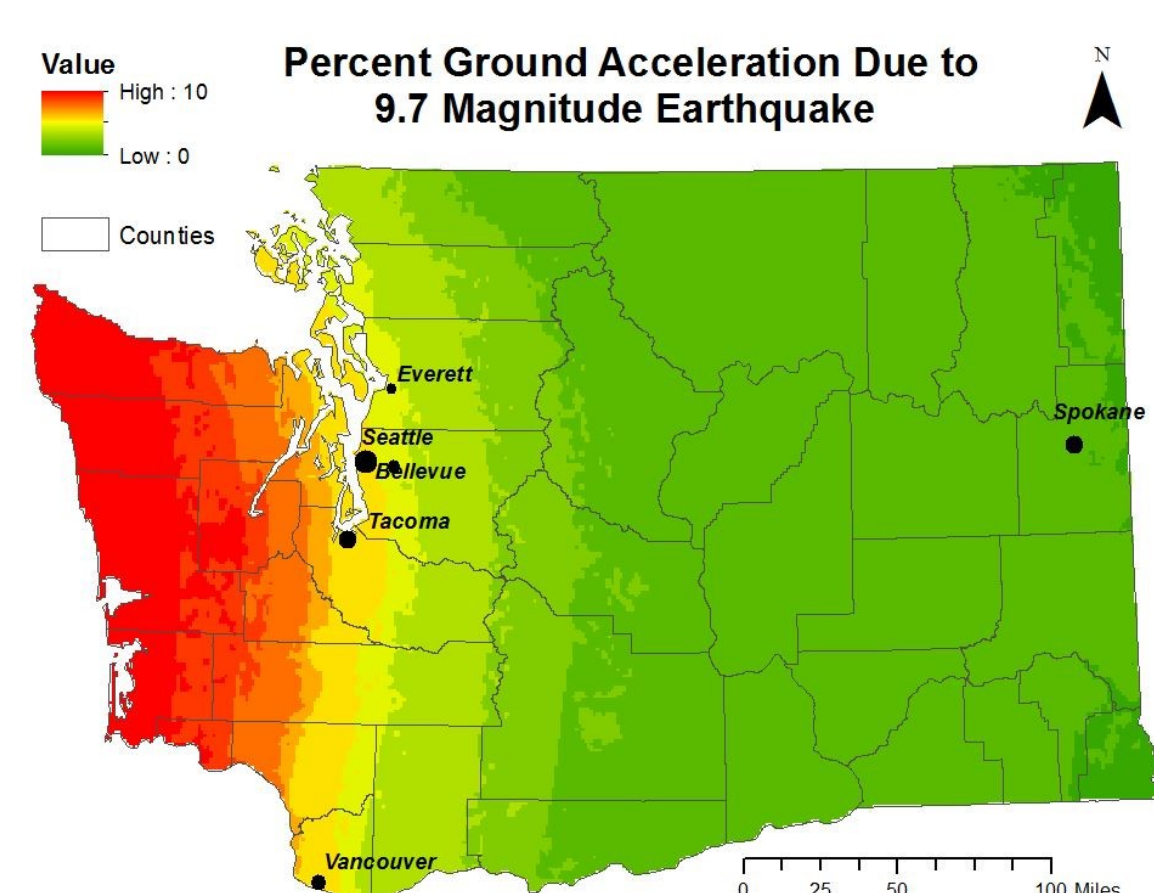
This map shows which regions are most vulnerable to an earthquake by nature. It was created by combining the 3 maps below using a weighted average. The equation used was: Vulnerability = (Population Density)*.7 + (Hospital Vulnerability)*.2 + (Fire Station Vulnerability)*.1

Authorship

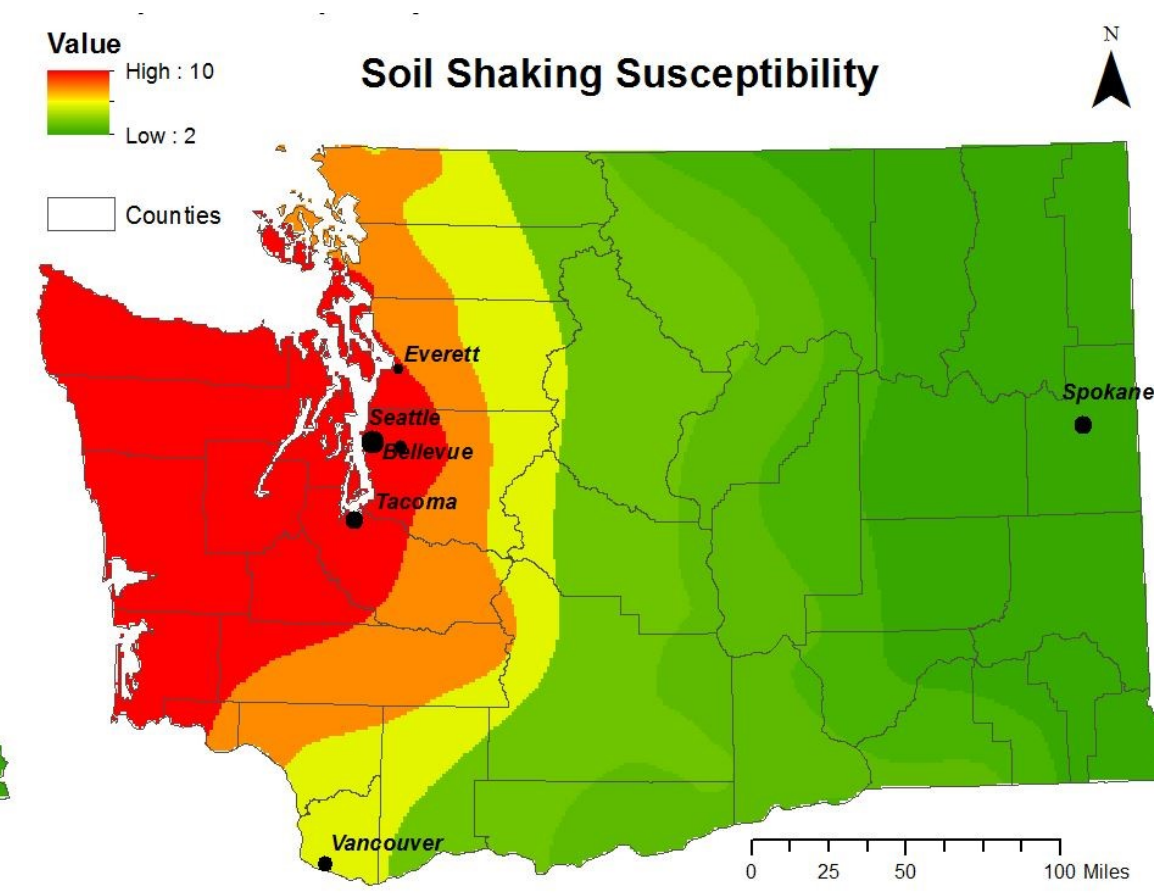
Created By: Aleksandr Kirpach
 Created For: CEE 187 - GIS
 Date: 12/6/17
 Data Source: WSDOT, OFM, and USGS
 Coordinate System: NAD 1983 HARN State Plane
 Washington South FIPS 4602 Feet
 Projection: Lambert Conformal Conic
 Datum: North American 1983 HARN

References

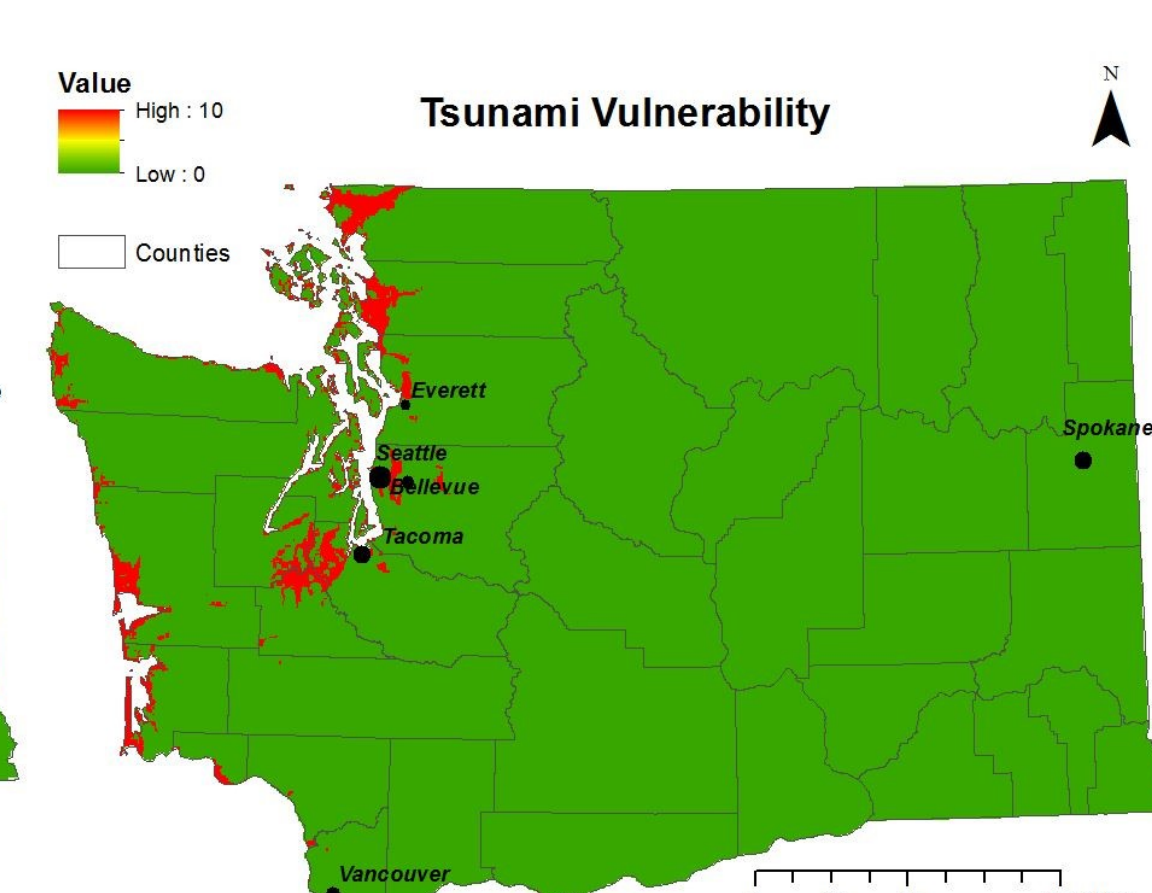
- <http://www.ofm.wa.gov/pop/geographic/tiger.asp>.
- <https://earthquake.usgs.gov/hazards/hazmaps/>
- <https://www.doh.wa.gov/DataandStatisticalReports/DataSystems/GeographicInformationSystem/DownloadableDataSets>
- <https://prd-tnm.s3.amazonaws.com/index.html?prefix=StagedProducts/Struct/Shape/>
- https://earthquake.usgs.gov/scenarios/eventpage/bssc2014cascadia_sub0_m9p34_se#executive



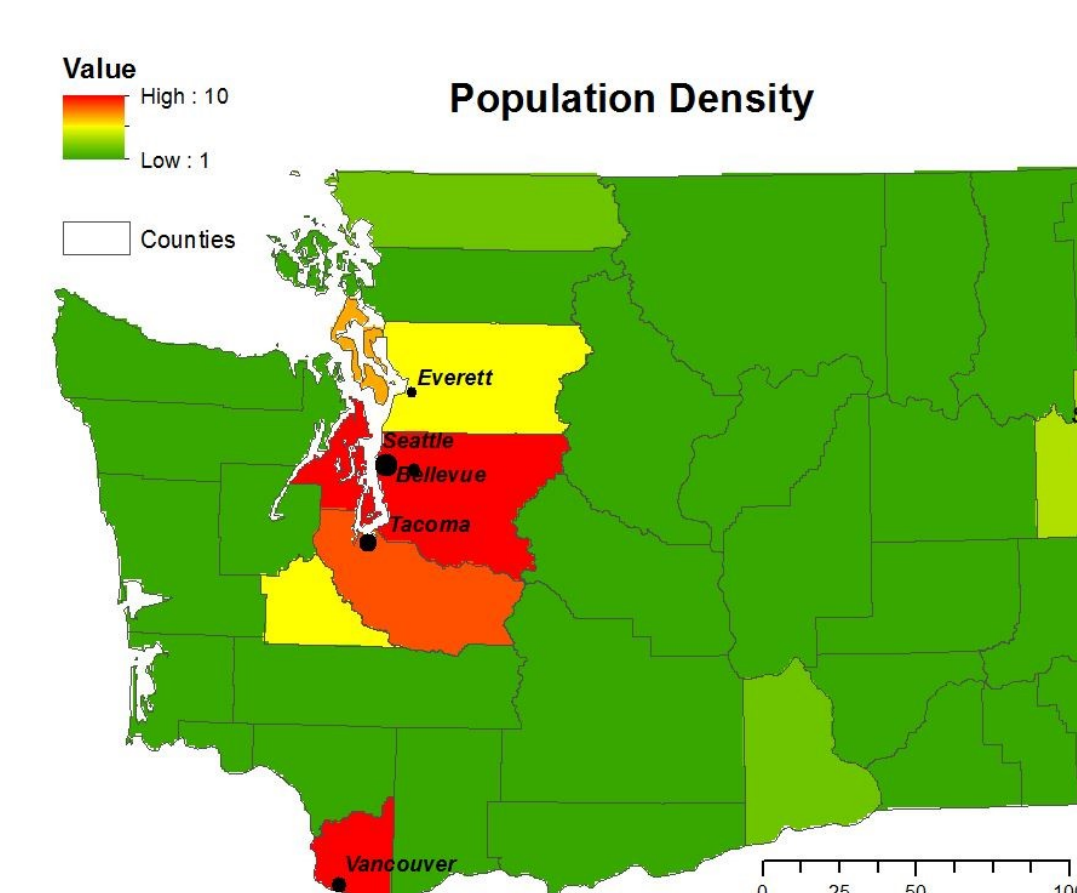
This map shows the predicted percent ground acceleration (pga) of Washington state due to the expected 9.7 magnitude earthquake. The quake is expected to happen along the Cascadia fault and the pga values are based off a scenario study done by USGS. This map essentially shows which regions will get hit the hardest.



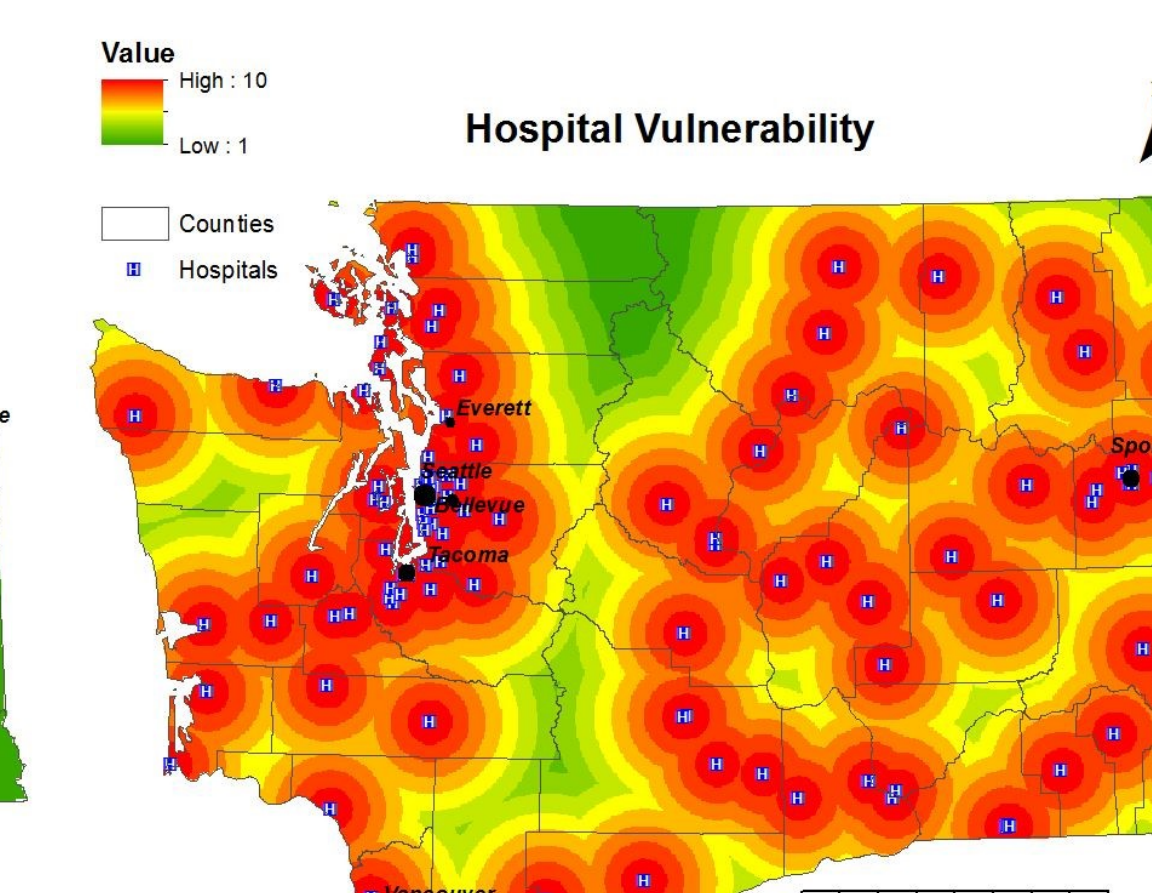
This map shows how susceptible various soils are to shaking. The information is based off of known site conditions and it indicates which areas would have the "worst reaction" to an earthquake.



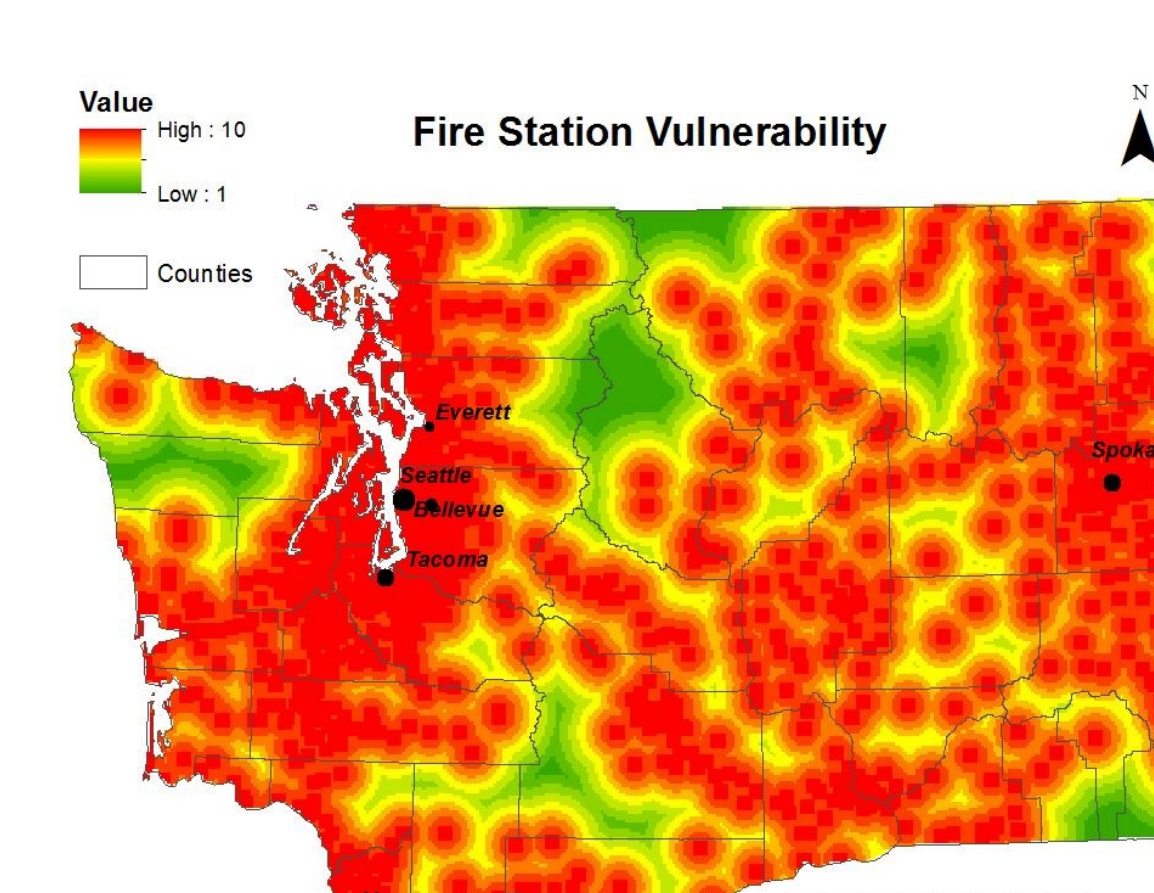
This map shows which regions in Washington state are most susceptible to a tsunami. Based on predictions done by USGS, the expected 9.7 magnitude earthquake will trigger a 100 foot tall tsunami. The distance that this tsunami goes inland depends on the topography. As a result, the tsunami will continue to travel inland until it encounters land that has an elevation greater than 100 feet. Red regions on the map indicate regions that have elevations less than 100 feet and which are expected to be underwater after the tsunami hits.



This map shows the population density of each county and ranks it on a scale from 1 to 10. Counties with higher population densities are more at risk because they contain more people who might get hurt in the event of an earthquake.



This map shows the vulnerability of various regions based on hospital proximity. Regions that are closest to hospitals are the most at risk because if an earthquake hits a hospital and the hospital collapses, that region will be in serious danger for 2 reasons. The first is that that hospital will not be able to provide care to the people who need it. The second is that the people who are in the hospital have a lower probability of surviving the earthquake.



This map shows the vulnerability of various regions based on fire station proximity. Regions that are closest to fire stations are the most at risk because if an earthquake hits a fire station and the fire station collapses, that region will be in serious danger because the fire station will not be able to provide care to the people who need it.