Social/Demographic Capacity

Social/demographic capacity is a significant indicator of community hazard resilience. The characteristics and qualities of the community population such as language, race and ethnicity, age, income, educational attainment, and health are significant factors that can influence the community's ability to cope, adapt to and recover from natural disasters. Population vulnerabilities can be reduced or eliminated with proper outreach and community mitigation planning.

Population

Washington County is part of the tri-county metro area comprised of Multnomah, Clackamas, and Washington Counties. While the tri-county metro area did experience population growth between 2010 and 2015, Washington County outpaced its neighbors. Washington County's population grew 7.4% from 2010 to 2015. It remains the second most populous Oregon county.

The tri-county metro area accounts for roughly 43% of Oregon's population. Washington County accounts for just under one-third of the tri-county metro area's population. Hillsboro and Beaverton are the county's largest cities at roughly 90,000 each, while Tigard is the third largest city with just over half the population of the two larger cities (49,280). The unincorporated area of the county accounts for about 40% of the overall population (237,984) and is growing faster than the largest cities (2.1% AAGR).

Oregon's state-wide land use planning policies require local jurisdictions to manage growth using an urban growth boundary, which contains most new growth inside of incorporated areas. Since 2010 the unincorporated area of the county grew faster than almost all of the incorporated cities; reversing the trend from previous years when incorporated areas grew faster. Although the trend reversed the growth in these areas does emphasize the importance of partnerships between the county and the cities for effective county-wide mitigation efforts.

C-1 Population Estimate for Tri-County Area and Washington County Cities

Jurisdiction	2010 Number	2010 Percent*	2015 Number	2015 Percent*	Change Number	Change Percent	Change AAGR
Oregon	3,837,300	-	4,013,845	-	176,545	4.6%	0.9%
3-County Area	1,644,635	42.9%	1,745,385	43.5%	100,750	6.1%	1.2%
Clackamas County	376,780	9.8%	397,385	9.9%	20,605	5.5%	1.1%
Multnomah County	736,785	19.2%	777,490	19.4%	40,705	5.5%	1.1%
Washington County	**531,070**	**13.8%**	**570,510**	**14.2%**	**39,440**	**7.4%**	**1.4%**
Banks	1,775	0.3%	1,775	0.3%	0	0.0%	0.0%
Beaverton	89,925	16.9%	94,215	16.5%	4,290	4.8%	0.9%
Cornelius	11,875	2.2%	11,900	2.1%	25	0.2%	0.0%
Durham	1,355	0.3%	1,880	0.3%	525	38.7%	6.8%
Forest Grove	21,130	4.0%	23,080	4.0%	1,950	9.2%	1.8%
Gaston	635	0.1%	640	0.1%	5	0.8%	0.2%
Hillsboro	**91,970**	**17.3%**	**97,480**	**17.1%**	**5,510**	**6.0%**	**1.2%**
King City	3,115	0.6%	3,425	0.6%	310	10.0%	1.9%
Lake Oswego (part)	9	0.0%	9	0.0%	0	0.4%	0.1%
North Plains	1,970	0.4%	2,015	0.4%	45	2.3%	0.5%
Portland (part)	1,547	0.3%	1,590	0.3%	43	2.8%	0.6%
Rivergrove (part)	32	0.0%	37	0.0%	4	13.7%	2.6%
Sherwood	18,205	3.4%	19,080	3.3%	875	4.8%	0.9%
Tigard	**48,090**	**9.1%**	**49,280**	**8.6%**	**1,190**	**2.5%**	**0.5%**
Tualatin (part)	23,191	4.4%	23,726	4.2%	535	2.3%	0.5%
Wilsonville (part)	2,140	0.4%	2,394	0.4%	254	11.9%	2.3%
Unincorporated	214,106	40.3%	237,984	41.7%	23,878	11.2%	2.1%

Source: Portland State University, Population Research Center, "Annual Population Estimates", 2015.
Jurisdictions in **bold** are participating in this plan.

The Office of Economic Analysis' Long-term County Population Forecast projects that by 2035 Washington County's population will increase to over 782,000, a 37% increase from the 2015 estimate.[4]

C-2 Population Forecast for Tri-County Metro Area

Jurisdiction	2015 Number	2015 Percent	2035 Number	2035 Percent	Change Number	Change Percent	Change AAGR
Oregon	4,013,845	-	4,995,200	-	981,355	24.4%	1.1%
3-County Area	1,745,385	34.9%	2,204,994	44.1%	459,609	26.3%	1.2%
Clackamas County	397,385	8.0%	512,731	10.3%	115,346	29.0%	1.3%
Multnomah County	777,490	15.6%	909,947	18.2%	132,457	17.0%	0.8%
Washington County	**570,510**	**11.4%**	**782,316**	**15.7%**	**211,806**	**37.1%**	**1.6%**

Source: Portland State University, Population Research Center, "Annual Population Estimates", 2015; Office of Economic Analysis, Long-Term County Population Forecast, 2010-2050 (2013 release).

As required by law Metro forecasts population and employment growth that is expected in the Portland region (including Washington County). Metro last updated their "Regional

[4] Office of Economic Analysis. Long Term County Population Forecast, 2010-2050 (2013 release).

Growth Distribution" in 2012.[5] According to their forecasts Unincorporated Washington County Traffic Analysis Zone (TAZ) is expected to increase 31% for a total population of 245,766 by 2035. During the same period the Hillsboro TAZ is forecasted to grow 25% and Tigard TAZ is forecasted to grow 25%. For more information and analysis see the Metro website.

Tourists

Tourists are not counted in population statistics; and are therefore considered separately in this analysis. The table below shows the estimated number of person nights in private homes, hotels and motels, and other types of accommodations. The table shows that, between 2013-2015, approximately three-quarters of all visitors to Washington County lodged in private homes, with just under one-quarter staying in hotels/ motels, the remaining visitors stay on other accommodations (vacation homes/ campgrounds). Tourists' lodging in private homes suggests these visitors are staying with family and friends. For hazard preparedness and mitigation purposes, outreach to residents in Washington County will likely be transferred to these visitors in some capacity. Visitors staying at hotel/motels are less likely to benefit from local preparedness outreach efforts aimed at residents.

C-3 Annual Visitor Estimates in Person Nights

	2013 Person-Nights (1,000's)	Percent	2014 Person-Nights (1,000's)	Percent	2015p Person-Nights (1,000's)	Percent
All Overnight	7,694	100%	7,629	100%	7,882	100%
Hotel/Motel	1,775	23%	1,746	23%	1,823	23%
Private Home	5,763	75%	5,726	75%	5,898	75%
Other	156	2%	158	2%	160	2%

Source: Oregon Tourism Commission, Oregon Travel Impacts: 1991-2015, Dean Runyan Associates

Tourists are specifically vulnerable due to the difficulty of locating or accounting for travelers within the region. Tourists are often at greater risk during a natural disaster because of unfamiliarity with evacuation routes, communication outlets, or even the type of hazard that may occur. Knowing whether the region's visitors are staying in friends/relatives homes in hotels/motels, or elsewhere can be instructive when developing outreach efforts.[6]

Vulnerable Populations

Vulnerable populations, including seniors, disabled citizens, women, and children, as well those people living in poverty, often experience the impacts of natural hazards and disasters more acutely. Hazard mitigation that targets the specific needs of these groups has the potential to greatly reduce their vulnerability. Examining the reach of hazard mitigation policies to special needs populations may assist in increasing access to services and

[5] Metro, "Regional 2035 forecast distribution", http://www.oregonmetro.gov/regional-2035-forecast-distribution

[6] MDC Consultants (n.d.). When Disaster Strikes – Promising Practices. Retrieved March 18, 2014, from http://www.mdcinc.org/sites/default/files/resources/When%20Disaster%20Strikes%20-%20Promising%20Practices%20- %20Tourists.pdf

programs. FEMA's Office of Equal Rights addresses this need by suggesting that agencies and organizations planning for natural hazards identify special needs populations, make recovery centers more accessible, and review practices and procedures to remedy any discrimination in relief application or assistance.

County survey (2010) respondents catalogued the places where these vulnerable populations exist as population assets that should be targets for mitigation actions. These assets include schools – from pre-kindergarten through to the universities and community colleges. The campuses are where the young people of the communities spend their time and, similarly to workplace safety training, mitigation actions on the physical facilities as well as awareness and training will help keep students safe. Likewise, elderly living at home or in assisted living communities are more vulnerable to the negative impacts of a hazard. Survey respondents (2010) listed these facilities as important community assets that should be given careful consideration for hazard mitigation and preparedness efforts.

Population size itself is not an indicator of vulnerability. More important is the location, composition, and capacity of the population within the community. Research by social scientists demonstrates that human capital indices such as language, race, age, income, education and health can affect the integrity of a community. Therefore, these human capitals can impact community resilience to natural hazards.

Language

Special consideration should be given to populations who do not speak English as their primary language. Language barriers can be a challenge when disseminating hazard planning and mitigation resources to the general public, and it is less likely they will be prepared if special attention is not given to language and culturally appropriate outreach techniques.

There are various languages spoken across Washington County; the primary language is English. Overall, 9.3% of the total population in Washington County is not proficient in English. Hillsboro (11,276, 12.8%) and Beaverton (9,586, 11.1%) have the largest population of residents who do not speak English "very well". Outreach materials used to communicate with, plan for, and respond to non-English speaking populations should take into consideration the language needs of these populations.

Table C-4 Washington County Language Barriers

	Population 5 years and over	Speak English less than "very well"	
	Estimate	Estimate	Percent
Washington County	510,100	47,624	9.3%
Beaverton	86,634	9,586	11.1%
Forest Grove	20,563	1,743	8.5%
Hillsboro	88,088	11,276	12.8%
Sherwood	17,078	634	3.7%
Tigard	46,831	4,008	8.6%
Other Incorporated*	37,440	2,705	7.2%

Source: U.S. Census Bureau, 2010-2014 American Community Survey, Table DP02
* The "other incorporated" cities include: Banks, Cornelius, Durham, Gaston, King City, and North Plains.

Race

The impact in terms of loss and the ability to recover may also vary among minority population groups following a disaster. Studies have shown that racial and ethnic minorities can be more vulnerable to natural disaster events. This is not reflective of individual characteristics; instead, historic patterns of inequality along racial or ethnic divides have often resulted in minority communities that are more likely to have inferior building stock, degraded infrastructure, or less access to public services. The table below describes Washington County's population by race and ethnicity.

The majority of the population in Washington County is racially white (77.4%); Beaverton and Hillsboro have the largest percentage of non-white population (27.1%). Approximately, 16% of the population is Hispanic or Latino; the cities of Hillsboro (24.1%) and Forest Grove (22.3%) have the highest percentages of Hispanic or Latino residents.

Table C-5 Washington Race and Hispanic or Latino Origin

	Washington County	Beaverton	Forest Grove	Hillsboro	Sherwood	Tigard	Other Incorporated*
Total Population	547,451	92,593	22,070	95,765	18,687	49,633	21,016
White	77.4%	72.9%	82.9%	72.9%	88.7%	83.3%	83.2%
Black	1.8%	2.5%	0.5%	1.5%	0.1%	1.4%	0.6%
AIAN	0.8%	0.8%	0.6%	1.3%	0.1%	0.5%	1.8%
Asian	9.0%	12.3%	2.7%	8.8%	4.3%	6.3%	1.7%
NHPI	0.5%	0.7%	0.1%	0.8%	0.6%	0.5%	0.0%
Some Other Race	6.3%	6.8%	9.1%	9.6%	2.3%	3.7%	9.5%
Two or More Races	4.3%	4.1%	4.2%	5.2%	3.9%	4.2%	3.1%
Hispanic or Latino	87,650	14,661	4,925	23,110	1,217	5,586	6,603
Percent	16.0%	15.8%	22.3%	24.1%	6.5%	11.3%	31.4%

Source: Social Explorer, Table T12, U.S. Census Bureau, 2010-2014 American Community Survey
AIAN = American Indian and Alaskan Native, NHPI = Native Hawaiian and Other Pacific Islanders
* The "other incorporated" cities include: Banks, Cornelius, Durham, Gaston, King City, and North Plains.

It is important to identify specific ways to support all portions of the community through hazard mitigation, preparedness, and response. Culturally appropriate, and effective outreach can include both methods and messaging targeted to diverse audiences. For example, connecting to historically disenfranchised populations through already trusted sources or providing preparedness handouts and presentations in the languages spoken by the population will go a long way to increasing overall community resilience.

Gender

Washington County has slightly more females than males (Female 50.8%, Male: 49.2%).[7] It is important to recognize that women tend to have more institutionalized obstacles than men during recovery due to sector-specific employment, lower wages, and family care responsibilities.[8]

[7] Social Explorer, Table T12, U.S. Census Bureau, 2010-2014 American Community Survey

[8] Ibid.

Age

Of the factors influencing socio demographic capacity, the most significant indicator in Washington County may be age of the population. As depicted in the table below, as of 2014, 11.0% of the county population is over the age of 64, a percentage that is projected to rise to 19.1% by 2035. The Washington County age dependency ratio[9] is 46.7; Forest Grove (53.0), Sherwood (55.8), and the smaller incorporated communities (58.7) have the highest age dependency ratios (Beaverton has the lowest ratio, 43.0). The age dependency ratio indicates a higher percentage of dependent aged people to that of working age. The Oregon Office of Economic Analysis projects that, in 2035, there will be a higher percentage of the overall population over the age of 64. As the population ages, the county may need to consider different mitigation and preparedness actions to address the specific needs of this group. The age dependency ratio is expected to be 62.9 in 2035, largely because of the rise in the older age cohorts.

Table C-6 Washington Population by Vulnerable Age Groups

Jurisdiction	Total	< 15 Years Old		> 64 Years Old		15 to 64 Years Old	Age Dependency Ratio
		Number	Percent	Number	Percent		
Washington County	547,451	114,133	20.8%	60,029	11.0%	373,289	46.7
Beaverton	92,593	18,157	19.6%	9,707	10.5%	64,729	43.0
Forest Grove	22,070	4,690	21.3%	2,955	13.4%	14,425	53.0
Hillsboro	95,765	21,664	22.6%	8,019	8.4%	66,082	44.9
Sherwood	18,687	5,180	27.7%	1,514	8.1%	11,993	55.8
Tigard	49,633	8,924	18.0%	6,784	13.7%	33,925	46.3
Other Incorporated*	21,016	4,719	22.5%	3,054	14.5%	13,243	58.7
2035							
Oregon	4,995,200	865,889	17.3%	1,082,781	21.7%	3,046,530	64.0
Washington County	782,316	152,300	19.5%	149,754	19.1%	480,262	62.9

Source: Social Explorer, Table 17, U.S. Census Bureau, 2010-2014 American Community Survey, Office of Economic Analysis, Long-Term County Population Forecast, 2010-2050 (2013 release).
* The "other incorporated" cities include: Banks, Cornelius, Durham, Gaston, King City, and North Plains.

The age profile of an area has a direct impact both on what actions are prioritized for mitigation and how response to hazard incidents is carried out. School age children rarely make decisions about emergency management. Therefore, a larger youth population in an area will increase the importance of outreach to schools and parents on effective ways to teach children about fire safety, earthquake response, and evacuation plans. Furthermore, children are more vulnerable to the heat and cold, have few transportation options and require assistance to access medical facilities. Older populations may also have special needs prior to, during and after a natural disaster. Older populations may require assistance in evacuation due to limited mobility or health issues. Additionally, older populations may

[9] The age dependency ratio is derived by dividing the combined under 15 and 65-and-over populations by the 15-to-64 population and multiplying by 100. A number close to 50 indicates about twice as many people are of working age than non-working age. A number that is closer to 100 implies an equal number of working age population as non-working age population. A higher number indicates greater sensitivity.

require special medical equipment or medications, and can lack the social and economic resources needed for post-disaster recovery.[10]

Families and Living Arrangements

Two ways the census defines households are by type of living arrangement and family structure. A householder may live in a "family household" (a group related to one another by birth, marriage or adoption living together); in a "nonfamily household" (a group of unrelated people living together); or alone. Washington County is predominately comprised of family households (67.5%). Of all households[11], 25.2% are one-person non-family households (householder living alone). Beaverton (11,150, 30.1%) has the highest percentage, and largest population of householders living alone. Approximately 8.5% of all households are individuals 65 years or older living alone.

Table C-7 Householder Living Alone

	Total Households	Householder Living Alone		Householder Living Alone > 64	
	Estimate	Estimate	Percent	Estimate	Percent
Washington County	203,901	51,414	25.2%	17,268	8.5%
Beaverton	37,028	11,150	30.1%	3,418	9.2%
Forest Grove	7,686	1,910	24.9%	914	11.9%
Hillsboro	33,559	8,339	24.8%	2,184	6.5%
Sherwood	6,532	1,247	19.1%	581	8.9%
Tigard	19,694	5,308	27.0%	2,045	10.4%
Other Incorporated*	7,266	2,023	27.8%	1,217	16.7%

Source: U.S. Census Bureau, 2010-2014 American Community Survey, Table DP02
* The "other incorporated" cities include: Banks, Cornelius, Durham, Gaston, King City, and North Plains.

The table below shows household structures for families with children. Nearly 22% of all households within the county are family households that have children; Adair Village has the highest percentage of family households with children (63.7%) and Corvallis has the largest number (4,292). There are about four times as many single parent households that are headed by females than by males; Adair Village (18.0%) has the highest percentage of single parent households, while Corvallis (861) has the largest number (excluding Albany). These populations will likely require additional support during a disaster and will inflict strain on the system if improperly managed.

[10] Wood, Nathan. Variations in City Exposure and Sensitivity to Tsunami Hazards in Oregon. U.S. Geological Survey, Reston, VA, 2007.

[11] Social Explorer Table SE17, 2010-2014 American Community Survey

Table C-8 Family Households with Children by Head of Household

	Total Households	Married-Couple with Children		Single Parent with Children	
	Estimate	Estimate	Percent	Estimate	Percent
Washington County	203,901	52,948	26.0%	18,536	9.1%
Beaverton	37,028	7,687	20.8%	3,464	9.4%
Forest Grove	7,686	2,024	26.3%	889	11.6%
Hillsboro	33,559	9,272	27.6%	3,838	11.4%
Sherwood	6,532	2,646	40.5%	526	8.1%
Tigard	19,694	4,591	23.3%	1,469	7.5%
Other Incorporated*	7,266	3,709	51.0%	1,124	15.5%

Source: Social Explorer, Table T18, U.S. Census Bureau, 2010-2014 American Community Survey
Note: The table shows the percent of total households represented by each family household structure category.
* The "other incorporated" cities include: Banks, Cornelius, Durham, Gaston, King City, and North Plains.

Income

Household income and poverty status are indicators of socio demographic capacity and the stability of the local economy. Household income can be used to compare economic areas as a whole, but does not reflect how the income is divided among the area residents. Between 2010 and 2014 the share of households making less than $15,000 increased more than other income cohorts; the next largest cohort gain was for households earning between $15,000 and $29,999.

Table C-9 Household Income

	2010^		2014		Change in Share	
Household Income	Households	Percent	Households	Percent	Households	Percent
Less than $15,000	13,513	6.9%	17,125	8.4%	3,612	1.5%
$15,000-$29,999	22,946	11.7%	25,361	12.4%	2,415	0.8%
$30,000-$44,999	25,786	13.1%	27,045	13.3%	1,259	0.1%
$45,000-$59,999	23,757	12.1%	25,095	12.3%	1,338	0.2%
$60,000-$74,999	21,128	10.8%	20,904	10.3%	-224	-0.5%
$75,000-$99,999	27,713	14.1%	29,695	14.6%	1,982	0.5%
$100,000-$199,999	48,504	24.7%	47,631	23.4%	-873	-1.3%
$200,000 or more	13,091	6.7%	11,045	5.4%	-2,046	-1.2%

Source: Social Explorer, Table 56, U.S. Census Bureau, 2010-2014 American Community Survey and 2006-2010 American Community Survey
^ 2010 dollars are adjusted for 2014 using the Social Explorers Inflation Calculator.

The 2014 median household income across Washington County is $65,272; this is lower than the inflation adjusted 2010 figure, representing a 4.1% decline in real incomes. Sherwood ($84,360) and Hillsboro ($66,668) have the highest median household incomes, while Forest Grove ($48,365) and the other incorporated cities ($51,705) have the lowest median household incomes. The table below shows decreases in real incomes across Washington County and cities (except for Hillsboro which slightly increased).

Table C-10 Median Household Income

	Median Household Income			Percent Change
		2010^	2014	
Washington County	$	67,968	$65,272	-4.1%
Beaverton	$	60,062	$57,068	-5.2%
Forest Grove	$	51,373	$48,365	-6.2%
Hillsboro	$	65,927	$66,668	1.1%
Sherwood	$	89,697	$84,360	-6.3%
Tigard	$	67,428	$60,849	-10.8%
Other Incorporated*	$	64,533	$51,705	-24.8%

Source: Social Explorer, Table 57, U.S. Census Bureau, 2010-2014 American Community Survey and 2006-2010 American Community Survey
^ 2010 dollars are adjusted for 2014 using the Social Explorers Inflation Calculator.
* The "other incorporated" cities include: Banks, Cornelius, Durham, Gaston, King City, and North Plains.

The table below identifies the percentage of individuals and cohort groups that are below the poverty level in 2014. It is estimated that 11.8% of individuals and 15.7% of children under 18 live below the poverty level across the county. Forest Grove (17.2%, 3,626) has the highest percent of individuals in poverty, while Beaverton (14.7%, 13,502) and Hillsboro (14.1%, 13,331) have the largest number of individuals in poverty. Forest Grove (22.3%) and Beaverton (14.7%) have the highest poverty rates for children.

Table C-11 Poverty Rates

	Total Population in Poverty		Children Under 18 in Poverty		18 to 64 in Poverty		65 or over in Poverty	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Washington County	64,022	11.8%	21,115	15.7%	38,573	11.1%	4,334	7.3%
Beaverton	13,502	14.7%	4,335	20.9%	8,209	13.3%	958	10.0%
Forest Grove	3,626	17.2%	1,286	22.3%	1,878	15.1%	462	16.2%
Hillsboro	13,331	14.1%	5,015	19.6%	7,606	12.4%	710	9.1%
Sherwood	1,249	6.7%	399	6.7%	689	6.2%	161	10.6%
Tigard	5,249	10.6%	1,472	13.8%	3,379	10.5%	398	5.9%
Other Incorporated*	2,471	11.9%	889	16.4%	1,346	10.9%	236	7.9%

Source: Social Explorer Table 115, U.S. Census Bureau, 2010-2014 American Community Survey.
* The "other incorporated" cities include: Banks, Cornelius, Durham, Gaston, King City, and North Plains.

Cutter's research suggests that lack of wealth contributes to social vulnerability because individual and community resources are not as readily available. Affluent communities are more likely to have both the collective and individual capacity to more quickly rebound from a hazard event, while impoverished communities and individuals may not have this capacity –leading to increased vulnerability. Wealth can help those affected by hazard incidents to absorb the impacts of a disaster more easily. Conversely, poverty, at both an individual and community level, can drastically alter recovery time and quality.[12]

[12] Cutter, S. L. (2003). Social Vulnerability to Environmental Hazards. *Social Science Quarterly*.

Federal assistance programs such as food stamps are another indicator of poverty or lack of resource access. Statewide social assistance programs like the Supplemental Nutritional Assistance Program (SNAP) and Temporary Assistance for Needy Families (TANF) provide assistance to individuals and families. In Washington County, TANF reaches approximately 1,774 families per month and SNAP helps to feed about 59,723 people (30,576 households) per month.[13] Those reliant on state and federal assistance are more vulnerable in the wake of disaster because of a lack of personal financial resources and reliance on government support.

Education

Educational attainment of community residents is also identified as an influencing factor in socio demographic capacity. Educational attainment often reflects higher income and therefore higher self-reliance. Widespread educational attainment is also beneficial for the regional economy and employment sectors as there are potential employees for professional, service and manual labor workforces. An oversaturation of either highly educated residents or low educational attainment can have negative effects on the resiliency of the community.

According to the U.S. Census, 90.6% of the Washington County population over 25 years of age has graduated from high school or received a high school equivalency, with 39.8% going on to earn a Bachelor's Degree. Forest Grove (84.4%), Hillsboro (86.8%) and the other incorporated cities (80.1%) have the lowest percentages of high school graduates. Beaverton (43.4%), Sherwood (43.2%), and Tigard (41.5%) have the highest percentage of their population with a Bachelor's degree or higher, and Forest Grove (22.5%) has the lowest percentage.

Table C-12 Educational Attainment

	Washington County	Beaverton	Forest Grove	Hillsboro	Sherwood	Tigard	Other Incorporated*
Population 25 years and over	365,774	62,962	13,488	61,515	11,583	34,392	13,563
Less than high school	9.4%	9.0%	15.7%	13.2%	3.5%	8.1%	20.0%
High school graduate or GED	19.1%	17.7%	30.3%	20.8%	15.0%	16.1%	27.0%
Some college, no degree	31.7%	29.8%	31.6%	32.3%	38.4%	34.5%	35.0%
Bachelor's degree	25.8%	29.2%	14.3%	20.4%	30.5%	27.8%	13.2%
Graduate or professional degree	14.0%	14.2%	8.2%	13.3%	12.7%	13.7%	4.9%
Percent without Highschool Degree	*9.4%*	*9.0%*	*15.7%*	*13.2%*	*3.5%*	*8.1%*	*20.0%*
Percent High School Graduate or Higher	*90.6%*	*90.9%*	*84.4%*	*86.8%*	*96.6%*	*92.1%*	*80.1%*
Percent Bachelor's Degree or Higher	*39.8%*	*43.4%*	*22.5%*	*33.7%*	*43.2%*	*41.5%*	*18.1%*

Source: Social Explorer, Table 25,U.S. Census Bureau, 2010-2014 American Community Survey, Table DP02.
* The "other incorporated" cities include: Banks, Cornelius, Durham, Gaston, King City, and North Plains.

Health

Individual and community health play an integral role in community resiliency, as indicators such as health insurance, people with disabilities, dependencies, homelessness and crime

[13] Sabatino, J. (2016). *Oregon TANF Caseload FLASH, "One and Two Parent Families Combined",* District 16; May 2016 data, and Sabatino, J. (2016). *Oregon SNAP Program Activity, "SSP, APD and AAA Combined",* District 16; May 2016 data. Retrieved from State of Oregon Office of Business Intelligence website: http://www.oregon.gov/DHS/ASSISTANCE/Pages/Data.aspx, June 2016.

rate paint an overall picture of a community's well-being. These factors translate to a community's ability to prepare, respond to, and cope with the impacts of a disaster.

The Resilience Capacity Index recognizes those who lack health insurance or are impaired with sensory, mental or physical disabilities, have higher vulnerability to hazards and will likely require additional community support and resources. The "other" incorporated cities (21.4%) have the highest percentage of population in Washington County without health insurance. The percentage of uninsured changes with age, the highest rates of uninsured are within the 18 to 64-year cohort; the other incorporated cities have the highest rate of this age group that is uninsured while Beaverton (12,626) and Hillsboro (12,005) have the largest population uninsured in this age cohort. The ability to provide services to the uninsured populations may burden local providers following a natural disaster. Between 2012 and 2014 there was a drop in the percent of uninsured Washington County residents, declining from 13.2% to 9.3% uninsured (approximately 52,000 uninsured); presumably this is a result of enrollment in health care coverage through the Affordable Care Act (ACA) coverage expansion.[14]

Table C-13 Health Insurance Coverage

		Without Health Insurance							
		Total Population		Under 18 years		18 to 64 years		65+	
Jurisdiction	Population^	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Washington County	543,990	70,879	13.0%	7,468	5.5%	62,807	18.0%	604	1.0%
Beaverton	92,224	13,881	15.1%	1,170	5.5%	12,626	20.6%	85	0.9%
Forest Grove	21,944	2,754	12.6%	341	5.8%	2,308	17.4%	105	3.7%
Hillsboro	94,843	13,805	14.6%	1,618	6.3%	12,005	19.6%	182	2.3%
Sherwood	18,617	913	4.9%	97	1.6%	800	7.3%	16	1.1%
Tigard	49,504	7,025	14.2%	721	6.7%	6,291	19.6%	13	0.2%
Other Incorporated*	20,894	4,468	21.4%	574	10.5%	3,785	30.5%	109	3.7%

Source: Social Explorer, Table 145, U.S. Census Bureau, 2010-2014 American Community Survey.
^Non-institutionalized population
* The "other incorporated" cities include: Banks, Cornelius, Durham, Gaston, King City, and North Plains.

The table below describes disability status of the population. As of 2014, 9.7% of the Washington County non-institutionalized population identifies with one or more disabilities. Forest Grove has the highest percentage of its total population with a disability (15.1%). Forest Grove also has the highest percentage of individuals under 18 (15.1%) and 65 years and over with a disability (52.8%).

[14] Oregon Health Authority, Impacts of the Affordable Care Act on Health Insurance Coverage in Oregon: County Results/ Statewide Update. February 2015, https://www.ohsu.edu/xd/research/centers-institutes/center-for-health-systems-effectiveness/upload/Health-Insurance-Coverage-in-Oregon-County-Results.pdf

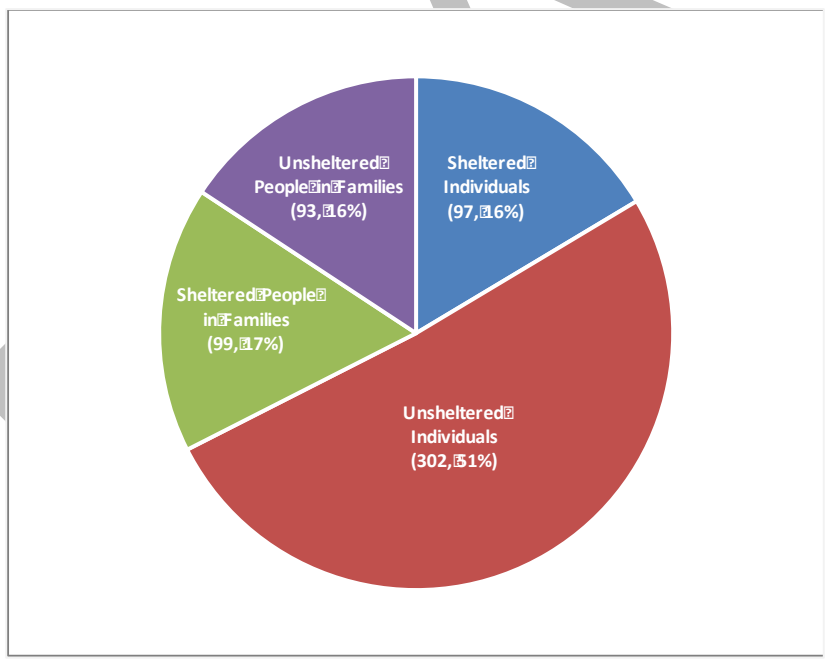
Table C-14 Disability Status

	Total Population^ Estimate	With a disability Estimate	With a disability Percent	Under 18 years with a disability Estimate	Under 18 years with a disability Percent^^	65 years and over with a disability Estimate	65 years and over with a disability Percent^^
Washington County	543,990	52,989	9.7%	4,428	3.2%	19,594	33.1%
Beaverton	92,224	9,502	10.3%	714	3.4%	3,352	35.0%
Forest Grove	21,944	3,324	15.1%	269	4.6%	1,504	52.8%
Hillsboro	94,843	8,751	9.2%	795	3.1%	2,960	37.7%
Sherwood	18,617	1,377	7.4%	233	3.8%	572	37.8%
Tigard	49,504	5,081	10.3%	230	2.1%	2,179	32.5%
Other Incorporated*	20,894	2,464	11.8%	215	3.9%	1,120	37.5%

Source: U.S. Census Bureau, 2010-2014 American Community Survey, Table DP02.
^Non-institutionalized population, ^^Percent of age group
* The "other incorporated" cities include: Banks, Cornelius, Durham, Gaston, King City, and North Plains.

In 2015, Oregon Housing and Community Services (OHCS) conducted a point-in-time homeless count to identify the number of homeless, their age and their family type. The OHCS study found that 591 individuals and persons in families in Washington County identify as homeless; 196 were sheltered (97 individuals and 99 persons in families), 395 were unsheltered (302 individuals and 93 persons in families).

Figure C-3 Washington County PIT Homeless Count (2015)



Source: Oregon Housing and Community Services, 2015 Point-in-Time Homeless Count

The homeless have little resources to rely on, especially during an emergency. It will likely be the responsibility of the county and local non-profit entities to provide services such as shelter, food and medical assistance. Therefore, it is critical to foster collaborative relationships with agencies that will provide additional relief such as the American Red Cross

and homeless shelters. It will also be important to identify how to communicate with these populations, since traditional means of communication may not be appropriate or available.

Synthesis

For planning purposes, it is essential Washington County consider both immediate and long-term socio-demographic implications of hazard resilience. Immediate concerns include the growing elderly population and language barriers associated with a culturally diverse community. Even though the vast majority of the population is reported as proficient in English, there is still a segment of the population not proficient in English. These populations would serve to benefit from mitigation outreach, with special attention to cultural, visual and technology sensitive materials. The current status of other social/-demographic capacity indicators such as graduation rate, poverty level, and median household income can have long-term impacts on the economy and stability of the community ultimately affecting future resilience.

In mitigation and preparedness planning it is critical for the safety of all residents that messaging and actions are culturally sensitive to all racial and ethnic groups. This may range from providing multi-lingual services to adopting entirely different strategies for outreach or specialized mitigation actions to address the unique risk faced by various racial and ethnic groups. For example, if multigenerational family units are more typical in some cultures, evacuation may be more take longer to accommodate the elderly and children living at home, or could even be impeded if there is only one family car. Additionally, varying cultural perceptions of the trustworthiness of government may need to be overcome so that suggestions to evacuate or shelter in place are taken seriously by residents.

Economic Capacity

Economic capacity refers to the financial resources present and revenue generated in the community to achieve a higher quality of life. Income equality, housing affordability, economic diversification, employment and industry are measures of economic capacity. However, economic resilience to natural disasters is far more complex than merely restoring employment or income in the local community. Building a resilient economy requires an understanding of how the component parts of employment sectors, workforce, resources and infrastructure are interconnected in the existing economic picture. Once any inherent strengths or systematic vulnerabilities become apparent, both the public and private sectors can take action to increase the resilience of the local economy.

Regional Affordability

The evaluation of regional affordability supplements the identification of Social/demographic capacity indicators, i.e. median income, and is a critical analysis tool to understanding the economic status of a community. This information can capture the likelihood of individuals' ability to prepare for hazards, through retrofitting homes or purchasing insurance. If the community reflects high-income inequality or housing cost burden, the potential for home-owners and renters to implement mitigation can be drastically reduced. Therefore, regional affordability is a mechanism for generalizing the abilities of community residents to get back on their feet without Federal, State or local assistance.

Income Equality

Income equality is a measure of the distribution of economic resources, as measured by income, across a population. It is a statistic defining the degree to which all persons have a similar income. The table below illustrates the county and cities level of income inequality. The Gini index is a measure of income inequality. The index varies from zero to one. A value of one indicates perfect inequality (only one household has any income). A value of zero indicates perfect equality (all households have the same income).[15]

The cities within the county have similar income equality scores; Sherwood, Hillsboro, and the smaller cities have slightly greater income equality than do Tigard, Beaverton, and Forest Grove. Based on social science research, the region's cohesive response to a hazard event may be affected by the distribution of wealth in communities that have less income equality[16].

[15]University of California Berkeley. Building Resilient Regions, Resilience Capacity Index. http://brr.berkeley.edu/rci/.

[16] Susan Cutter, Christopher G. Burton, and Christopher T. Emrich. 2010. "Disaster Resilience Indicators for Benchmarking Baseline Conditions," Journal of Homeland Security and Emergency Management 7, no.1: 1-22

Table C-15 Regional Income Equality

Jurisdiction	Income Inequality Coefficient
Washington County	0.430
Beaverton	0.430
Forest Grove	0.430
Hillsboro	0.390
Sherwood	0.370
Tigard	0.440
Other Incorporated*	n/a

Source: Social Explorer, Table 157, U.S. Census Bureau, 2010-2014 American Community Survey
* The "other incorporated" cities include: Banks, Cornelius, Durham, Gaston, King City, and North Plains.

Housing Affordability

Housing affordability is a measure of economic security gauged by the percentage of an area's households paying less than 35% of their income on housing.[17] Households spending more than 35% are considered housing cost burdened. The table below displays the percentage of homeowners and renters reflecting housing cost burden across the region.

Amongst homeowners with a mortgage, Sherwood has the highest percent with a housing cost burden. Among renters, the smaller cities, Forest Grove, and Tigard renters have the highest percent of households with housing cost burdens. In general, the population that spends more of their income on housing has proportionally fewer resources and less flexibility for alternative investments in times of crisis.[18] This disparity imposes challenges for a community recovering from a disaster as housing costs may exceed the ability of local residents to repair or move to a new location. These populations may live paycheck to paycheck and are extremely dependent on their employer, in the event their employer is also impacted it will further the detriment experienced by these individuals and families.

[17] University of California Berkeley. Building Resilient Regions, Resilience Capacity Index. http://brr.berkeley.edu/rci/.

[18] Ibid.

Table C-16 Households Spending > 35% of Income on Housing

Jurisdiction	Owners		Renters
	With Mortgage	Without Mortgage	
Washington County	35.2%	4.5%	48.1%
Beaverton	37.6%	4.0%	47.4%
Forest Grove	33.6%	4.2%	56.8%
Hillsboro	32.2%	4.6%	44.8%
Sherwood	42.5%	1.7%	43.7%
Tigard	35.9%	4.5%	50.0%
Other Incorporated*	39.5%	9.7%	63.5%

Source: Social Explorer, Tables 103 and 109, U.S. Census Bureau, 2010-2014 American Community Survey
* The "other incorporated" cities include: Banks, Cornelius, Durham, Gaston, King City, and North Plains.

Economic Diversity

Economic diversity is a general indicator of an area's fitness for weathering difficult financial times. Business activity in the Willamette Valley region is fairly homogeneous and consists mostly of small businesses.

Economic diversity is a general indicator of an area's fitness for weathering difficult financial times. One method for measuring economic diversity is through use of the Herfindahl Index, a formula that compares the composition of county and regional economies with those of states or the nation as a whole. Using the Herfindahl Index, a diversity ranking of 1 indicates the county with the most diverse economic activity compared to the state as a whole, while a ranking of 36 corresponds with the least diverse county economy. The table below describes the Herfindahl Index Scores for counties in the region.

Table C-17 shows that Washington County has an economic diversity rank of 16, this is on a scale between all 36 counties in the state where 1 is the most diverse economic county in Oregon and 36 is the least diverse.

Table C-17 Regional Herfindahl Index Scores

County	2008			2013		
	Employment	Number of Industries	State Rank	Employment	Number of Industries	State Rank
Clackamas	132,209	266	1	127,242	267	1
Columbia	8,683	171	8	7,881	166	11
Multnomah	380,236	280	2	381,347	281	2
Waschington	225,776	260	14	235,258	261	16

Source: Oregon Employment Department

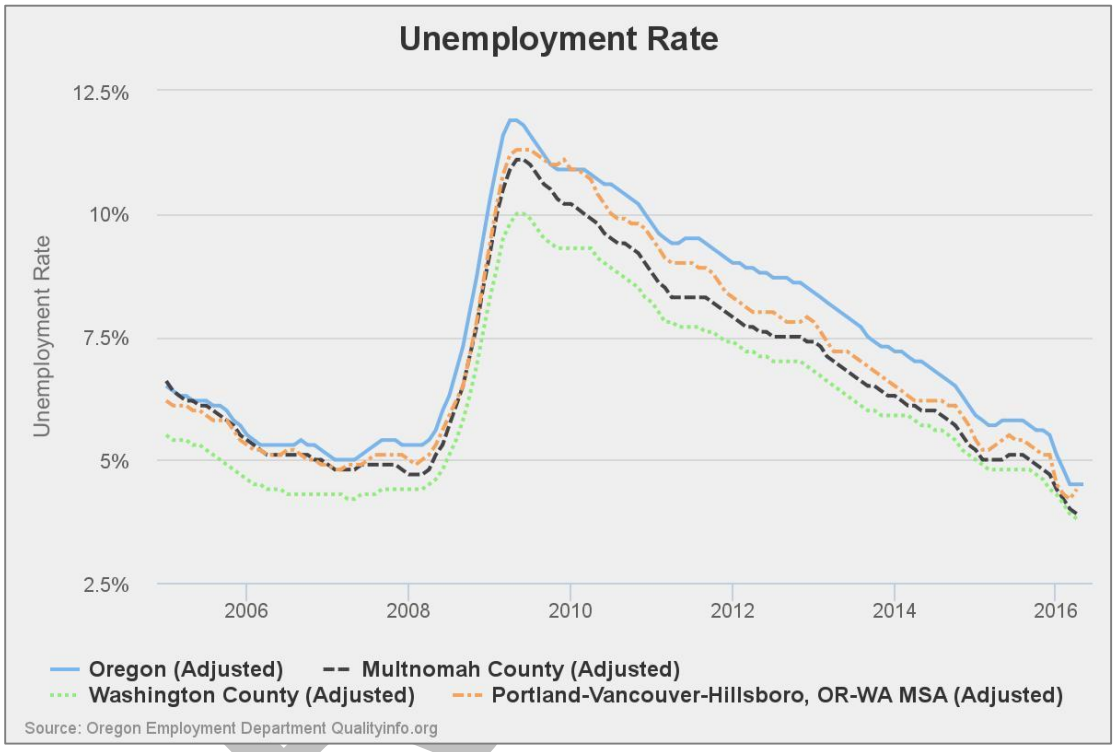
While illustrative, economic diversity is not a guarantor of economic vitality or resilience. Washington County, as of 2015, is listed as an economically non-distressed community as prescribed by Oregon Law. The economic distress measure is based on indicators of

decreasing new jobs, average wages and income, and is associated with an increase of unemployment.[19]

Employment and Wages

According to the Oregon Employment Department, unemployment has declined since 2010 and remains lower than the rate for Oregon.

Figure C-4 Unemployment Rate



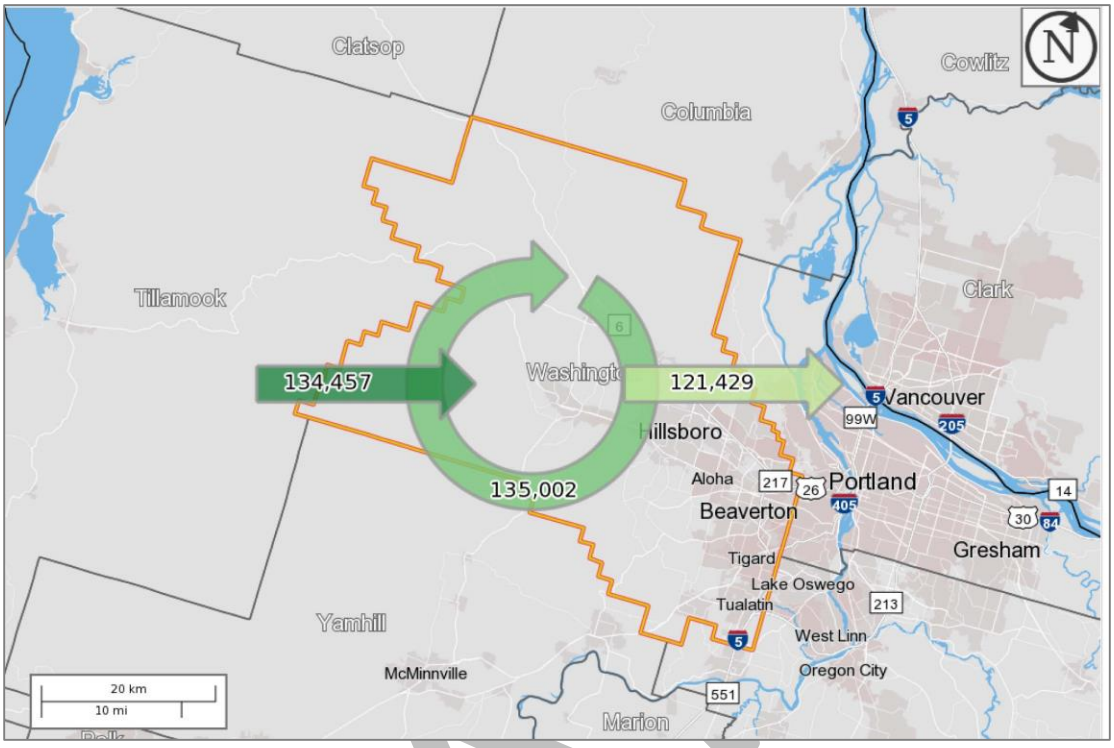
Source: Oregon Employment Department, "Local Area Employment Statistics".

Table C-18 (below) displays the payroll and employee figures for Washington County. As of 2014, there were roughly 275,000 individuals employed in the county, with an average wage of $65,610.

Washington County employers draw in 50% of their workers from outside the county. The Washington County economy is a cornerstone of regional economic vitality. Figure C-5 shows the county's laborshed; the map shows that about 50% of workers live and work in the county (135,002), 50% of workers come from outside the county (134,457), and about 47% of residents work outside of the county (121,429).

[19] Business Oregon – Oregon Economic Data "Distressed Communities List", http://www.oregon4biz.com/Publications/Distressed-List/

Figure C-5 Washington County Laborshed



Source: U.S. Bureau of the Census, On The Map.

Mitigation activities are needed at the business level to ensure the health and safety of workers and limit damage to industrial infrastructure. Employees are highly mobile, commuting from all over the surrounding area to industrial and business centers. As daily transit rises, there is an increased risk that a natural hazard event will disrupt the travel plans of residents across the region and seriously hinder the ability of the economy to meet the needs of Washington County residents and businesses.

Approximately 85% of commuters travel by car; 75% of these individuals commute alone while 10% carpool[20]. Increased commuting creates a greater dependency on roads, communications, accessibility, and, in the event of a hazard incident, emergency evacuation routes to reunite people with their families. Before a natural hazard event, large or small businesses can develop strategies to prepare for natural hazards, respond efficiently, and prevent loss of life and property.

Industry

Key industries are those that represent major employers and are significant revenue generators. Different industries face distinct vulnerabilities to natural hazards, as illustrated by the industry specific discussions below. Identifying key industries in the region enables communities to target mitigation activities towards those industries' specific sensitivities. It is important to recognize that the impact that a natural hazard event has on one industry can reverberate throughout the regional economy.

[20] Social Explorer, U.S. Census Bureau, 2010-2014 American Community Survey. Table T128

This is of specific concern when the businesses belong to the basic sector industry. Basic sector industries are those that are dependent on sales outside of the local community; they bring money into a local community via employment. The farm and ranch, information, and wholesale trade industries are all examples of basic industries. Non-basic sector industries are those that are dependent on local sales for their business, such as retail trade, construction, and health services.

Employment by Industry

Economic resilience to natural disasters is particularly important for the major employment industries in the region. If these industries are negatively impacted by a natural hazard, such that employment is affected, the impact will be felt throughout the regional economy. Thus, understanding and addressing the sensitivities of these industries is a strategic way to increase the resiliency of the entire regional economy.

The table below identifies Employment by industry. The top five industry sectors in Washington County with the most employees, as of 2014, are Professional and Business Services (52,826), Trade, Transportation and Utilities (48,114), Manufacturing (47,175), Education and Health Services (33,106), and Health Care and Social Assistance (27,915). While Washington County has some basic industries, such as Manufacturing; four out of their five largest industrial sectors are of the non-basic nature and thus they rely on local sales and services. Trending towards basic industries can lead to higher community resilience.

Key Resources

- **Commercial facilities**: The Washington County Visitors Association boasts shopping as a major attraction. Oregon has no sales tax and the Metro Region is easily accessible by residents of Washington State. There are several well- developed shopping destinations in the county including Washington Square Mall, Streets of Tanasbourne, Bridgeport Village Mall, and Cedar Hills Crossing.
- **Critical manufacturing**: Washington County is home to a number of large technology companies including Intel and Tektronix. These campuses have both software development and manufacturing components.

Table C-18 Total Employment by Industry 2015, Expected Growth 2024

Jurisdiction	2015 Firms	2015 Employment	2015 Percent Employment	2015 Average Wage	Percent Change in Employment	Employment Forecast^ (2014-2024)
Total Payroll Employment	18,044	274,846	100%	$ 65,610	17%	15%
Total Private	17,736	252,287	92%	$ 66,986	19%	16%
Natural Resources and Mining	210	3,144	1%	$ 32,266	-3%	12%
Construction	1,502	13,133	5%	$ 58,107	25%	23%
Manufacturing	**801**	**47,175**	**17%**	**$ 108,242**	**15%**	**8%**
Trade, Transportation & Utilities	**3,358**	**48,114**	**18%**	**$ 47,712**	**3%**	**13%**
Wholesale Trade	1,531	12,832	5%	$ 86,072	-19%	13%
Retail Trade	1,547	30,941	11%	$ 31,023	12%	14%
Information	408	7,397	3%	$ 90,290	-5%	13%
Financial Activities	1,777	14,012	5%	$ 63,354	3%	6%
Professional and Business Services	**3,777**	**52,826**	**19%**	**$ 87,454**	**56%**	**25%**
Education and Health Services	**2,055**	**33,106**	**12%**	**$ 48,417**	**16%**	**19%**
Health Care and Social Assistance	**1,765**	**27,915**	**10%**	**$ 50,800**	**17%**	**20%**
Leisure and Hospitality	1,399	24,005	9%	$ 18,977	23%	19%
Accomodations and Food Services	1,181	20,183	7%	$ 18,880	25%	20%
Other Services	2,388	9,326	3%	$ 42,581	28%	13%
Unclassified	57	45	0%	$ 51,263	-37%	-
Government	307	22,558	8%	$ 50,220	0%	6%
Federal	31	759	0%	$ 70,672	-23%	-4%
State	40	3,247	1%	$ 43,049	23%	5%
State Health Care and Social Assistance	8	1,699	1%	$ 27,122	58%	-
Local	236	18,551	7%	$ 50,641	-2%	8%
Local Government Educational Services	137	10,244	4%	$ 45,415	-6%	10%

Source: Oregon Employment Department, "2010 and 2015 Covered Employment and Wages Summary Reports" and "Regional Employment Projections by Industry & Occupation 2014-2024". http://www.qualityinfo.org. Accessed March 2016.

High Revenue Sectors

In 2012, the three sectors with the highest revenue were Retail Trade, Wholesale Trade, and Manufacturing. The table below shows the revenue generated by each economic sector (Note: not all sectors are reported). All of the sectors combined generated more than $2 billion in revenue for the county.

Washington County relies on both basic and non-basic sector industries and it is important to consider the effects each may have on the economy following a disaster. Basic sector businesses have a multiplier effect on a local economy that can spur the creation of new jobs, some of which may be non-basic. The presence of basic sector jobs can help speed the local recovery; however, if basic sector production is hampered by a natural hazard event, the multiplier effect could be experienced in reverse. In this case, a decrease in basic sector purchasing power results in lower profits and potential job losses for the non-basic businesses that are dependent on them.

Table C-19 Revenue of Top Sectors in Washington County (Employer)

Sector Meaning (NAICS code)	Sector Revenue ($1,000)	Percent of Total Revenue
Manufacturing	$ 13,525,848	33.4%
Wholesale trade	$ 8,667,640	21.4%
Retail trade	$ 8,389,744	20.7%
Health care and social assistance	$ 3,238,074	8.0%
Professional, scientific, and technical services	$ 1,788,361	4.4%
Administrative and support and waste management and remediation services	$ 1,390,697	3.4%
Real estate and rental and leasing	$ 1,207,142	3.0%
Accommodation and food services	$ 970,572	2.4%
Transportation and warehousing	$ 544,931	1.3%
Other services (except public administration)	$ 530,158	1.3%
Arts, entertainment, and recreation	$ 188,754	0.5%
Educational services	$ 99,322	0.2%
Total	$ 40,441,921	100%

Source: U.S. Census Bureau, 2012 Economic Census, Table EC1200A1.The *Manufacturing* sector was the third largest revenue generator, generating $13.5 billion. It is highly dependent upon the transportation network in order to access supplies and send finished products to outside markets. As a base industry, manufacturers are not dependent on local markets for sales, which contribute to the economic resilience of this sector.

Wholesale Trade generated nearly about $8.7 billion. Wholesale Trade is closely linked with retail trade but it has a broader client base, with local and non-local businesses as the typical clientele. Local business spending will be likely to diminish after a natural disaster, as businesses repair their properties and wait for their own retail trades to increase. Distanced clients may have difficulty reaching the local wholesalers due to transportation disruptions from a natural disaster.

The *Retail Trade* sector generated $8.4 billion, making it the largest earning sector in Washington County. The *Retail Trade* sector typically relies on local residents and tourists and their discretionary spending ability. Residents' discretionary spending diminishes after a natural disaster when they must pay to repair their homes and properties. In this situation, residents will likely concentrate their spending on essential items that would benefit some types of retail (e.g., grocery) but hurt others (e.g., gift shops). The potential income from tourists also diminishes after a natural disaster as people are deterred from visiting the impacted area. Retail trade is also largely dependent on wholesale trade and the transportation network for the delivery of good for sale. Disruption of the transportation system could have severe consequences for retail businesses. In summary, depending on the type and scale, a disaster could affect specific segments of retail trade, or all segments.

In the event that any of these primary sectors are impacted by a disaster, Washington County may experience a significant disruption of economic productivity.

Future Employment in Industry

Between 2010 and 2015 the sectors that experienced the largest percent growth were state health care and social assistance (58%), professional and business services (56%), other services (28%), accommodations and food services (25%), and construction (25%). Some of these sectors often require more training and education, while others require less education and have lower wages. Table C-9 shows that the number of residents making between

$100,000 and $200,000 declined by 1.2% while those making under $15,000 increase by 1.5%. Manufacturing and Professional and Business Services are among the highest employers, fastest growing, and have the highest average wages.

Sectors that are anticipated to be major employers in the future also warrant special attention in the hazard mitigation planning process. As shown in Table C-18, between 2014 and 2024, the largest employment growth is anticipated within Professional and Business Services (25%), Construction (23%), Health Care and Social Assistance (20%), Accommodations and Food Services (20%), and Education and Health Services (19%).[21] Retail Trade and Wholesale Trade are expected to increase by 13% and 14% respectively, while manufacturing is expected to increase by 8%.

Synthesis

The current and anticipated financial conditions of a community are strong determinants of community resilience, as a strong and diverse economic base increases the ability of individuals, families and the community to absorb disaster impacts for a quick recovery. Because Professional and Business Services, Construction, Health Care and Social Assistance, Education and Health Services, and Manufacturing are key to post-disaster recovery efforts, the region is bolstered by its major employment sectors. The county's economy is expected to grow by 2024, with much of the growth within the industries of construction, professional and business services, and education and health services industries. It is important to consider what might happen to the county economy if the largest revenue generators and employers are impacted by a disaster. Areas with less income equality, particularly in the smaller cities, higher housing costs, and overall low economic diversity are factors that may contribute to slower recovery from a disaster.

[21] Oregon Employment Department, "Employment Projections by Industry and Occupations: 2012-2022 Oregon and Regional Summary", http://qualityinfo.org/pubs/projections/projections.pdf, accessed October 2014.

Built Environment Capacity

Built Environment capacity refers to the built environment and infrastructure that supports the community. The various forms, quantity, and quality of built capital mentioned above contribute significantly to community resilience. Physical infrastructures, including utility and transportation lifelines, are critical during a disaster and are essential for proper functioning and response. The lack or poor condition of infrastructure can negatively affect a community's ability to cope, respond and recover from a natural disaster. Following a disaster, communities may experience isolation from surrounding cities and counties due to infrastructure failure. These conditions force communities to rely on local and immediately available resources.

Land Use and Development Patterns

One significant way in which Washington County residents can increase or decrease their vulnerability to natural hazards is through development patterns. The way in which land is used – is it a parking lot or maintained as a open space – will determine how closely the man-made systems of transportation, economy, etc, interact with the natural environment. All patterns of development, density as well as sprawl, bring separate sets of challenges for hazard mitigation. Current land use in Washington County includes urban development, high-tech industries, agriculture and farming activities, forests, rural residential, and recreational uses. Urban development in the county is not only regulated by county ordinance, but also by the long-range planning conducted at the regional level by the elected regional government, Metro. Metro's primary mission is to manage growth in this region. By Oregon law, Metro is the organization that establishes, reviews, and amends the Urban Growth Boundary (UGB) that separates urban from rural land. Metro, in coordination with the Counties and Cites in the region, reviews the UGB and can adjust the boundary to accommodate employment, industrial, and residential land needed for development. Buildable lands within the UGB were intended to satisfy the demands of population and employment growth for a 20-year period. The most recent expansion of the UGB occurred in 2005.

Future Development Areas

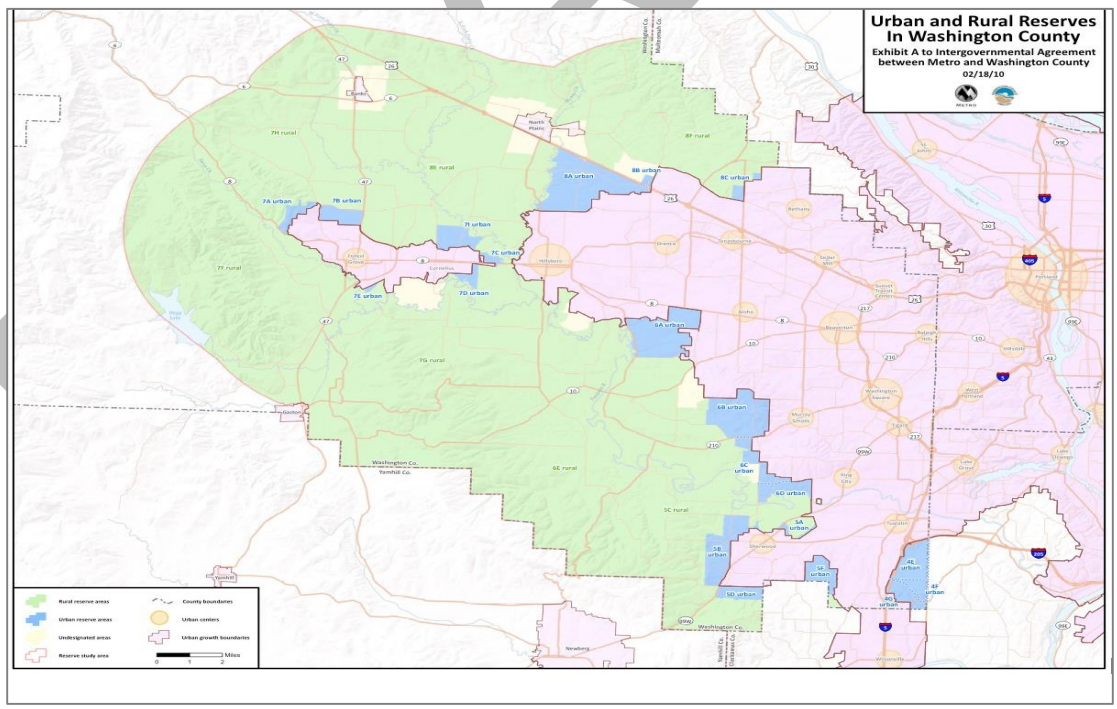
Future residential development in Washington County will be contained in two large additions to the regional urban growth boundary, in Bull Mountain and North Bethany. The county is currently completing master plans, including development codes, for these two areas. While the areas remain in unincorporated Washington County and are not likely to incorporate in the foreseeable future, they will house a larger portion of the county's future growth in mixed-use communities as the population grows. The county has been proactively addressing natural hazard risk in these planning processes. They have identified steep slopes, floodplains, and other risks, and concept planning will account for these risks and restrict development from occurring in areas of known risk. Appendix F shows current maps for these two areas that identify areas where development should not occur. More detail on areas likely to experience future growth follows:

- **North Bethany** was added into the regional Urban Grown Boundary in 2002. The area is undergoing concept planning and the county is working with stakeholders to identify land use designations. In 2009 the county began developing ordinances and

identifying funding strategies to implement the plans for parks, open space, schools, infrastructure, and neighborhood services

- **Bull Mountain** is an unincorporated community in the southeast corner of Washington County. The area lies within the regional urban growth boundary and Tigard has considered annexation of the community on several occasions, though local residents generally have resisted. The area has steep grading which causes concern for county staff and residents particularly in regards to landslides as a result of earthquake or heavy rain.
- **Urban and Rural Reserves** have been designated throughout the Metro region. The three county governments and the Metro Regional government agreed to set aside land for either: 1) incorporation into the Urban Growth Boundary in the future, or 2) preservation as agricultural, forest, or natural land. The areas are shown in Figure C-6.
    - **Urban reserve** means lands outside an urban growth boundary that will provide for: (a) future expansion over a long-term period; and (b) the cost-effective provision of public facilities and services within the area when the lands are included within the urban growth boundary.
    - **Rural reserve** means land reserved to provide long-term protection for agriculture, forestry or important natural landscape features that limit urban development or help define appropriate natural boundaries of urbanization, including plant, fish and wildlife habitat, steep slopes and floodplains.

Figure C-6 Urban and Rural Reserve Map



Source: Metro, Urban and Rural Reserve Planning Process, Washington County Map.

Regulatory Context

Oregon land use laws require land outside Urban Growth Boundaries (UGBs) to be protected for farm, forest, and aggregate resource values. For the most part, this law limits the amount of development in the rural areas. However, the land use designation can change from resource protection in one of two ways:

- The requested change could qualify as an exception to Statewide Planning Goals, in which case the city must demonstrate to the State that the change meets requirements for an exception. These lands, known as exception lands, are predominantly designated for residential use.
- Resource land can also be converted to non-resource use when it can be demonstrated to Corvallis that the land is no longer suitable for farm or forest production.

Local and state policies currently direct growth away from rural lands into UGBs, and, to a lesser extent, into rural communities. If development follows historical development trends, urban areas will expand their UGBs, rural unincorporated communities will continue to grow, and overall rural residential density will increase slightly with the bulk of rural lands kept in farm and forest use. The existing pattern of development in the rural areas, that of radiating out from the urban areas along rivers and streams is likely to continue. Most of the “easy to develop” land is already developed, in general leaving more constrained land such as land in the floodplains or on steep slopes to be developed in the future, perhaps increasing the rate at which development occurs in natural hazard areas.

Since 1973, Oregon has maintained a strong statewide program for land use planning. The foundation of that program is a set of 19 statewide planning goals that express the state's policies on land use and on related topics, such as citizen involvement, land use planning, and natural resources.

Most of the goals are accompanied by "guidelines," which are suggestions about how a goal may be applied. Oregon's statewide goals are achieved through local comprehensive planning. State law requires each city and city to adopt a comprehensive plan and the zoning and land-division ordinances needed to put the plan into effect. The local comprehensive plans must be consistent with the statewide planning goals. Plans are reviewed for such consistency by the state's Land Conservation and Development Commission (LCDC). When LCDC officially approves a local government's plan, the plan is said to be "acknowledged." It then becomes the controlling document for land use in the area covered by that plan.

Goal 7

Goal 7: Areas Subject to Natural Disasters and Hazards has the overriding purpose to “protect people and property from natural hazards”. Goal 7 requires local governments to adopt comprehensive plans (inventories, policies and implementing measures) to reduce risk to people and property from natural hazards. Natural hazards include floods, landslides, earthquakes, tsunamis, coastal erosion, and wildfires.

To comply with Goal 7, local governments are required to respond to new hazard inventory information from federal or state agencies. The local government must evaluate the hazard risk and assess the:

a) frequency, severity, and location of the hazard;
b) effects of the hazard on existing and future development;
c) potential for development in the hazard area to increase the frequency and severity of the hazard; and
d) types and intensities of land uses to be allowed in the hazard area.

Local governments must adopt or amend comprehensive plan policies and implementing measures to avoid development in hazard areas where the risk cannot be mitigated. In addition, the siting of essential facilities, major structures, hazardous facilities and special occupancy structures should be prohibited in hazard areas where the risk to public safety cannot be mitigated. The state recognizes compliance with Goal 7 for coastal and riverine flood hazards by adopting and implementing local floodplain regulations that meet the minimum National Flood Insurance Program (NFIP) requirements.

In adopting plan policies and implementing measures for protection from natural hazards local governments should consider:

a) the benefits of maintaining natural hazard areas as open space, recreation, and other low density uses;
b) the beneficial effects that natural hazards can have on natural resources and the environment; and
c) the effects of development and mitigation measures in identified hazard areas on the management of natural resources.

Local governments should coordinate their land use plans and decisions with emergency preparedness, response, recovery and mitigation programs. Given the numerous waterways and forested lands throughout Corvallis, special attention should be given to problems associated with river bank erosion and potential for wild land/urban interface fires.

Goal 7 guides local governments to give special attention to emergency access when considering development in identified hazard areas, including:

a) Consider programs to manage stormwater runoff as a means to address flood and landslide hazards,
b) Consider non-regulatory approaches to help implement the goal,
c) When reviewing development requests in high hazard areas, require site specific reports, appropriate for the level and type of hazards. Site specific reports should evaluate the risk to the site, as well as the risk the proposed development may pose to other properties.
d) Consider measures exceeding the National Flood Insurance Program.

Housing

In addition to location, the characteristics of the housing stock affect the level of risk posed by natural hazards. The table below identifies the types of housing most common throughout the county. Of particular interest are mobile homes, which account for about

2.7% of the housing in Washington County (12.2% in the smaller incorporated cities). Mobile homes are particularly vulnerable to certain natural hazards, such as windstorms, and special attention should be given to securing the structures, because they are more prone to wind damage than wood-frame construction.[22] In other natural hazard events, such as earthquakes and floods, moveable structures like mobile homes are more likely to shift on their foundations and create hazardous conditions for occupants. Beaverton has the largest number (18,609), and greatest percentage (47.4%) of multi-family housing.

Table C-20 Housing Profile

	Housing	Single Family		Multi-Family		Mobile Homes^	
	Units	Estimate	Percent	Estimate	Percent	Estimate	Percent
Washington County	215,140	143,113	66.5%	65,990	30.7%	5,908	2.7%
Beaverton	39,224	20,359	51.9%	18,609	47.4%	256	0.7%
Forest Grove	8,089	5,140	63.5%	2,414	29.8%	535	6.6%
Hillsboro	35,865	22,473	62.7%	12,892	35.9%	462	1.3%
Sherwood	6,673	5,333	79.9%	1,146	17.2%	194	2.9%
Tigard	20,811	14,066	67.6%	6,657	32.0%	72	0.3%
Other Incorporated*	7,698	5,427	70.5%	1,334	17.3%	937	12.2%

Source: Social Explorer, Table 97, U.S. Census Bureau, 2010-2014 American Community Survey
* The "other incorporated" cities include: Banks, Cornelius, Durham, Gaston, King City, and North Plains.
^ Also includes boats, RVs, vans, etc. that are used as a residence.
Note: the percentages listed in the table above do not reflect the number of structures that are built within special flood hazard areas, or that are at risk of seismic damage.

Aside from location and type of housing, the year structures were built has implications. Seismic building standards were codified in Oregon building code starting in 1974; more rigorous building code standards were passed in 1993 that accounted for the Cascadia earthquake fault.[23] Therefore, homes built before 1993 are more vulnerable to seismic events. Also in the 1970's, FEMA began assisting communities with floodplain mapping as a response to administer the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Upon receipt of floodplain maps, communities started to develop floodplain management ordinances to protect people and property from flood loss and damage.

Regionally about 20% of the housing stock was built prior to 1970, before the implementation of floodplain management ordinances; however, Forest Grove has about one-third of its housing units built prior to 1970. Countywide, about 60% of the housing stock was built before 1990 and the codification of seismic building standards. Approximately 40% of the county's housing stock was built after 1990; Hillsboro (61.3%) and Sherwood (81.1%) have the highest percentage of housing units built after 1990.

[22] Ibid.

[23] State of Oregon Building Codes Division. *Earthquake Design History: A summary of Requirements in the State of Oregon*, February 7, 2012. http://www.oregon.gov/OMD/OEM/osspac/docs/history_seismic_codes_or.pdf

Table C-21 Year Structure Built

	Total Housing Units	Pre 1970		1970 to 1989		1990 or later	
		Number	Percent of Total	Number	Percent of Total	Number	Percent of Total
Washington County	215,140	42,039	19.5%	78,603	36.5%	94,498	43.9%
Beaverton	39,224	7,372	18.8%	17,330	44.2%	14,522	37.0%
Forest Grove	8,089	2,535	31.3%	2,707	33.5%	2,847	35.2%
Hillsboro	35,865	4,654	13.0%	9,237	25.8%	21,974	61.3%
Sherwood	6,673	499	7.5%	761	11.4%	5,413	81.1%
Tigard	20,811	3,676	17.7%	9,691	46.6%	7,444	35.8%
Other Incorporated*	7,698	1,925	25.0%	2,574	33.4%	3,199	41.6%

Source: U.S. Census Bureau, 2010-2014 American Community Survey, Table DP04
* The "other incorporated" cities include: Banks, Cornelius, Durham, Gaston, King City, and North Plains.

The National Flood Insurance Program's (NFIP's) Flood Insurance Rate Maps (FIRMs) delineate flood-prone areas. They are used to assess flood insurance premiums and to regulate construction so that in the event of a flood, damage minimized. The table below shows the initial and current FIRM effective dates for Washington County communities. For more information about the flood hazard, NFIP, and FIRMs, please refer to Flood Hazard section of the Risk Assessment.

Infrastructure Profile

Infrastructure and critical facilities are vital to the continued delivery of key governmental and private services as well as recovery efforts. The loss of these services may cause serious secondary impact as well as significantly hamper the public's ability to recover from a disaster event. Homeland Security Presidential Directive 7 calls out seventeen sectors as Critical Infrastructure and Key Resources that are "essential to the nation's security, public health and safety, economic vitality, and way of life." This section identifies critical infrastructure and key resources in Washington County and includes resources emphasized in the survey of county residents. The sectors include:

Agriculture and food: This is a primarily private sector industry but includes both imported / exported food as well and what is grown in the county.

Banking and finance: For Washington County, this sector would include not only accounts payable /receivable and payroll, but social services provided to residents through community welfare programs.

Chemical: Manufacturing and agricultural processes can often require the use of chemicals and substances that would harm residents if air or water resources were contaminated.

Communications and Information technology: Phone lines, cell towers, broadcast internet, and radio and television signals are mediums for interpersonal connection, economic vitality, and emergency communications in the county. Survey respondents highlighted TV and radio as primary modes of communication. Additionally, and of importance to the region as much as to the county, weather stations such as the Doppler Radar site near northern county border, can be quickly cut off by fire or earthquake. In the case of a crisis, the ability to transmit information between responders and to residents can mean the difference between life and death.

Defense industrial base: The Oregon Military Department maintains armories in Washington County and the Oregon Army National Guard has units based in Tigard, Hillsboro, and Forest Grove.

Emergency services: 911 call centers and police and fire stations provide first responders for most hazard events and often become the base of response operations during prolonged hazard events. Population distribution and service areas as well as the availability and duplication of resources at each station can play a role in determining how, where, and when response and recovery are effective.

- **Law Enforcement**:
    - Washington County Sheriff's Office Headquarters and Jail (215 SW Adams Avenue, Hillsboro)
    - Sheriff's Office – East Precinct (3700 SW Murray Boulevard, Beaverton)
    - Sheriff's Office – City of Cornelius (1355 N Barlow, Cornelius)
    - Hillsboro Police Department (see city addendum for more information)
    - Tigard Police Department (see city addendum for more information)
- **Fire Districts:**
    - Tualatin Valley Fire and Rescue (21 stations)
    - Banks Fire District (3 stations)
    - Cornelius Fire District (1 station)
    - Forest Grove Fire and Rescue (2 stations)
    - Gaston Rural Fire District (1 station)
    - Hillsboro Fire and Rescue (5 stations)
    - Washington County Fire District #2 (2 stations)

Energy: In Washington County, electrical and gas utilities are provided by both private companies and some smaller cooperatives. Organizing mitigation across these diverse organizational structures and philosophies will ensure that services are provided equitably, even if a hazard incident stresses the supply or demand. Critical infrastructure includes power substations, gas-lines, and both underground and above ground transmission lines.

Governmental facilities: Every day, community leaders and residents rely on the buildings that house essential governmental functions: City Halls, Court Houses, public works buildings and more. Protecting and reinforcing these facilities will facilitate the return to "business as usual" after a hazard event.

Schools: Schools are occupied by vulnerable younger populations and may also be used as emergency shelters during hazard events. The following school districts are within the county:

- Banks School District (3 schools)
- Beaverton School District (51 schools)
- Forest Grove School District (10 schools)
- Gaston School District (2 schools)
- Hillsboro School District (37 schools)
- Portland School District (2 schools)
- Sherwood School District (8 schools)
- Tigard-Tualatin School District (17 schools)

- West Linn-Wilsonville School District (17 schools)
- Northwest Regional ESD (1 school)
- 47 private schools

Healthcare and public health: Hospitals, clinics, and shelters often play a critical role in the immediate aftermath of a hazard incident in saving lives and keeping residents safe. In addition to satellite clinics, doctors' offices, and urgent care facilities.

- **Hospitals:**
  - Cedar Hills Hospital (10300 SW Eastridge Street, Portland)
  - Kaiser Westside Medical Center (19301 NW Venetian Drive, Hillsboro)
  - Legacy Meridian Park Hospital (19300 SW 65th Avenue, Tualatin)
  - Providence St. Vincent Medical Center (9205 SW Barnes Road, Beaverton)
  - Tuality Forest Grove (1809 Maple Street, Forest Grove)
  - Tuality Community Hospital (335 SE 8th Avenue, Hillsboro)
  - Metro West Ambulance
- **Assisted living facilities:**
  - Beaverton – 11 facilities
  - Forest Grove – 8 facilities (1 memory care facility)
  - Hillsboro – 9 facilities
  - Portland – 6 facilities
  - Sherwood – 3 facilities
  - Tigard – 6 facilities
  - Tualatin – 5 facilities
  - West Linn – 2 facilities
  - Wilsonville – 4 facilities

Postal and shipping: The Port of Portland supports air, rail, marine, and highway transport and shipping throughout the region and U.S. The Port operates the Hillsboro Airport as well.

Transportation systems: Urban Washington County meets its current transportation needs through a mixture of municipal road systems, county roads, state and federal highways, and a regional transit system (Tri-Met). Major highways in the county include Interstate 5, State Highway 26, which runs from southeast to northwest, linking Portland to the coast, and State Highway 6, which branches off 26 and runs west to the coast. State Highway 217 is a bypass route that links Interstate 5 to Highway 26. State Highway 47 runs north south and links the western cities of Banks, Forest Grove, and Gaston to Columbia and Yamhill Counties. Tri- Met provides both bus and light rail service to the county and to the larger Portland metropolitan area. Cycling / pedestrian paths are used both for commuting and recreation and their bridges and overpasses connect communities in crucial ways. The Washington County Westside Light Rail is aligned in an east and west direction following Highways 26 and 217 to Beaverton and continues west to the Hillsboro Government Center. The MAX light rail system provides rail transit connections between Hillsboro and the east Portland suburb of Gresham.

It is important to identify bottleneck points or parts of the transportation system that are more vulnerable to failure than others. Survey respondents voiced a concern about limited egress and access in some more rural parts of the county that could be cut off from emergency services with the loss of a single road or bridge.

In Washington County, rail lines and bridges are more vulnerable to impacts from flood and earthquake as even minor shifts in their alignment can render them unusable and stop the flow of civilian and emergency service traffic on either side of the affected area.

Water: In Washington County water resources are abundant yet fragile and can even be dangerous. Water resources are susceptible to pollution from runoff or toxic spills. Low rain years can increase the risk of drought in the summer while intense periods of rain can bring floods or landslides. Rivers and their tributaries can only be managed so much by dams and culverts. Responsible development in the floodplain and throughout the county that maintains and supports and natural drainage system can help protect water resources.

2010 Survey respondents emphasized reservoirs and water treatment plants throughout the county as vital to their continued well-being. They noted that many of these facilities rely on power to pump and purify water or have storage tanks that sit vulnerable to earthquakes without retrofit or on unstable soil. Additionally, respondents called out the vulnerability of septic systems in more rural areas to power failures, severe weather, and earthquake.

Physical infrastructure such as dams, levees, roads, bridges, railways and airports support Washington County communities and economies. Due to the fundamental role that physical infrastructure plays both in pre and post-disaster, they deserve special attention in the context of creating resilient communities.

Utility systems such as potable water, wastewater, natural gas, telecommunications, and electric power are all networked systems. That is, they consist of nodes and links. Nodes are centers where something happens - such as a pumping plant, a treatment plant, a substation, a switching office and the like. Links are the connections (pipes or lines) between nodes.

Dams: These critical infrastructure pieces not only protect water resources that are used for drinking, agriculture, and recreation, but they protect downstream development from inundation. Dams may also be multifunction, serving two or more of these purposes.

The National Inventory of Dams, NID, which is maintained by the United States Army Corps of Engineers, is a database of approximately 76,000 dams in the United States. The NID does not include all dams in the United States. Rather, the NID includes dams that are deemed to have a high or significant hazard potential and dams deemed to pose a low hazard if they meet inclusion criteria based on dam height and storage volume. Low hazard potential dams are included only if they meet either of the following selection criteria:

- exceeds 25 feet in height and 15 acre-feet of storage, or
- exceeds 6 feet in height and 50-acre feet of storage.

There are many thousands of dams too small to meet the NID selection criteria. However, these small dams are generally too small to have significant impacts if they fail and thus are generally not considered for purposes of risk assessment or mitigation planning.

This NID potential hazard classification is solely a measure of the probable impacts if a dam fails. Thus, a dam classified as High Potential Hazard does not mean that the dam is unsafe or likely to fail. The level of risk (probability of failure) of a given dam is not even considered in this classification scheme. Rather, the High Potential Hazard classification simply means

that there are people at risk downstream from the dam in the inundation area, if the dam were to fail.

Dams assigned the low hazard potential classification are those where failure or mis-operation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the dam owner's property.

Dams assigned to the significant hazard potential classification are those where failure or mis-operation results in no probable loss of human life but can cause economic loss, environmental damage, or disruption of lifeline facilities. Significant hazard potential dams are often located in predominantly rural or agricultural areas.

Dams assigned to the high hazard potential classification are those where failure or mis-operation will probably cause loss of human life. Failure of dams in the high classification will generally also result in economic, environmental or lifeline losses, but the classification is based solely on probable loss of life.

Dam failures can occur at any time in a dam's life; however, failures are most common when water storage for the dam is at or near design capacity. At high water levels, the water force on the dam is higher and several of the most common failure modes are more likely to occur. Correspondingly, for any dam, the probability of failure is much lower when water levels are substantially below the design capacity for the reservoir.

For embankment dams, the most common failure mode is erosion of the dam during prolonged periods of rainfall and flooding. When dams are full and water inflow rates exceed the capacity of the controlled release mechanisms (spillways and outlet pipes), overtopping may occur. When overtopping occurs, scour and erosion of either the dam itself and/or of the abutments may lead to partial or complete failure of the dam. Especially for embankment dams, internal erosion, piping or seepage through the dam, foundation, or abutments can also lead to failure. For smaller dams, erosion and weakening of dam structures by growth of vegetation and burrowing animals is a common cause of failure.

For embankment dams, earthquake ground motions may cause dams to settle or spread laterally. Such settlement does not generally lead, by itself, to immediate failure. However, if the dam is full, relatively minor amounts of settling may cause overtopping to occur, with resulting scour and erosion that may progress to failure. For any dam, improper design or construction or inadequate preparation of foundations and abutments can also cause failures. Improper operation of a dam, such as failure to open gates or valves during high flow periods can also trigger dam failure. For any dam, unusual hydrodynamic (water) forces can also initiate failure. Landslides into the reservoir, which may occur on their own or be triggered by earthquakes, may lead to surge waves which overtop dams or hydrodynamic forces which cause dams to fail under the unexpected load. Earthquakes can also cause seiches (waves) in reservoirs that may overtop or overload dam structures. In rare cases, high winds may also cause waves that overtop or overload dam structures.

Concrete dams are also subject to failure due to seepage of water through foundations or abutments. Dams of any construction type are also subject to deliberate damage via sabotage or terrorism. For waterways with a series of dams, downstream dams are also subject to failure induced by the failure of an upstream dam. If an upstream dam fails, then downstream dams also fail due to overtopping or due to hydrodynamic forces.

Dam failures can occur rapidly and with little warning. Fortunately, most failures result in minor damage and pose little or no risk to life safety. However, the potential for severe damage still exists. The Oregon Water and Resources Department has inventoried all dams located in Oregon and Washington County. There are three dams categorized as high hazard; Key Lake located on a Tributary to McKay Creek, Trask River Barney Reservoir on the Middle Fork of the North Fork Trask River, and Scoggins located on Scoggins Creek (forming Haag Lake). There are also 15 dams categorized as significant hazard.

Table C-22 Washington County Dam Inventory

Threat Potential	Number of Dams	Dams (Rivers)
High	3	Kay Lake (Tributary to McKay Creek); Trask River Barney Reservoir (Middle Fork of North Fork Trask River); Scoggins (Scoggins Creek)
Significant	15	Hoefer-Pierson Reservoir (Christensen Creek); Dierickx, Maple Headquarters Reservoir (Tributary to Dairy Creek); Dober Reservoir (Davis Creek); Ettinger Pond (Gordon Creek); Lind Reservoir (Tributary to McKay Creek); Pierson-Upper, Unger-Bill Dam, Walters, Glenn #1 - Large, Walters, Glenn #5, Cook Reservoir (Wash), Tualatin Park, Burkhalter #2 (Tributary to Tualatin River); Jesse Enlargement; Paul Chobin Dam
Low	59	-
Total	77	-

Source: Oregon water Resources Department, "Dam Inventory Query"

Bridges: Because of earthquake risk, the seismic vulnerability of the county's bridges is an important issue. Non-functional bridges can disrupt emergency operations, sever lifelines, and disrupt local and freight traffic. These disruptions may exacerbate local economic losses if industries are unable to transport goods. The county's bridges are part of the state and interstate highway system that is maintained by the Oregon Department of Transportation (ODOT) or that are part of regional and local systems that are maintained by the region's counties and cities.

The bridges in Washington County require ongoing management and maintenance due to the age and types of bridges. Modern bridges, which require minimum maintenance and are designed to withstand earthquakes, consist of pre-stressed reinforced concrete structures set on deep steel piling foundations.

Table C-23 Bridge Inventory

	State Owned			County Owned			City Owned			Other Owned			Area Total			Historic
	Di	ST	%D*	De	ST	%D	De	ST	%D	De	ST	%D	D	T	%D	Covered
Oregon	610	2,718	22%	633	3,420	19%	160	614	26%	40	115	35%	1,443	6,769	21%	334
Region 2	154	549	28%	117	429	27%	64	182	35%	11	23	48%	346	1137	30%	76
Washington	27	120	24%	44	149	30%	5	34	15%	5	7	71%	81	302	27%	2

Source: Oregon Department of Transportation, 2014; Oregon Department of Transportation (2013), Oregon's Historic Bridge Field Guide

Note: Di = ODOT bridges Identified as distressed with structural or other deficiencies; De = Non-ODOT bridge Identified with a structural deficiency or as functionally obsolete; D = Total od Di and De bridges; ST = Jurisdictional Subtotal; %D = Percent distressed (ODOT) and/or deficient bridges; * = ODOT bridge classifications

overlap and total (ST) is not used to calculate percent distressed, calculation for ODOT distressed bridges accounts for this overlap.

The table above shows the structural condition of bridges in the region. A distressed bridge (Di) is a condition rating used by the Oregon Department of Transportation (ODOT) indicating that a bridge has been identified as having a structural or other deficiency, while a deficient bridge (De) is a federal performance measure used for non-ODOT bridges; the ratings do not imply that a bridge is unsafe.[24] The table shows that the county has a lower percentage of bridges that are distressed and/ or deficient (27%), than does the state (21%). About 27% of the county and 35 % of the city owned bridges are distressed, compared to 28% of State Owned (ODOT) bridges.

The county along with ODOT has identified seismically vulnerable bridges. Records indicate that there are four seismically vulnerable county-owned bridges (#1211, #1331, #1343, and #1408). Nineteen other state-owned bridges were identified as seismically vulnerable by ODOT.

Utility lifelines: are the resources that the public relies on daily, (i.e., electricity, fuel and communication lines). If these lines fail or are disrupted, the essential functions of the community can become severely impaired. Utility lifelines are closely related to physical infrastructure, (i.e., dams and power plants) as they transmit the power generated from these facilities.

Washington County receives oil and gas from Alaska by way of the Puget Sound through pipelines and tankers. Most of the natural gas Oregon uses originates in Alberta, Canada. Northwest Natural Gas owns the main natural gas transmission pipeline. The network of transmission lines running through the county may be vulnerable to severe, but infrequent natural hazards, such as windstorm, winter storms, and earthquakes.

Seismic lifeline routes help maintain transportation facilities for public safety and resilience in the case of natural disasters. Following a major earthquake, it is important for response and recovery agencies to know which roadways are most prepared for a major seismic event. The Oregon Department of Transportation has identified lifeline routes to provide a secure lifeline network of streets, highways, and bridges to facilitate emergency services response after a disaster.[25]

System connectivity and key geographical features were used to identify a three-tiered seismic lifeline system. Routes identified as Tier 1 are considered to be the most significant and necessary to ensure a functioning statewide transportation network. The Tier 2 system provides additional connectivity to the Tier 1 system, it allows for direct access to more locations and increased traffic volume capacity. The Tier 3 lifeline routes provide additional connectivity to the systems provided by Tiers 1 and 2.

The Lifeline Routes in the Portland Metro Geographic Zone consist of the following:

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[24] Oregon. Bridge Engineering Section (2012). 2012 Bridge Condition Report. Salem, Oregon: Bridge Section, Oregon Department. of Transportation.

[25] CH2MHILL, Prepared for Oregon Department of Transportation. Oregon Seismic Lifeline Routes Identification Project, *Lifeline Selection Summary Report,* May 15 2012.

- Tier I: Interstate 5 (excluding the section between the northern and southern I-405 interchanges), I-405, I-205, and OR 99W from I-5 to OR 217
- Tier II: I-84, I-5 between the northern and southern I-405 interchanges, US 26 from OR 217 to I-405
- Tier III: OR 217, US 26 from I-5 to I-205, OR43

Synthesis

The planning considerations seemingly most significant for the county are contingency planning for medical resources and lifeline systems due to the imminent need for these resources. As mentioned above, functionality of hospitals and dependent care facilities are a significant priority in providing for Washington County residents. One factor that is critical to consider in planning is the availability of medical beds in local hospitals and dependent care facilities. In the event of a disaster, medical beds may be at a premium providing not just for the growing elderly population, but the entire county. Some of these facilities may run at almost full capacity on a daily basis, hospitals should consider medical surge planning and develop memorandums with surrounding counties for medical transport and treatment. Other facilities to consider are utility lifelines and transportation lifelines such as, airports, railways, roads and bridges with surrounding counties to acquire utility service and infrastructure repair.

While these elements are traditionally recognized as part of response and recovery from a natural disaster, it is essential to start building relationships and establishing contractual agreements with entities that may be critical in supporting community resilience.

Community Connectivity Capacity

Community connectivity capacity places strong emphasis on social structure, trust, norms, and cultural resources within a community. In terms of community resilience, these emerging elements of social and cultural capital will be drawn upon to stabilize the recovery of the community. Social and cultural capitals are present in all communities; however, it may be dramatically different from one city to the next as these capitals reflect the specific needs and composition of the community residents.

Social Systems and Service Providers

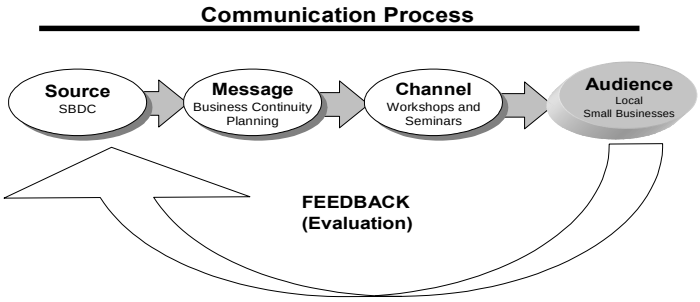
Social systems include community organizations and programs that provide social and community-based services, such as employment, health, senior and disabled services, professional associations and veterans' affairs for the public. In planning for natural hazard mitigation, it is important to know what social systems exist within the community because of their existing connections to the public. Often, actions identified by the plan involve communicating with the public or specific subgroups within the population (e.g. elderly, children, low income, etc.). The county can use existing social systems as resources for implementing such communication-related activities because these service providers already work directly with the public on a number of issues, one of which could be natural hazard preparedness and mitigation. The presence of these services are more predominantly located in urbanized areas of the county, this is synonymous with the general urbanizing trend of local residents.

The following is a brief explanation of how the communication process works and how the community's existing social service providers could be used to provide natural hazard related messages to their clients.

There are five essential elements for communicating effectively to a target audience:

- The source of the message must be credible,
- The message must be appropriately designed,
- The channel for communicating the message must be carefully selected,
- The audience must be clearly defined, and
- The recommended action must be clearly stated and a feedback channel established for questions, comments and suggestions.

Figure C-7 Communication Process



Source: Adapted from the U.S. Environmental Protection Agency Radon Division's outreach program

The following table provides a list of existing social systems within Washington County. The table provides information on each organization or program's service area, types of services offered, populations served, and how the organization or program could be involved in natural hazard mitigation. The three involvement methods identified in the table are defined below:

- Education and outreach – organization could partner with the community to educate the public or provide outreach assistance on natural hazard preparedness and mitigation.
- Information dissemination – organization could partner with the community to provide hazard related information to target audiences.
- Plan/project implementation – organization may have plans and/or policies that may be used to implement mitigation activities or the organization could serve as the coordinating or partner organization to implement mitigation actions.

The information provided in the table can also be used to complete action item worksheets by identifying potential coordinating agencies and internal and external partners.

Civic Engagement

Civic engagement and involvement in local, state and national politics are important indicators of community connectivity. Those who are more invested in their community may have a higher tendency to vote in political elections. The 2012 Presidential General Election resulted in 80.7% voter turnout in the county as of November 16th, 2012.[26] These results are relatively equal to voter participation reported across the State (82.8%).[27] Other indicators such as volunteerism, participation in formal community networks and community charitable contributions are examples of other civic engagement that may increase community connectivity.

Cultural Resources

The cultural and historic heritage of a community is more than just tourist charm. For families that have lived in the county for generations and new resident alike, it is the unique places, stories, and annual events that make Washington County an appealing place to live. The cultural and historic assets in the county are both intangible benefits and obvious quality-of-life- enhancing amenities. Mitigation actions to protect these assets span many of the other systems already discussed. Some examples of that overlap could be seismic retrofit (preserving historic buildings and ensuring safety) or expanding protection of wetlands (protect water resources and beautify the county).

As part of the public outreach survey, county residents catalogued numerous cultural and historic assets including:

[26] Daily Ballot Return, http://www.Washingtonco.org/dailyballotreturn, accessed March 2013.

[27] Oregon Blue Book, Voter Participation. http://bluebook.state.or.us/state/elections/elections04.htm

Parks and recreational facilities: Powerline park, sports and recreation facilities at Portland Community College-Rock Creek campus.

Environmental attractions: Lee Falls, Bar-T Bison ranch.

Historic buildings and places: West Union Baptist Church, Imbrie Barn, Leedy Grange, Historic Market Building, the Hillsboro Courthouse, Jenkins Estate, Pioneer Cemetery, Native American Cultural sites, John Quincy Adams house.

Public gathering places: Rock Creek campus, Cedar Mill library, Rock Creek Tavern.

Community Stability

Residential Geographic Stability

Community stability is a measure of rootedness in place. It is hypothesized that resilience to a disaster stems in part from familiarity with place, not only for navigating the community during a crisis, but also accessing services and other supports for economic or social challenges.[28] The table below estimates residential stability across the region. It is calculated by the number of people who have lived in the same house and those who have moved within the same county a year ago, compared to the percentage of people who have migrated into the region. Washington County overall has geographic stability rating of about 82.3% (i.e., 82.3% of the population lived in the same house or moved within the county). The figures of community stability are relatively consistent across the region with the smaller cities having generally greater geographic stability. Countywide 3.4% of residents in 2014 lived in a different Oregon county one year before; 4.2% lived outside of Oregon one year before.

Table C-24 Regional Residential Stability

Jurisdiction	Population	Geographic Stability	From Different County in Oregon	From Outside Oregon
Washington County	540,380	82.3%	3.4%	4.2%
Beaverton	91,299	78.2%	4.2%	6.2%
Forest Grove	21,759	77.8%	2.5%	4.4%
Hillsboro	94,249	79.2%	3.2%	5.1%
Sherwood	18,473	88.8%	4.1%	1.3%
Tigard	49,019	83.6%	4.1%	3.6%
Other Incorporated*	20,765	83.9%	2.1%	3.0%

Source: Social Explorer, Table 130, U.S. Census Bureau, 2010-2014 American Community Survey.
* The "other incorporated" cities include: Banks, Cornelius, Durham, Gaston, King City, and North Plains.

Homeownership

Housing tenure describes whether residents rent or own the housing units they occupy. Homeowners are typically more financially stable but are at risk of greater property loss in a

[28] Cutter, Susan, Christopher Burton, Christopher Emrich. "Disaster Resilience Indicators for Benchmarking Baseline Conditions". Journal of Homeland Security and Emergency Management.

post-disaster situation. People may rent because they choose not to own, they do not have the financial resources for home ownership, or they are transient.

Collectively, about 61% of the occupied housing units in Washington County are owner-occupied; about 39% are renter occupied. The smaller incorporated cities (76.2%) have the highest rate of owner-occupied units. Beaverton (52.2%) and Hillsboro (46.5%) have the highest rate of renter-occupied households. Beaverton (5.3%) and Hillsboro (5.3%) have the highest vacancy rates within the county. In addition, seasonal or recreational housing accounts for approximately 0.6% of the county's housing stock (1.2% in Hillsboro). [29]

Table C-25 Housing Tenure and Vacancy

	Occupied	Owner-occupied		Renter-occupied		Vacant^	
	Units	Estimate	Percent	Estimate	Percent	Estimate	Percent
Washington County	203,901	123,661	60.6%	80,240	39.4%	9,892	4.6%
Beaverton	37,028	17,701	47.8%	19,327	52.2%	2,072	5.3%
Forest Grove	7,686	4,513	58.7%	3,173	41.3%	377	4.7%
Hillsboro	33,559	17,943	53.5%	15,616	46.5%	1,886	5.3%
Sherwood	6,532	4,885	74.8%	1,647	25.2%	98	1.5%
Tigard	19,694	12,026	61.1%	7,668	38.9%	948	4.6%
Other Incorporated*	7,266	5,540	76.2%	1,726	23.8%	0	0.0%

Source: Social Explorer, Table 94, U.S. Census Bureau, 2010-2014 American Community Survey, Table B25004.
^ = Functional vacant units, computed after removing seasonal, recreational, or occasional housing units from vacant housing units.
* The "other incorporated" cities include: Banks, Cornelius, Durham, Gaston, King City, and North Plains.

According to Cutter, wealth increases resiliency and recovery from disasters. Renters often do not have personal financial resources or insurance to assist them post-disaster. On the other hand, renters tend to be more mobile and have fewer assets at risk of natural hazards.[30] In the most extreme cases, renters lack sufficient shelter options when lodging becomes uninhabitable or unaffordable post-disaster.

Synthesis

Washington County has distinct social and cultural resources that work in favor to increase community connectivity and resilience. Sustaining social and cultural resources, such as social services and cultural events, may be essential to preserving community cohesion and a sense of place. The presence of larger communities makes additional resources and services available for the public. However, it is important to consider that these amenities may not be equally distributed to the rural portions of the county and may produce implications for recovery in the event of a disaster.

In the long-term, it may be of specific interest to the county to evaluate community stability. A community experiencing instability and low homeownership may hinder the effectiveness of social and cultural resources, distressing community coping and response mechanisms.

[29] U.S. Census Bureau, 2010-2014 American Community Survey, Table DP04 and Table B25004.
[30] Cutter, S. L. (2003). Social Vulnerability to Environmental Hazards. *Social Science Quarterly*.

Political Capacity

Political capacity is recognized as the government and planning structures established within the community. In terms of hazard resilience, it is essential for political capital to encompass diverse government and non-government entities in collaboration; as disaster losses stem from a predictable result of interactions between the physical environment, social and demographic characteristics and the built environment.[31] Resilient political capital seeks to involve various stakeholders in hazard planning and works towards integrating the Natural Hazard Mitigation Plan with other community plans, so that all planning approaches are consistent.

Regulatory Context: Oregon Statewide Planning Goal 7[32]

Since 1973, Oregon has maintained a strong statewide program for land use planning. The foundation of that program is a set of 19 statewide planning goals that express the state's policies on land use and on related topics, such as citizen involvement, land use planning, and natural resources.

Most of the goals are accompanied by "guidelines," which are suggestions about how a goal may be applied. Oregon's statewide goals are achieved through local comprehensive planning. State law requires each city and county to adopt a comprehensive plan and the zoning and land-division ordinances needed to put the plan into effect. The local comprehensive plans must be consistent with the statewide planning goals. Plans are reviewed for such consistency by the state's Land Conservation and Development Commission (LCDC). When LCDC officially approves a local government's plan, the plan is said to be "acknowledged." It then becomes the controlling document for land use in the area covered by that plan.

Statewide Planning Goal 7

Goal 7: Areas Subject to Natural Disasters and Hazards has the overriding purpose to "protect people and property from natural hazards." Goal 7 requires local governments to adopt comprehensive plans (inventories, policies and implementing measures) to reduce risk to people and property from natural hazards. Natural hazards include floods, landslides, earthquakes, tsunamis, coastal erosion, and wildfires.

To comply with Goal 7, local governments are required to respond to new hazard inventory information from federal or state agencies. The local government must evaluate the hazard risk and assess the:

- frequency, severity, and location of the hazard;
- effects of the hazard on existing and future development;
- potential for development in the hazard area to increase the frequency and severity of the hazard; and
- types and intensities of land uses to be allowed in the hazard area.

[31] Mileti, D. 1999. Disaster by Design: a Reassessment of Natural Hazards in the United States. Washington D.C.: Joseph Henry Press.

[32] Adapted from Hillsboro NHMP (2008)

Local governments must adopt or amend comprehensive plan policies and implementing measures to avoid development in hazard areas where the risk cannot be mitigated. In addition, the siting of essential facilities, major structures, hazardous facilities and special occupancy structures should be prohibited in hazard areas where the risk to public safety cannot be mitigated. The state recognizes compliance with

Goal 7 for coastal and riverine flood hazards by adopting and implementing local floodplain regulations that meet the minimum National Flood Insurance Program (NFIP) requirements.

Goal 7 Planning Guidelines

- In adopting plan policies and implementing measures for protection from natural hazards, local governments should consider:
    - the benefits of maintaining natural hazard areas as open space, recreation, and other low density uses;
    - the beneficial effects that natural hazards can have on natural resources and the environment; and
    - the effects of development and mitigation measures in identified hazard areas on the management of natural resources.
- Local governments should coordinate their land use plans and decisions with emergency preparedness, response, recovery and mitigation programs. For Hillsboro, such coordination includes Washington County and nearby cities.

Goal 7 Implementation Guidelines

Goal 7 guides local governments to give special attention to emergency access when considering development in identified hazard areas.

- Consider programs to manage stormwater runoff as a means to address flood and landslide hazards.
- Consider non-regulatory approaches to help implement the goal.
- When reviewing development requests in high-hazard areas, require site. specific reports, appropriate for the level and type of hazard. Reports should evaluate the risk to the site, as well as the risk the proposed development may pose to other properties.
- Consider measures exceeding the National Flood Insurance Program.

Existing Plans and Policies

Communities often have existing plans and policies that guide and influence land use, land development, and population growth. Such existing plans and policies can include comprehensive plans, zoning ordinances, and technical reports or studies. Plans and policies already in existence have support from local residents, businesses and policy makers. Many land-use, comprehensive, and strategic plans get updated regularly, and can adapt easily to changing conditions and needs.[33]

[33] Burby, Raymond J., ed. 1998. Cooperating with Nature: Confronting Natural Hazards with Land-Use Planning for Sustainable Communities.

The Washington County NHMP includes a range of recommended action items that, when implemented, will reduce the county's vulnerability to natural hazards. Many of these recommendations are consistent with the goals and objectives of the county's existing plans and policies. Linking existing plans and policies to the NHMP helps identify what resources already exist that can be used to implement the action items identified in the plan. Implementing the natural hazards mitigation plan's action items through existing plans and policies increases their likelihood of being supported and getting updated, and maximizes the county's resources. In addition to the plans listed below the county and incorporated cities also have zoning ordinances (including floodplain development regulations) and building regulations.

Existing plans that can incorporate mitigation actions include the:

- Comprehensive Framework Plan for the Urban Area
- Emergency Operations Plan
- Rural Natural Resource Plan
- Community Plans (Sherwood, Cedar Hills, Aloha-Reedville-Cooper Mountain, Bethany, West Union, Bull Mountain, Sunset West, Raleigh Hills-Garden Home, Metzger-Progress, East Hillsboro, West Tigard)
- Transportation Plan
- Capital Improvement Projects
- Public Facilities Plan

For more information on these plans see the county website.