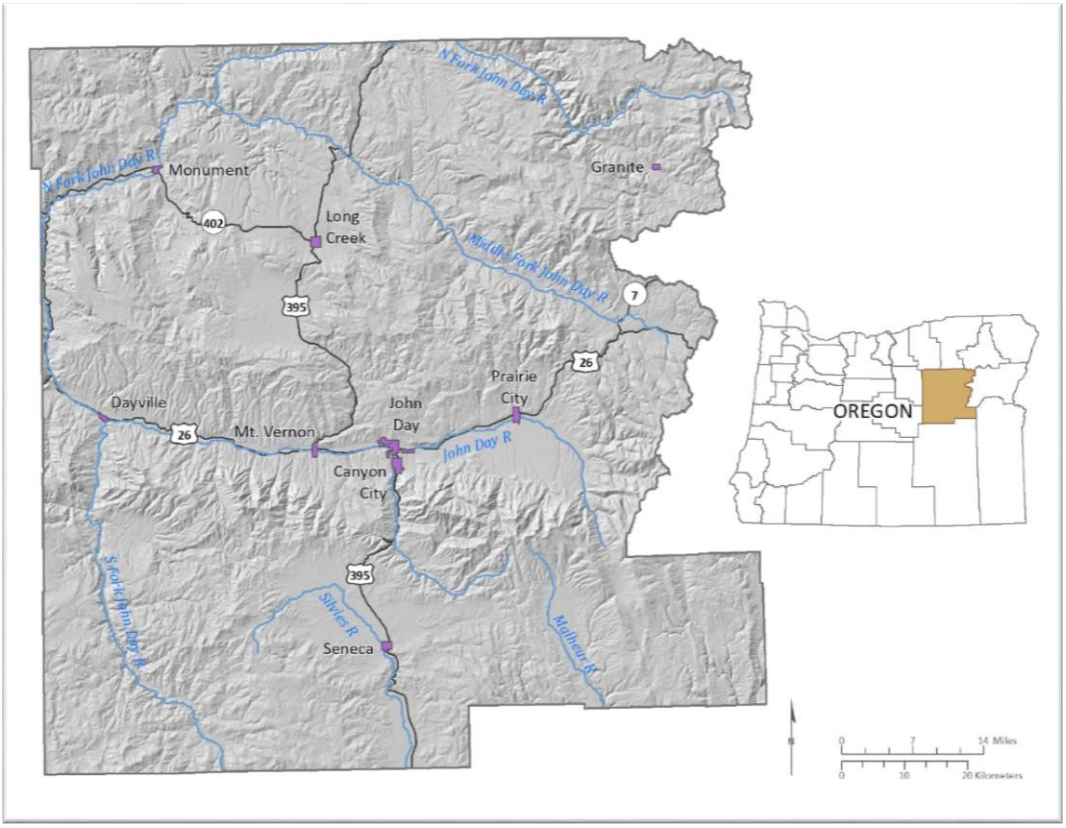
Volume III: Resources

Appendix A: Community Profile

Grant County was established on Oct. 14, 1864, and named for General Ulysses S. Grant, commander of the Union Army during the Civil War. Early in his military career Grant was stationed at Fort Vancouver and assigned to protect the increasing number of travelers on the Oregon Trail. Grant County is located in eastern Oregon and was created out of Wasco and Umatilla Counties. At that time Grant County was the largest county in the state. Its size was later reduced by the transfer of land to Lake County and the creation of Harney and Wheeler Counties. Grant County shares boundaries with 8 counties: Morrow, Umatilla, and Union to the north; Harney to the south; Malheur and Baker to the east; and Crook and Wheeler to the west.

Prior to 1864, cases brought to court were tried in The Dalles, county seat of the vast Wasco County. The great distance from the John Day country to The Dalles made law enforcement a difficult problem and imposed a heavy burden on citizens who had a need to transact business at the courthouse. The settlers, feeling a need for a more centralized county government, successfully petitioned the Legislative Assembly.

Figure 1. Map of Grant County Oregon and its incorporated cities



Source: Department of Geology and Mineral Industries

The first county court session was convened at Canyon City, the county seat, on Nov. 7, 1864. Five officials composed the administration of the county: a judge, sheriff, clerk and two commissioners. A month later the court appointed a treasurer, surveyor, superintendent of schools and coroner. The first county election, held in June 1866, resulted in the election of a county judge, clerk and sheriff. The first courthouse was known as "Dunker's Hall," and the present courthouse was built in 1952. Grant County government consists of a county court made up of a county judge and two commissioners. The county judge retains judicial authority only over probate matters.

After gold was discovered on Whiskey Flat in 1862 the increased population created a need for county government. It is estimated that within ten days of the original discovery of gold 1,000 miners were camped along Canyon Creek. Over $20 million in gold was mined from the Canyon City and Susanville areas. Following the decline of gold and placer mining, stock raising and agriculture became the main work of residents.

A. Environmental, Demographic and Socio-economic Profile

Grant County contains the headwaters of the John Day River, which has more miles of wild and scenic designation than any other river in the United States. More than 60% of the county's land area is under public ownership, and the county contains parts of four national forests. Principal industries in Grant County include agriculture, livestock, forestry and recreation.

The first census was in 1870 and counted 2,251 persons. The population of Grant County in 2013 was 7,445. This represented a slight decrease from 2010.[1] The county's largest community is the City of John Day and the county seat is the City of Canyon City. Most of the residents in the county reside along the John Day River (see Figure 1 in Volume I, page 8).

Grant County encompasses an area of 4,528 square miles (2,897,920 acres). Approximately 63% of the land area of the county is controlled by the Federal Government. Grant County contains most of the Malheur National Forest and sections of the Wallowa–Whitman, Umatilla and Ochoco National Forests, and contains more than 150,000 acres of federally designated Wilderness Areas.

The county has a total of 8,417 buildings, both residential buildings as well as agricultural structures dominate the building inventory. Of the total number of buildings in the county, 4,933 (59%) are in unincorporated areas and collectively they make up an estimated total building value of $1,169,279,000 or about 58% of the total for all buildings in the county as shown in Table 1, below. The data contained in the DOGAMI Risk Assessment also illustrates that the majority of buildings in the county are agricultural structures, but approximately 1,000 structures in unincorporated Grant County are residential in nature.

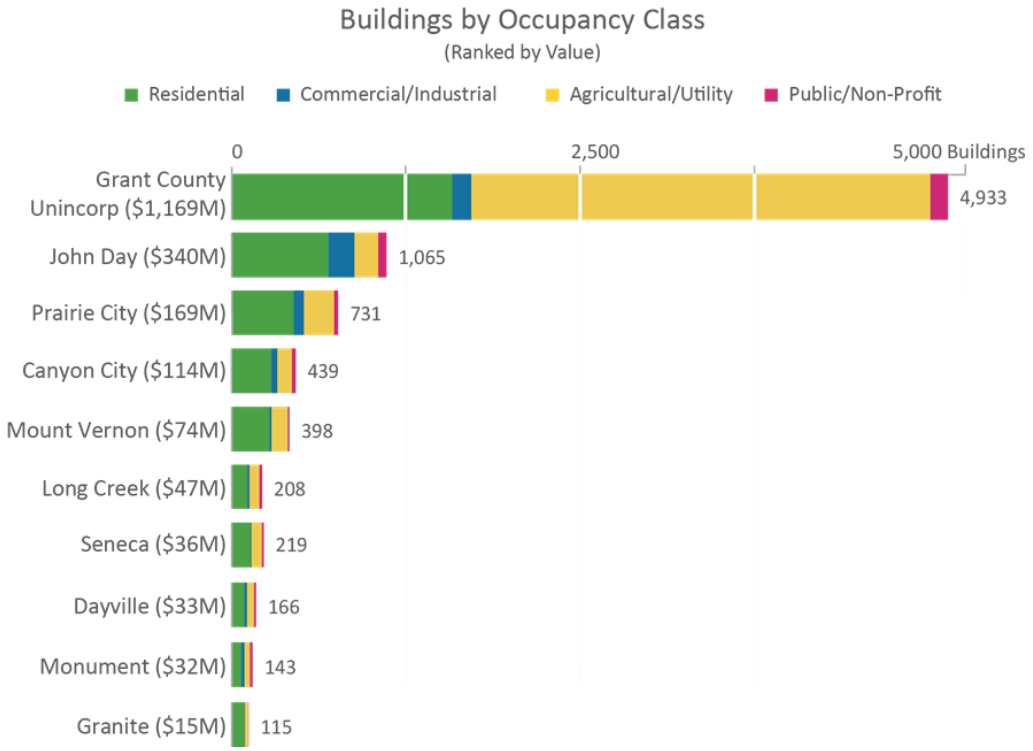
[1] Oregon Blue Book, https://sos.oregon.gov/blue-book/Pages/local/counties/grant.aspx, accessed August 22, 2019

Table 1. Study area building inventory.

Community	Total Number of Buildings	Percentage of Total Buildings	Estimated Total Building Value ($)	Percentage of Total Building Value
Unincorporated County	4,933	59%	1,169,279,000	58%
Canyon City	439	5.2%	114,298,000	5.6%
Dayville	166	2.0%	33,364,000	1.6%
Granite	115	1.4%	15,264,000	0.8%
John Day	1,065	13%	339,542,000	17%
Long Creek	208	2.5%	46,914,000	2.3%
Monument	143	1.7%	32,015,000	1.6%
Mount Vernon	398	4.7%	73,681,000	3.6%
Prairie City	731	8.7%	169,267,000	8.3%
Seneca	219	2.6%	35,692,000	1.8%
Total Grant County	8,417	100%	2,029,317,000	100%

Source: Natural Hazard Risk Report For Grant County, Oregon: Final Report to the Oregon Department of Land Conservation and Development, Williams, Anthony & O'Brien, DOGAMI, 2019

Figure 2. Community building value in Grant County by occupancy class



Source: Natural Hazard Risk Report For Grant County, Oregon: Final Report to the Oregon Department of Land Conservation and Development, Williams, Anthony & O'Brien, DOGAMI, 2019

1. Natural Environment

Natural environment capacity is recognized as the geography, climate, and land cover of the area such as, urban, water and forested lands that maintain clean water, air and a stable climate.[2] Natural resources such as wetlands and forested hill slopes play significant roles in protecting communities and the environment from weather-related hazards, such as flooding and landslides. However, natural systems are often impacted or depleted by human activities adversely affecting community resilience.

Geography

The Northeast Region encompasses approximately 12,808 square miles.[3]The region is bordered by the Snake River to east and the Columbia River to the north. Columbia River Basalt lava flows formed the high plateaus of the region; the two major mountain ranges are the Blue and Wallowa Ranges. Major rivers include the John Day, Grande Ronde, the Powder, and the Snake.[4]

Blue Mountains

The Blue Mountains extend from the northeast corner of the state into the John Day Valley. It extends east to the Snake River Canyon, northwest to the Columbia Plateau and south to the High Lava Plains and Owyhee Plateau.[5] The range forms sub-ranges including the Elkhorn Mountains in western Baker and northeastern Grant counties; and the Strawberry Mountains in central Grant County.[6] The Blue Mountains drain into the Grande Ronde, Imnaha, Wallowa, and John Day Rivers.[7]

The Blue Mountains are not a single cohesive range, but rather a complex of ranges and inter-mountain basins and valleys that extend from southeast Washington into central Oregon, ending near Prineville.

Aldrich Mountains

The Aldrich Mountains are an east–west range rising south of the John Day River valley, the mountains are bounded on the west by the South Fork John Day River, on the south by Murderers Creek and the Bear Valley, and on the east by Canyon Creek.[8] Most of the Aldrich Mountains and the mountainous terrain south of them are contained within the Malheur National Forest. The highest point in the range is Fields Peak at 7,362 feet (2,244 m), and the nearest human settlement is Mount Vernon, located in

[2]Mayunga, J. 2007. Understanding and Applying the Concept of Community Disaster Resilience: A capital-based approach. Summer Academy for Social Vulnerability and Resilience Building.

[3] Oregon Blue Book, County Government, http://bluebook.state.or.us/local/counties/counties.htm; *Baker 3,089 sq. mi., Grant 4,528 sq. mi., Union 2,038 sq. mi., 3,153 sq. mi;* Accessed May 2013

[4] Loy, W.G., ed. 2001. *Atlas of Oregon*, 2nd Edition. Eugene: University of Oregon Press.

[5] Idaho Power Boardman to Hemingway Transmission Line Project; Exhibit H

[6] Oregon State University "Blue Mountain Ecological Province" http://oregonstate.edu/dept/range/sites/default/files/EcologicalProvincesOfOregon/blue_mountain.htm Accessed May 2013

[7] Idaho Power Boardman to Hemingway Transmission Line Project; Exhibit H

[8] Oregon Road & Recreation Atlas (Map) (Third ed.). Medford, Oregon: Benchmark Maps. 2006. pp. 65–66. ISBN 0-929591-88-7.

the John Day River valley.[9] Across the South Fork John Day River to the west are the Ochoco Mountains, while across Canyon Creek to the east is the Strawberry Range.

Ochoco Mountains

The Ochoco Mountains in central Oregon form the western end of the Blue Mountains province. The Ochoco portion of the province is part of a wide uplifted plateau made of rocks from the Permian, Triassic, and Jurassic periods (300 to 200 million years old) that were transported by the Pacific Plate and accreted in the late Mesozoic era (about 100 million years ago) as part of a vast shallow sea, then slowly uplifted by volcanic eruptions during the Eocene epoch (50 to 37 million years ago) to form the Clarno Formation. From 37 to 17 million years ago, eruptions in the western Cascade Range spread ash across eastern Oregon, forming the John Day Formation. From 17 to 14 million years ago, major volcanic eruptions covered much of the province with basalt flows, creating the Columbia River Basalt Group. Since then, continued faulting and uplift has resulted in a deeply eroded landscape. Steins Pillar is an excellent example of this erosion.[10]

During the Eocene epoch, central Oregon volcanoes deposited layers of lava and ash up to 1,000 feet (300 m) thick over the area that is now the Ochoco Mountains. Large mudflows called lahars were also common during that period. These mudflows often covered and preserved the plants and animals, resulting in fossil beds. Today, fossils of prehistoric trees, fruits, nuts, and flowers can be found in the Ochoco Mountains along with fossilized animals including horses, camels, rhinoceros, and hippopotami.[11]

Surface Water Resources

Grant County is situated at the headwaters of three principle watersheds, the John Day River, the Silvies River and the Malheur River.

Most of Grant County is drained by the four forks of the John Day River, all of which have their headwaters in the county. The John Day River system drains some 7,900 square miles. It is the third longest free-flowing river in the lower 48 states and has more miles of federal 'Wild and Scenic River' designation than any other river in the United States.

The river system in Grant County includes the upper 100 miles of the Main Stem, all of the 112 miles of the North Fork, all 75 miles of the Middle Fork, and all 60 miles of the South Fork of the John Day River. From Grant County, the lower John Day River flows another 184 miles to its confluence with the Columbia River. The southeastern corner of the county includes the headwaters of the Malheur and Little Malheur rivers, which find their way to the Snake River. The southern part of Grant County includes the northern-most reaches of the Great Basin, including the Silvies River watershed, which

[9] "Field's Peak Trail #212". U.S. Forest Service. Retrieved July 27, 2018.

[10] "Blue Mountains Province", Deschutes and Ochoco National Forests, United States Forest Service, United States Department of Agriculture, Bend, Oregon. Archived from the original on 3 September 2005.

[11] "Additional Points of Interest - Geology of Central Oregon", Prineville Crook County Chamber of Commerce, Prineville, Oregon. Archived from the original on 6 October 2011

flows south into Harney Lake in the High Desert of Eastern Oregon. A small area in the southwestern corner of Grant County is in the Crooked River and Dechutes River watersheds

Grant County has several natural lakes. Their name, township and range location and ownership are listed below:

- Magone Lake T12S R32 E Section 6, 7 US Forest Service
- Strawberry Lake T14S R34E Section 31 US Forest Service
- Slide Lake T15S R34E Section 8 US Forest Service
- Bull Prairie T6N R26E Section 7 US Forest Service
- Unnamed Lake T18S R32E Section 6 Private Ownership
- Olive Lake T9S R34E Section 15 US Forest Service
- Lost Lake T9S R34E Section 8 US Forest Service
- Upper Reservoir T9S R34E Section 22 US Forest Service Wilderness Area
- Buddy Lake T8S R36E Section 21, 28 US Forest Service
- Crawfish Lake T7S R36E Section 23 US Forest Service
- Unnamed Lake T15S R30E Section 31 Private Ownership
- Unnamed Lake T15S R30E Section 33 Private Ownership
- Unnamed Lake T13S R30E Section 33 Private Ownership

Grant County also has one man-made water storage reservoir at Bates State Park,T11S R35E Section 28.

The Oregon Water Resources Department (OWRD) supports the Water Resources Commission which determines the policies and procedures for the use and control of the state's water resources. The OWRD recently developed a new Strategic plan. One of the key objectives is to continue to improve its work in addressing instream and out-of-stream water supply needs now and into the future.[12] The Program includes funding opportunities and other resources through three program components: Planning Grants, Feasibility Study Grants, and Water Project Grants and Loans. In 2019, the Grant Soil and Water Conservation District applied for funding to perform an aquifer management feasibility study and in 2018 The Freshwater Trust applied to conduct an irrigation efficiency and conveyance upgrade project in the Upper John Day River basin.[13] The Blue Mountain Eagle reported that five John Day River restoration projects will receive $489,100 in funding from the Oregon Watershed Enhancement Board. The North Fork and South Fork watershed councils will use the funding to enhance fish and wildlife habitat for chinook salmon, steelhead and bull trout, restore clean water, increase water quality and reduce fire risk.[14]

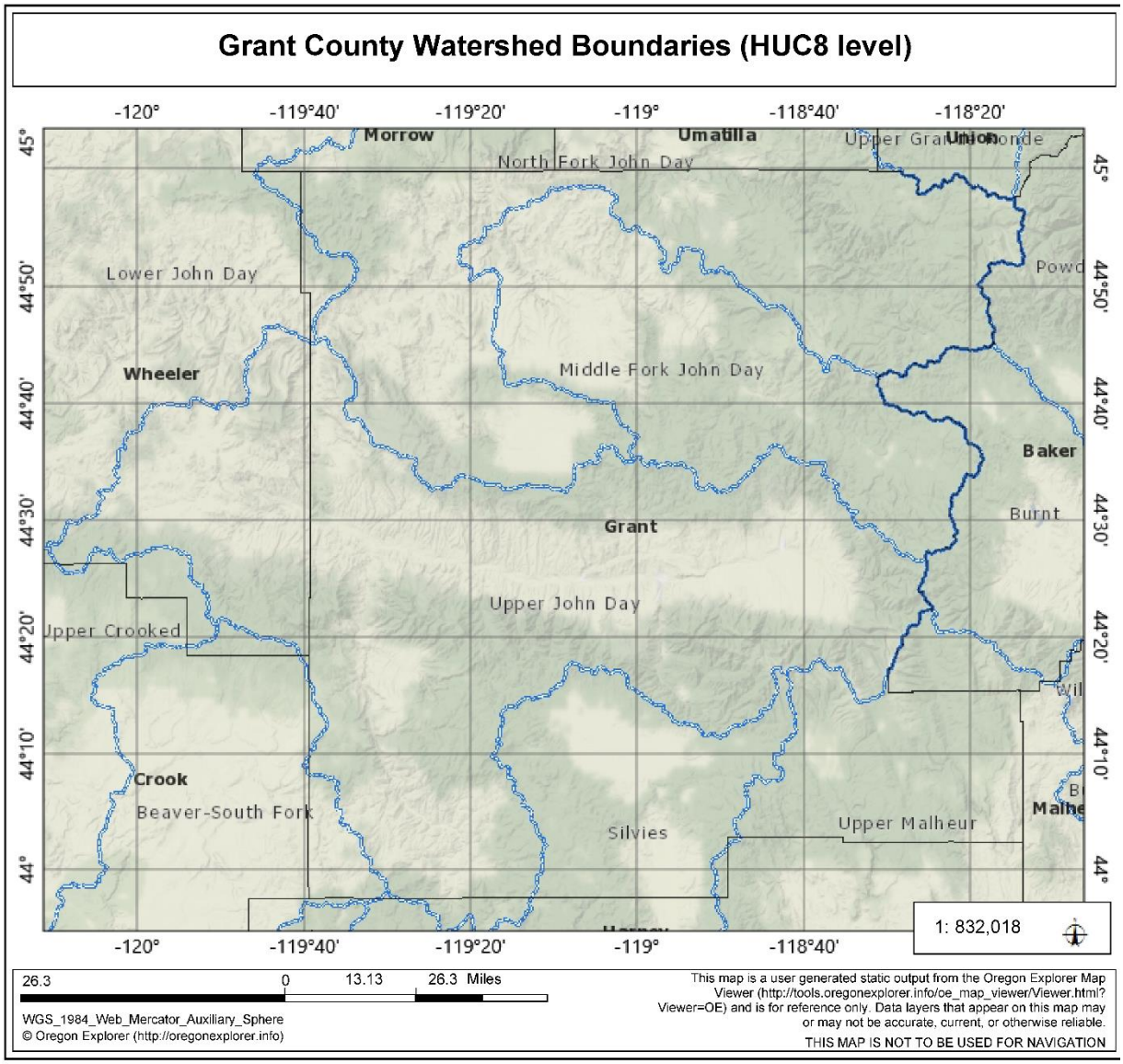
The figure below illustrates the location the sub-basins of the John Day watershed.

[12] OWRD Strategic Plan 2019-2024, https://www.oregon.gov/owrd/wrdreports/OWRD_2019-2024_Strategic_Plan_Final.pdf

[13] Oregon Water Resources Department, https://www.oregon.gov/owrd/Pages/index.aspx

[14] Blue Mountain Eagle, July 30, 2019, https://www.bluemountaineagle.com/news/state-funding-will-support-five-river-projects/article_9950782e-8ee6-11e9-96cf-87e322974b9e.html

Figure 3. John Day Watershed sub-basins



Source: Oregon Explorer

John Day River

The John Day River is a tributary of the Columbia River and drains from the Blue Mountains before entering the Columbia River Gorge. The John Day River is the longest free flowing river in the United States. The John Day River system represents the watershed for most of Grant County, primarily the northern half, drained by the four forks of the John Day River.[15]

[15] Grant County CWPP 2013 "2.2 Existing Conditions"

Silvies River

The Silvies River extends through the southern portion of Grant County into Harney County and drains approximately 1,275 square miles of the northern Harney Basin. The headwaters are near the flank of the Aldrich Mountains and the river runs roughly south where it empties into Malheur Lake, near Burns, Oregon.

Malheur River

The Malheur River is a 190-mile-long tributary of the Snake River in eastern Oregon in the United States. It drains a high desert area, between the Harney Basin and the Blue Mountains.

Watershed Councils

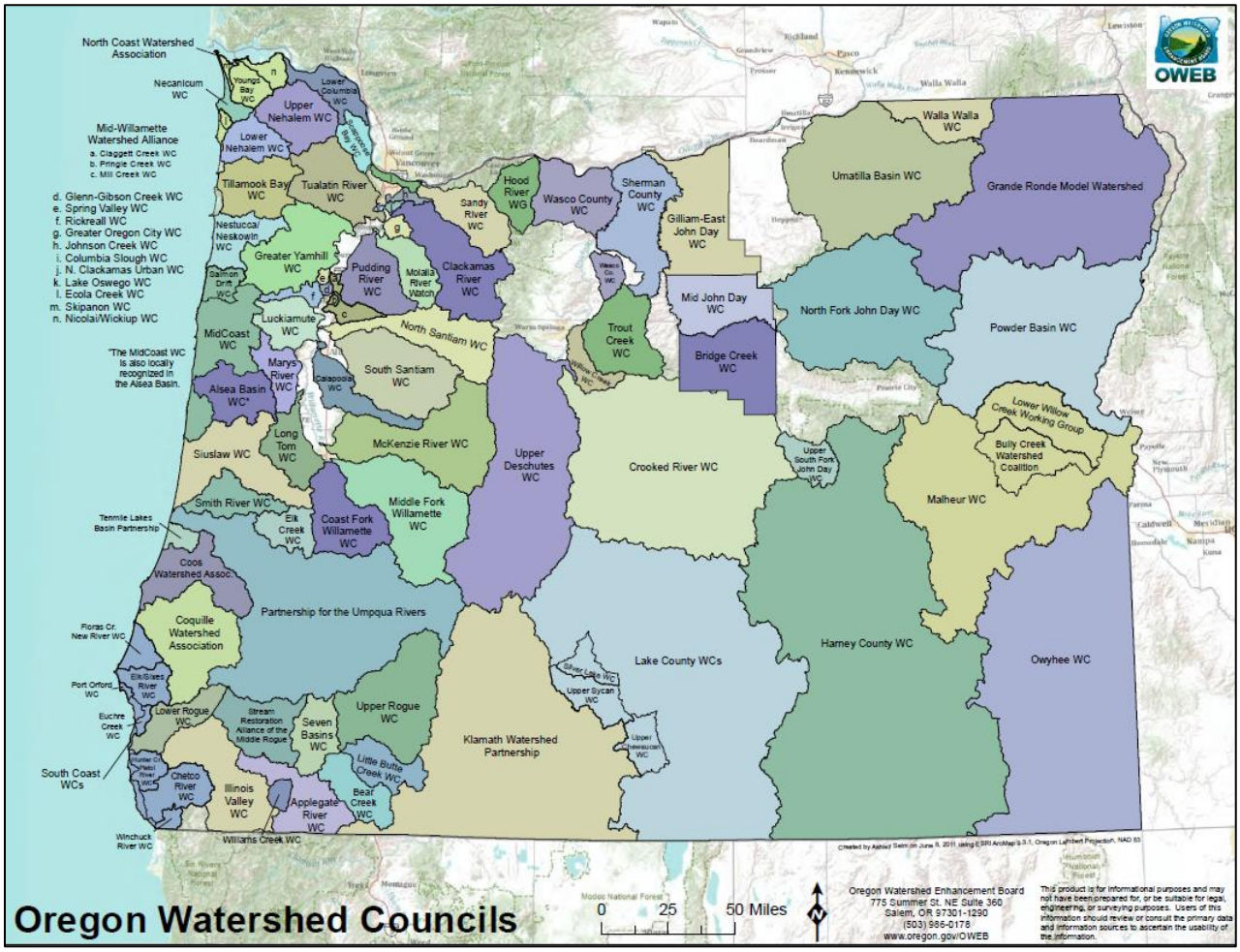
A watershed council is a community-based, voluntary, non-regulatory group that meets regularly in their local communities to assess conditions in a given watershed (usually a river or creek and the lands that drain into them) and to conduct projects to restore or enhance the waters and lands for fish and native plants in their areas. Oregon is one of the few states to have this community-based model – supported by the state and recognized by local governments – to focus on restoring land and water from "ridgetop to ridgetop." Four Watershed Councils represent portions of Grant County: North Fork John Day WC, South Fork John Day River WC, Malheur WC and Harney County WC. Grant County is situated at the headwaters of three principle watersheds, the John Day River, the Silvies River and the Malheur River.

Table 2. Area Watershed Council Contact Information

WC Name	Contact Person	Address	Phone number	Email address	Website
North Fork John Day WC	Valeen Madden	PO Box 444, Long Creek, OR 97856	(541) 421-3018	valeen@nfjdwc.org	http://nfjdwc.org/
South Fork John Day River WC	Amy Stiner	PO Box 522, Mt. Vernon, OR 97865	(541) 792-0435	astiner@outlook.com	http://www.southforkjohnday.com
Harney County WC	Karen Moon	PO Box 1289 Hines, OR 97738	(541) 573-2000	HCwatershedcouncil@gmail.com	http://hcwatershedcouncil.com/
Malheur WC	Ken Diebel	710 SW 5th Ave., Ontario, OR 97914	(541) 910-4034	diebelk12@gmail.com	http://malheurwatershed.org/
Mid John Day Bridge Creek WC	Debra Bunch	40535 Hwy 19, Fossil OR 97830	(541) 468-2990	debrabunch@gmail.com	

Source: https://www.oregon.gov/oweb/resources/Pages/Watershed-Councils.aspx

Figure 4. Location of Oregon Watershed Councils



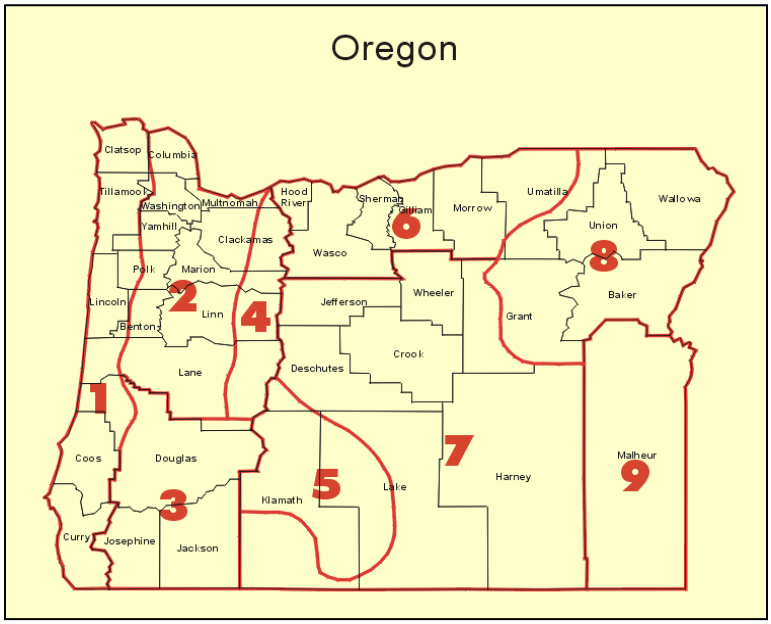
Source: Oregon Watershed Enhancement Board "Watershed Councils in Oregon" https://www.oregon.gov/oweb/resources/Pages/Watershed-Councils.aspx

Climate

The eastern half of Grant County is within NOAA's Climate Division 8 and the western third is in Climate Division 7 as shown in Figure 3 below. The region is generally dry and there are large seasonal variations in temperature ranging from high temperatures of 80 to 90 degrees F from June to September to average highs of low teens in the winter months. In most winters, there are frequent and severe winter storms characterized by temperature, wind velocity, ground saturation, and snow pack. Winter storms can slow or halt traffic, damage power lines, and kill livestock.[16]

[16] Climate divisions are created by the National Oceanic Oregon and Atmospheric Administration to separate regions that have similar climates.

Figure 5. Map of Climatic Divisions



Source: National Oceanic and Atmospheric Administration, National Weather Service "Climate Divisions within Counties"

Precipitation: Rainfall and Snowfall

The average annual precipitation is mostly uniform at the different NOAA stations throughout the county. See Figure 5 below for precipitation (inches) for different NOAA Stations across the county. The highest and lowest levels are within 10 inches of one another. Average annual precipitation ranges from just over 11 inches of rain at Dayville 8 NW NOAA Station to just over 21 inches of rain at the Austin 3 S NOAA Station. Annual precipitation for the four counties is almost always below 20 inches. Areas of higher elevation generally have larger annual rainfall and areas of lower elevation have lower annual rainfall.

Precipitation tends to spike in spring and again in the late fall. Monthly distribution compared to the rest of Oregon is mostly uniform throughout the year, and well distributed across the months.

Snowfall similarly varies by elevation, ranging from approximately seven (7) inches at the Dayville station to nearly 88 inches at the Austin station.

Temperature and Climate Change Variability

Grant County usually experiences freezing winters and hot dry summer days. Seneca, located in the Blue Mountains at 4,690 feet elevation holds the record for the coldest temperature in Oregon at -54°F. The county also sees blistering summers when maximum daytime high temperatures can exceed 100°F. Figure 7 below shows monthly average temperatures averaged over a 30 year period from 1981 to 2010.

Figure 6. 30 Year Temperature Averages in Grant County (1981-2010 averages)

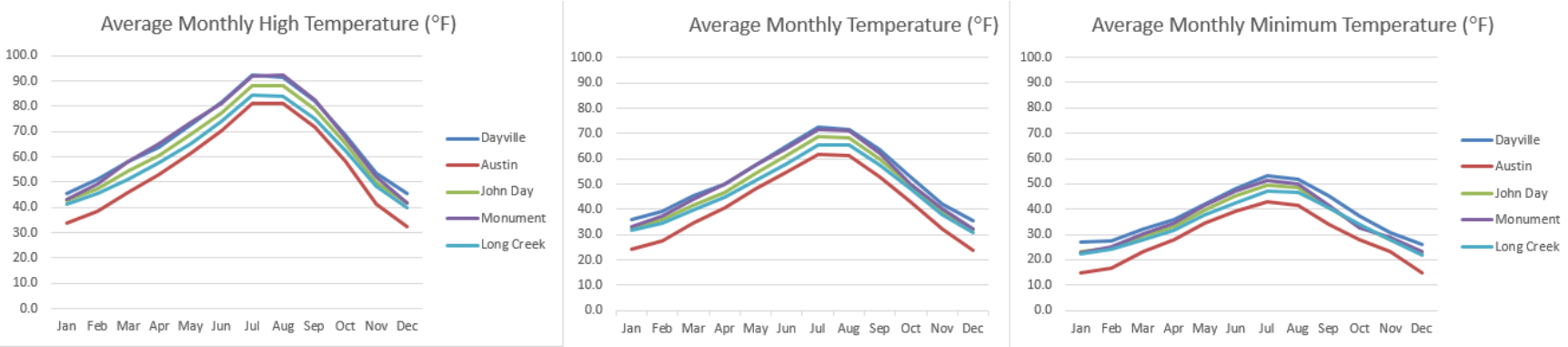
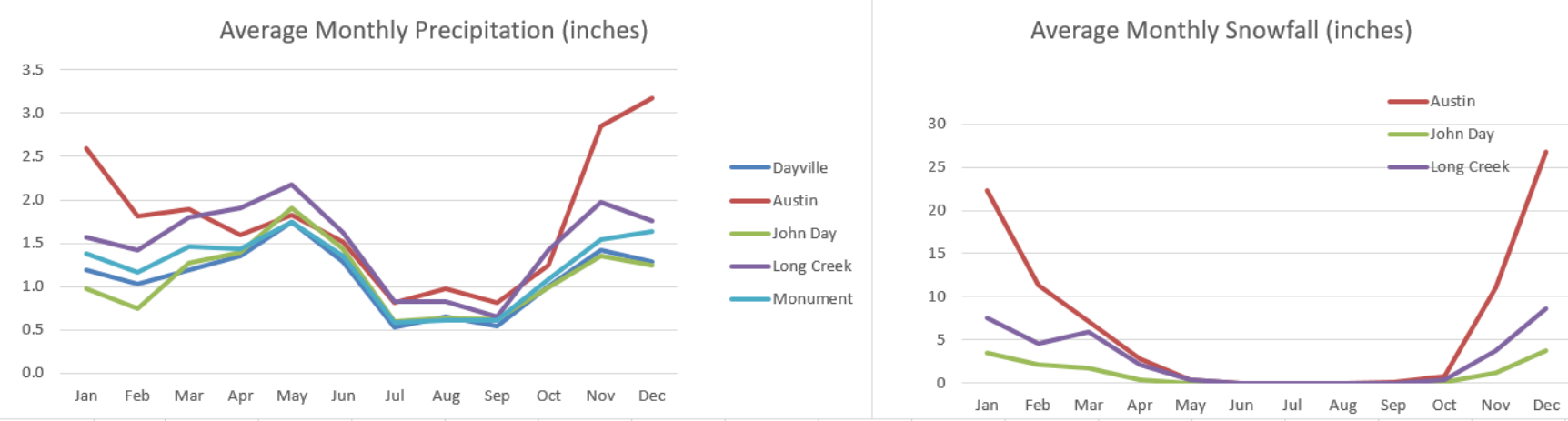


Figure 7. 30 Year Average Monthly Precipitation and Snowfall in Grant County (1981-2010 averages)



Source: NOAA National Centers for Environmental Information 1981-2010 Normals, https://www.ncdc.noaa.gov/cdo-web/datatools/normals data for the following NOAA stations: Dayville 8 NW, Austin 3 S, John Day, Long Creek, and Monument

Extreme heat events are expected to increase in frequency, duration, and intensity due to continued warming temperatures. [17]

In Grant County, the frequency of hot days per year with temperatures at or above 90°F is projected to increase on average by 27 days (ranging from 10 to 38 days), by the 2050s under the higher emissions scenario relative to the historical baselines. This average increase represents a more than tripling of hot days relative to the average historical baseline.[18]

In Grant County, the temperature of the hottest day of the year is projected to increase on average by nearly 8°F, (ranging from 3 to 11°F), by the 2050s under the higher emissions scenario relative to the historical baselines. Temperature increases will occur throughout all seasons, with the greatest differences in summer months.[19]

Increasing temperatures affects hydrology. Spring snowpack has substantially decreased throughout the Western part of the United States, particularly in areas with milder winter temperatures, such as the Cascade Mountains. In other areas of the West, such as east of the Cascades Mountains, snowfall is affected less by the increasing temperature because the temperatures are already cold and more by precipitation patterns. Spring flooding could be affected by warming climate. Mid- to low-elevation areas in Grant County's Blue Mountains that are near the freezing level in winter, receiving a mix of rain and snow, are projected to experience an increase in winter flood risk due to warmer winter temperatures causing precipitation to fall more as rain and less as snow. [20]

2. Demographics

Grant County Residents

With 7,176 residents in 2018, Grant County had the 5th lowest population among Oregon counties. About 60% of all residents are concentrated in five cities along the Highway 26 corridor that runs east-west through the County. These include the cities of Prairie City (2018 pop. 878), John Day (2018 pop. 1,665), Canyon City (2018 pop. 668), Mt. Vernon (2018 pop. 512) and Dayville (2018 pop. 144). Outside of this corridor are the towns of Seneca (2018 pop. 207) to the south, and Monument (2018 pop. 124), Long Creek (2018 pop. 189), and Granite (2018 pop. 37) to the north. The remainder of county residents are scattered in other small hamlets and unincorporated areas across a large, remote and rugged farm and forest land interspersed by wild river valleys and robust canyon lands.

Between the years 2010 and 2018, the total population of Grant County decreased by 3.6%. However, Eastern Oregon's[21] population as a whole increased by 8,048 people during this eight year time period.

[17] Future Climate Projection Grant County, OCCRI, February 2020

[18] Ibid.

[19] Ibid

[20] Ibid.

[21] Eastern Oregon is comprised of the following counties: Wallowa, Umatilla, Union, Morrow, Grant, Baker, Harney and Malheur.

Natural increase (+4,508) combined with net in migration (+3,540) pushed the total number of residents in the region to 190,180 people.

However, even with the increases, population growth rate in Eastern Oregon (4.4%) was less than half the overall growth rate in the State of Oregon (9.5%) for the period. While natural increase (births minus deaths) and net migration (in-migrants minus out-migrants) were both positive for the region, the two components varied among individual counties, creating notable differences in population shifts over time. According to Oregon Employment Department and Portland State University Population Research Center Grant and Harney Counties were the only ones in Eastern Oregon to experience a loss in population for the eight-year period.

Table 3. Grant County – Incorporated Cities Population 2000 & 2018.

Community	Population 2010	Population 2018	Change in population	Percent change
Canyon City	703	668	-35	-5.0%
Dayville	149	144	-5	-3.4%
Granite	38	37	-1	-2.6%
John Day	1744	1665	-79	-4.5%
Long Creek	197	189	-8	-4.1%
Monument	128	124	-4	-3.1%
Mt. Vernon	527	512	-15	-2.8%
Prairie City	909	878	-31	-3.4%
Seneca	199	207	8	4.0%
Sub-total of Cities	4594	4424	-170	-3.7%
Unicorporated Grant County	2851	2752	-99	-3.5%
Total	7445	7176	-269	-3.6%

Source: US Census Population and Housing Unit Estimates, consulted May 2020

Vulnerable Population Groups

People of certain population groups may be more vulnerable to natural hazards by virtue of age, both the youngest and the oldest; language, non-native English speakers, for example; educational background and household characteristics. Combinations of these factors may further exacerbate vulnerability. Elderly residents living alone are among the most vulnerable during natural disasters.

Age

Both children and the elderly are more vulnerable than are others to the risks posed by natural hazards.

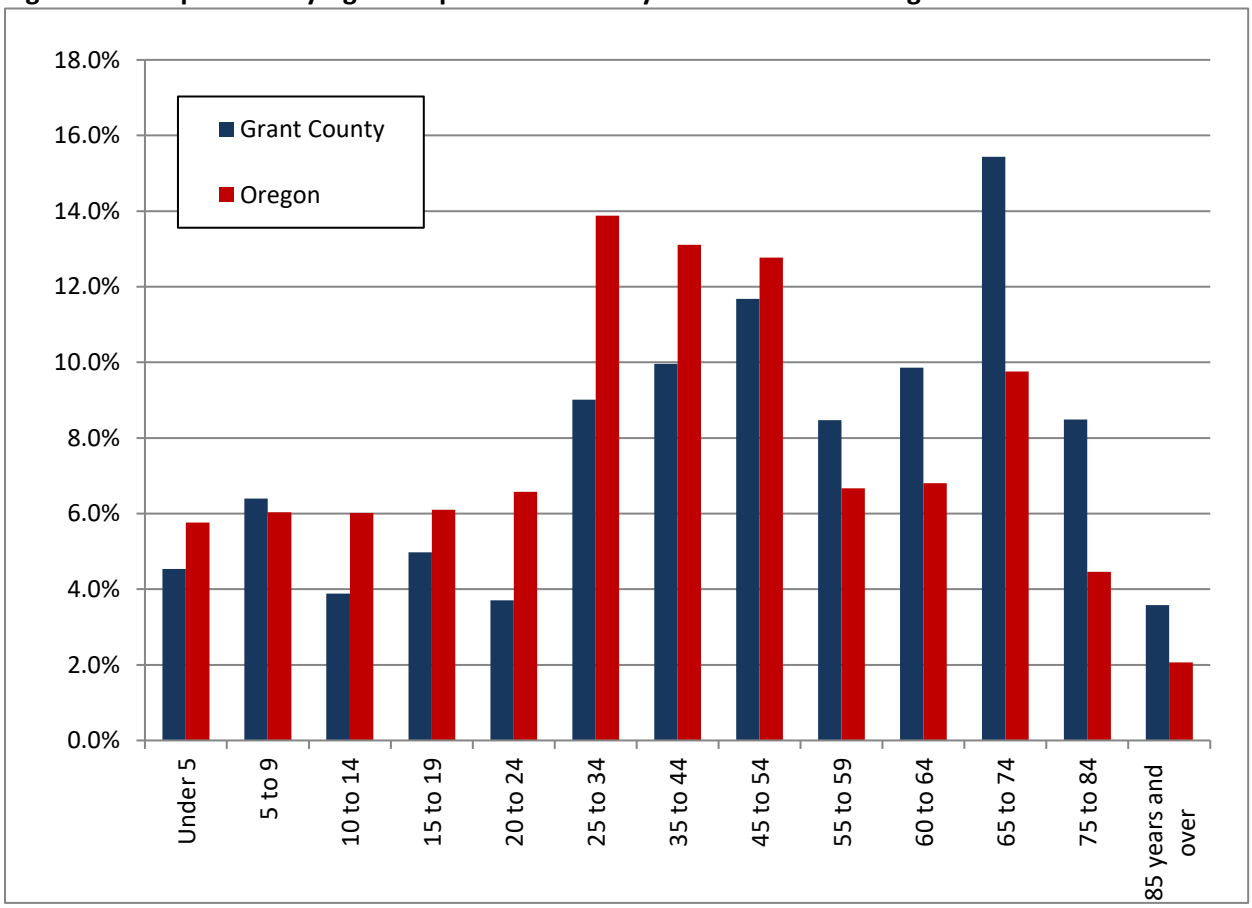
Many seniors are sensitive to heat and cold, reliant upon public transportation or other people to transport them to obtain medication and access medical facilities, and have comparatively more difficulty in making home modifications that reduce risks to hazards. In addition, seniors may be reluctant to leave home in a disaster event. This implies the need for targeted preparatory

programming that includes evacuation procedures and shelter locations accessible to seniors.[22] Seniors living alone may have more challenges knowing about and responding to a disaster than those living with other people.

Young children are also more vulnerable to heat and cold, have fewer transportation options, and require assistance to obtain medication and access medical facilities. In addition, parents may lose time and money when childcare facilities and schools are impacted by disasters. Therefore, special consideration should also be afforded young children, schools, and parents during the natural hazards mitigation process.[23]

Figure 6 below shows Grant County's population by age group. Like many rural areas, the percentage of the population over 55 is relatively high for Grant County, especially compared to the State of Oregon as a whole.

Figure 8. Population by Age Group in Grant County and the State of Oregon



Source: U.S. Census Bureau, 2013---2017 American Community Survey.

[22] Oregon NHMP: Oregon Department of Land Conservation and Development, 2015
[23] Ibid.

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. A small proportion of Grant County's population speaks a language other than English at home. While the vast majority of residents speak only English at home (95%), there are over 300 county residents who languages other than English at home. Spanish speakers comprise the majority of those.

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 supporting potential employment in the professional, governmental and service sectors. 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, 33.3% of the Grant County population over 25 years of age has graduated from high school or received a high school equivalency, with approximately 10.7% going on to earn a Bachelor's Degree.[24] In 2017-2018, the county's largest school - Grant Union High School - had an on time graduation rate of 86%. 97% of students earned their high school diploma or GED within five years. The county's 2nd largest school, Prairie City School, showed similar attainment.

Living Arrangements

As described in Volume I as part of the Vulnerability Assessment the 2020 Grant County NHMP Steering Committee identified people living in poverty as a vulnerable population. The American Fact Finder data for 2017 estimates that there were a total of 3,176 households (family and non-family households) in Grant County. Among the most vulnerable people are people living below the poverty line whether they live in families or not. Of all families in Grant County, 8.6% or 172 families of the total 2,002 families in Grant County are families whose income in the preceding 12 months was below the poverty level. Of families headed by a female householder with children under 5 years old in Grant County, 38% or 71 of these 187 single female parent families were living in poverty. Of people living alone, 335 single person households or others not living in families are living below the poverty line in Grant County. [25]

Seniors living alone may have more challenges knowing about and responding to a disaster than those living with other people. Based on the US Census American Fact Finder data for 2017 out of the 3,176 households in Grant County, 973 households were 1-person households. Of these 1-person households, 50.3% or 490 households are people over 65 years old living alone in Grant County.[26]

[24] US Census, 2018 American Community Survey (Educational Attainment), consulted May 2020
[25] US Census, consulted May 2020
[26] Ibid.

Home Ownership

Housing occupancy data may relate to factors that influence resilience to natural hazards, both positively and negatively. On the positive side, length of occupancy in the same residence may reflect how strongly people are tied to their community. Strong community ties may support community resilience in the face of a flood or fire. In addition, those who own their homes may be more likely to prepare their homes to be more resistant to natural hazards, such as maintenance of defensible space to combat the threat of wildfires.

In Grant County, there are 3,176 housing units, of which 2,323 (73.1%) are owner occupied. This is well above the Oregon statewide average of 61%.[27] Of the owner occupied housing in Grant County, a high percentage – 54.5% - is not burdened by a mortgage.[28] Requirements may be place on owners by mortgage lenders, such as obligatory flood insurance purchase for structures located in the FEMA floodplain. However, those home owners who do not hold mortgages, may drop flood insurance policies after the mortgage is paid off, particularly if household income is limited.

3. Economics

Income and Poverty

Household income and poverty rates are indicators of the stability of the local economy and broader community resilience to natural hazards. People living in poverty suffer a disproportionate burden from disasters. They are more likely to be isolated and less likely to have the assets to withstand economic setback. When a disaster interrupts work, the ability to provide housing, food, and basic necessities becomes increasingly difficult. In addition, low-income populations are hit especially hard as public transportation, public food assistance, public housing, and other public programs upon which they rely for day-to-day activities are often impacted in the aftermath of the disaster. [29]

Median household income across Grant County in 2017 was $44,826. Between 2010 and 2017 median income rose significantly in some cities within Grant County. Table 2 below shows the change in median household income for the state, the county and the cities in Grant County from 2010 to 2017, as well as the household poverty rate for those jurisdictions.

[27] Ibid.
[28] Ibid.
[29] FEMA Local Mitigation Planning Handbook, 2013

Table 3. Median Household Income and Households below the Poverty Level

Community	Median Household Income 2010	Median Household Income 2018	% Change	2010 % of Families in Poverty	2018 % of Families in Poverty
Oregon	$46,560	$63,426	36.2%	15.8%	12.6%
Grant County	$35,974	$45,357	26.1%	11.4%	7.6%
Canyon City	$47,917	$50,781	6.0%	11.4%	5.3%
Dayville	$27,321	$38,750	41.8%	0%	0%
John Day	$31,833	$40,192	26.3%	12.7%	11.4%
Long Creek	$20,833	$36,667	76.0%	17.7%	22.0%
Mt, Vernon	$34,180	$37,500	9.7%	10.6%	8.3%
Prairie City	$37,731	$48,646	28.9%	14.3%	10.2%
Seneca	$32,500	$39,659	22.0%	10.1%	1.5%

Source: US Census Bureau (https://www.census.gov/), Tables S1901 and S1702 consulted May 2020.

Within the wider region of Eastern Oregon, in 2017 the combined personal income of the residents of Baker, Grant, Harney, Malheur, Morrow, Umatilla, Union, and Wallowa counties) totaled about $6.8 billion in 2017, up from $5.1 billion in 2008, a growth rate of 33 percent. Baker County had the highest rate of personal income growth in the area (41%), followed by Grant (39%), Harney (34%), Wallowa (34%), Umatilla (33%), Morrow (32%), Malheur (30%), and Union (29%). Eastern Oregon's rate of growth was well below Oregon's statewide growth of 43%.

These data would suggest that those communities with higher poverty rates bear a disproportionate burden from disasters; those families in poverty are more likely to be isolated and when work is interrupted by a disaster, the ability to provide housing, food, and basic necessities becomes increasingly difficult for them.

Employment and Wages

According to the Oregon Employment Department and shown in Table 3 below, unemployment declined from 2009 to 2018 reflecting recovery from the Great Recession of 2008. However, unemployment in northeastern Oregon, remains higher than the State unemployment rate.

The understanding of the impact on unemployment by the COVID-19 pandemic in 2020 remains incomplete at the time of this writing. An April 21, 2020 Press Release from the Oregon Employment Department reported that statewide the department received 53,800 initial claims for unemployment

benefits from April 5-11. That's in addition to a revised total of 243,000 initial claims filed during the prior three weeks, March 15 to April 4. In comparison, the Employment Department received just 14,820 initial claims during the comparable four-week period in 2019 (March 17 to April 13). This surge in claims is unprecedented.[30]

In Eastern Oregon, initial claims had surged as well, with 2,473 processed initial unemployment insurance claims for the four-week period, March 15 to April 11. This represents a significant increase over the 379 claims during the comparable four-week period in 2019. All Eastern Oregon counties have seen a relatively large upswing in unemployment insurance claims. The majority of claims have come from four industries: accommodation and food services, health care and social assistance, manufacturing, and retail trade. [31]

Table 4. Unemployment Rates in Northeast Oregon (Region 7)

Community	Employment 2009	Employment 2018	Unemployment Rate 2009 (%)	Unemployment Rate 2018 (%)	% Change in Unempl. Rate
Oregon	1,608,760	1,920,804	11.3%	4.2%	-62.8%
Grant County	2,319	2,482	13.7%	7.3%	-46.7%
Baker County	5,286	5,544	10.4%	5.5%	-47.1%
Union County	9,447	10,173	11.6%	5.4%	-53.4%
Wallowa County	2,362	2,572	12.0%	6.1%	-49.1%

Source: Oregon Employment Department, Local Area Unemployment Statistics, accessed August 29, 2019.

4. NHMP Plan Holders - Jurisdictions and Institutions

Grant County

Grant County is located in the northeastern portion of the state and is bordered by Morrow, Umatilla, and Union Counties on the north, Baker and Malheur Counties on the east. Harney County on the south and Crook and Wheeler Counties on the east. The total area of Grant County is 4,528 square miles (11,727 square km). A significant portion of the county (70%) is federally or state owned with about 50% of the area of the county being part of the Ochoco or Malheur National Forests.

[30] Oregon Employment Department, April 21, 2020 Press Release
[31] Ibid.

The geography of Grant County consists of the rugged Blue Mountain range, which is a part of the Columbia River Plateau. Grant County features river canyons and high plateaus, which are interspersed with wide grasslands. The headwaters of the John Day, Malheur, North Fork John Day, and Silvies Rivers all originate within Grant County.

The economy of Grant County historically has been mainly forest products, agriculture and livestock, hunting, and recreation. Since 2005, there has been a significant decline in the forest products infrastructure in the county due primarily to the lack of consistent and stable supply of suitable raw materials. Agriculturally, the county is primarily livestock country with vast spring, summer and fall temperature ranges. In addition to beef cattle, which are the dominant livestock interest, there is also extensive raising of sheep, dairy herds, horses and swine. Field crops grown on commercial basis include potatoes, alfalfa, wheat, oats, barley and onions.

City of John Day

The City of John Day sits at the intersection of State Highways 26 and 395 and in 2018 had a population of 1,665 people, making it the largest city in the county.[32] It was named for the John Day River which runs east to west through the city. The County seat of Canyon City is adjacent to John Day to the south. The city is at an elevation of 3,087 feet and is surrounded by the Strawberry Range to the south other ranges of the Blue Mountains to the east and west.

Historically, industrial and agricultural businesses like gold mining, sheep and cattle ranching, timber harvesting, and lumber milling have been the economic mainstays of the community. Today, the economy of John Day is dominated by four industries: educational services, health care and social assistance, agriculture and government services.[33]

However, three decades of steady population decline has left the City of John Day struggling to find sufficient revenue to fund basic public services. The disruption to the natural resource-based economy in the 1990s and the subsequent loss of family-wage jobs created a vacuum filled largely by the unemployed, marginally employed and by retired residents living on fixed incomes.

The City has multiple initiatives focused on recovering financially and stemming the tide of population decline. It embraces being globally interconnected to digital economy of the Information Age. The strategy for growth views residents as customers who have a choice about where they live and where they spend their money. Today, the City is losing market share because its customers are leaving, and those customers are leaving because the City is not providing the amenities that will keep them here. A new strategy is being developed that clearly aligns spending priorities, investment options and decision-making with the growth they need to revitalize their community.[34] Resilience to natural hazards can be part of that strategy. A community that has a strong, well rounded economy can more easily mitigation for natural hazards, but recover from them when they do occur.

[32] US Census American Fact Finder 2018 Population Estimates

[33] Ibid

[34] A Strategy for Growth, John Day City Manager, January 24th, 2017

Grant County Education Services District

The mission of Grant County Education Service District (ESD) is to assist school districts and the State of Oregon in providing excellent and equitable educational opportunities and successful learning environments for all Grant County students. Grant ESD is dedicated to providing leadership in helping to achieve Oregon's education goals and working in partnership with schools and the community to enhance the healthy development of children and their families.

Grant ESD meets the challenge of its mission by providing services to its constituent districts that serve over 800 students in a 4,500 square-mile area. Schools and school districts within the Grant County ESD include: Grant School District which is comprised of Grant Union Junior and Senior High School, Humboldt Elementary, and Seneca Elementary; Dayville School District, Long Creek School District, Monument School District and Prairie City School District.

Grant School District

Grant School District is developing a long-range plan to address millions of dollars of needed repairs to its three schools and the district offices. In January 2020, the district received an estimate for the cost of major repairs at Humbolt Elementary, Grant Union Junior-Senior High School, Seneca Elementary and the District Office and is weighing the costs and benefits of repairs or replacement.[35]

The Grant School District, headquartered in Canyon City, OR and is made up of the three schools described below.

Grant Union Junior and Senior High School

Grant Union Junior and Senior High School is a public school located in the City of John Day. It serves grades 7 through 12. Enrollment in 2017-18 was 261 students. The south end of the building was seismically retrofitted with $1,234,950 in funding from Business Oregon. The principal risk posed by natural hazards is flooding. The impact of ground water seepage exacerbates the risk of riverine flooding.

Humbolt Elementary

Humboldt Elementary School is a public school located in the City of John Day. It serves grades K through 6. Enrollment in the 2017-18 school year was 309 students. The lower building was retrofitted to resist seismic damage with a $942,300 award from Business Oregon. Heating and cooling upgrades in seven of fourteen classrooms were completed recently. The electrical system dates from the 1960s and poses a fire hazard.[36] These repairs are a priority for the school district.

[35] Ibid.

[36] Blue Mountain Eagle, January 28, 2020, https://www.bluemountaineagle.com/news/district-developing-plans-to-repair-facilities/article_4ff62fcc-3d99-11ea-bc00-232eb6ae2b5a.html

Seneca Elementary

Seneca Elementary School is a public school located in Seneca, Oregon. It serves grades K through 6. Enrollment in the 2017-18 school year was 31 students.

Dayville School District

Dayville Elementary School is a public school located in Dayville, Oregon. It serves grades K through 12. Enrollment in the 2017-18 school year was 48 students. The school completed a Healthy and Safe Schools Plan in 2016. A recent bond measure was passed to support repairs and seismic retrofitting to the school buildings.[37]

Long Creek School District

Long Creek School is a public school located in Long Creek, Oregon. It serves grades K through 12. Enrollment in the 2017-18 school year was 36 students. The school has an International Student program.

Monument School District

Monument School is a public school located in Monument, Oregon. It serves grades K through 12. Enrollment in the 2017-18 school year was 47 students.

Prairie City School District

Prairie City School is a public school located in Prairie City, Oregon. It serves grades K through 12. Enrollment in the 2017-18 school year was 144 students. Prairie City School District was awarded a $2,496,990 grant to seismically retrofit the gym and cafeteria. [38]

Grant County Soil and Water District (Grant SWCD)

Soil and Water Conservation Districts (SWCDs) are local units of government that manage natural resource programs at the local level. Districts work in urban and rural settings with landowners and other units of government to carry out programs for the conservation and enhancement of soil, water and other natural resources.

The Grant SWCD was officially organized under Oregon Soil and Water District Law, with the issuance of a Certificate of Organization by the Secretary of State on July 30, 1956. The need for this District and determination of its boundaries were completed at a public hearing held March 8, 1956, at the Courthouse in Canyon City.

The original intent of organizing the Grant SWCD was to obtain technical assistance for landowners in working out their problems in range management, erosion control of streams, irrigation development,

[37] https://39dd929c-8a65-4b55-ba20-781c7e44c091.filesusr.com/ugd/05e59c_ecc0b8ee339c4bdb957af9d599d7ee44.pdf

[38] Business Oregon website, https://www.orinfrastructure.org/Infrastructure-Programs/Seismic-Rehab/ consulted May 2020.

and other conservation work. Early objectives of the District included development of full and lasting use of water, land, and other resources. This was to be pursued by entering into cooperative agreements and working with individuals and groups of ranchers and farmers, and enlisting the help of all existing organizations and agencies.

Today, the Grant SWCD is committed to sustainable conservation through leadership, education, planning and implementation of environmentally sound projects to ensure the long term productivity and responsible management of Grant County's natural resources.

B. Built Environment

1. Settlement Patterns

Balancing growth with hazard mitigation is key to planning resilient communities. Therefore, understanding where development occurs and the vulnerabilities of the region's building stock is integral to developing mitigation efforts that move people and property out of harm's way. Eliminating or limiting development in hazard prone areas can reduce exposure to hazards, and potential losses and damages.

Since 1973, Oregon has maintained a strong statewide program for land use planning. The foundation of Oregon's program is the 19 Statewide Land Use Planning Goals that "help communities and citizens plan for, protect and improve the built and natural systems." These goals are achieved through local comprehensive planning. The intent of Goal 7, Areas Subject to Natural Hazards, is to protect people and property from natural hazards.[39]

Grant County, John Day and the incorporated cities have an acknowledged comprehensive plan and implementing ordinances. Each city in the county also has identified an urban growth boundary intended to identify lands needed to accommodate population and employment growth for a 20-year period.

Most of the developed land in Grant County is within the Hwy 26 corridor between Dayville and Prairie City with a significant amount of this in John Day. Approximately 57% of the population lives in this area. Figure 1 in Volume I depicts the population density of Grant County.

While almost 6 out 10 residents live in the Highway 26 corridor, a significant amount of the building inventory for the county is located outside of this area. There are 8,417 buildings in Grant County. Of these, 59% or 4,933 are located in unincorporated areas (Figure 5). These structures account for 58% of the estimated total building value in the county. Much of the value of the structures in the unincorporated area is in agriculture facilities, whereas in the incorporated areas, the majority of the building stock is devoted to residential use.

[39] Department of Land Conservation and Development, http://www.oregon.gov/LCD/docs/goals/ goal7.pdf

Table 5. Building Inventory in Grant County

Community	Total # of Buildings	% of Total Buildings	Est. Total Building Value ($)	% of Total Building Value
Canyon City	439	5.2	114,298,000	5.6
Dayville	166	2.0	33,364,000	1.6
Granite	115	1.4	15,264,000	0.8
John Day	1,065	13.0	339,542,000	17.0
Long Creek	208	2.5	46,914,000	2.3
Monument	143	1.7	32,015,000	1.6
Mount Vernon	398	4.7	73,681,000	3.6
Prairie City	731	8.7	169,267,000	8.3
Seneca	219	2.6	35,692,000	1.8
Unincorporated County	4,933	59.0	1,169,279,000	58.0
Total Grant County	8,417	100.0	2,029,317,000	100.0

Source: Source: Natural Hazard Risk Report for Grant County, 2019. Oregon Department of Geology and Mineral Industries.

2. Critical or Essential Facilities

Critical facilities are structures and institutions necessary for a community's response to and recovery from emergencies. Critical facilities must continue to operate during and following a disaster to reduce the severity of impacts and accelerate recovery. When identifying vulnerabilities, consider both the structural integrity and content value of critical facilities and the effects of interrupting their services to the community.[40]

DOGAMI, in their risk assessment for Grant County, identified a number of critical facilities with data that came from the DOGAMI Statewide Seismic Needs Assessment.[41] We updated the SSNA data by reviewing Google Maps™ data. The critical facilities we attributed include hospitals, schools, fire stations, police stations, emergency operations, and military facilities. In addition to these standard building types, we considered other building types based on local input or special considerations that are specific to Grant County that would be essential during a natural hazard event, such as public works and water treatment facilities. Critical facilities are important to note because these facilities play a crucial role in emergency response efforts. Communities that have critical facilities that can function during and immediately after a natural disaster are more resilient than those with critical facilities that are inoperable after a disaster.

[40] FEMA Local Mitigation Planning Handbook, 2013

[41] Statewide Seismic Needs Assessment; Lewis, 2007

Table 6. Critical Facilities by Community

Critical Facilities by Community		Flood 1% Annual Chance	Earthquake Moderate to Complete Damage	Landslide High and Very High Susceptibility	Wildfire High Hazard
		Exposed	>50% Prob.	Exposed	Exposed
Dayville Sewage Treatment	County				X
Grant County Road Department	County	X			
Canyon City City Hall	Canyon City				
Canyon City VFD	Canyon City				
Grant County Courthouse	Canyon City				
Grant County Sheriff Dept	Canyon City				
Grant Union High School*	Canyon City	X			X
Humbolt Elementary School*	Canyon City				
Oregon Dept of Transportation	Canyon City	X	X		
Dayville Fire Department	Dayville				X
Dayville School	Dayville		X	X	X
Blue Mountain Hospital	John Day			X	
Grant County Elks Club	John Day				
Grant County Health Dept.	John Day				
Grant County Regional Airport	John Day				
John Day Fire Dept.	John Day				
John Day Fire Dept. (old)	John Day				
John Day Police Dept and City Hall	John Day				
John Day Radio Station KJDY	John Day	X			
John Day Sewage Treatment Plant	John Day				
Oregon Dept of Forestry	John Day	X			
Oregon State Police	John Day				
Oregon Trail Electric Co-op	John Day	X			
USFS Malheur District Office	John Day	X			
Long Creek City Hall	Long Creek				
Long Creek Fire Dept.	Long Creek				
Long Creek School	Long Creek				
Monument City Hall	Monument				
Monument School	Monument		X		
Mount Vernon City Hall	Mount Vernon				
Mount Vernon Fire Dept	Mount Vernon		X		
Mount Vernon Public Works	Mount Vernon		X		
Mount Vernon Sewage Treatment	Mount Vernon				
Oregon Telephone Corporation	Mount Vernon		X		
Prairie City Fire Dept. and City Hall	Prairie City				
Prairie City School	Prairie City		X		
Prairie City Sewage Treatment	Prairie City				X
Seneca Elementary School	Seneca				
Seneca Fire Dept and City Hall	Seneca				

Source: Grant County Natural Hazard Risk Assessment, DOGAMI, 2019

Blue Mountain Hospital District (BMHD)

Blue Mountain Hospital District (BMHD) is a non-profit organization directed by a local Board of Directors. The District consists of a 25-bed hospital located in John Day and a 40-bed care center in Prairie City. John Day currently has a general surgeon as well as several family practice providers, including physicians and nurse practitioners. They participate in the Oregon Health Sciences University Family Practice Residency program, which rotates residents and interns through the community on a regular basis.

Blue Mountain Hospital is well staffed, with most nurses ACLS and trauma-certified. There are three monitored ICU/CCU beds, two modern birthing suites, and two surgery suites that provide both inpatient and outpatient same-day surgeries. Blue Mountain Hospital is a level IV trauma hospital in the Oregon State Trauma System with 24-hour emergency department coverage, and medical evacuation to tertiary care centers by Air Link of Oregon and Life Flight. Blue Mountain Hospital has a helipad on site to offer rapid transport under critical circumstances. In addition, the hospital has an ambulance service that is staffed by volunteer EMTs and staff paramedics.

The hospital houses a Surgery Clinic and a Rural Health family practice clinic. The Surgery Clinic is staffed by a Board-Certified General Surgeon. The family practice clinic, Strawberry Wilderness Community Clinic (SWCC), has several providers including family physicians and nurse practitioners. They have two outreach primary care clinics in neighboring communities for those who have difficulty traveling the distance to the hospital. The hospital also offers monthly specialty clinics with physicians specializing in urology, ophthalmology, cardiology and podiatry.

Blue Mountain Care Center is an intermediate care facility that has skilled staff to provide care to the elderly and others who are unable to live independently. In addition to full-time care, the care center is licensed to provide adult day care when families need regular or occasional daytime relief from caring for their elderly family members.

3. Cultural and Historic Resources

Cultural and historic resources provide information about our past, insight into our present, and frame our local character and identity. Grant County has 10 sites on the National Register of Historic Places.

Grant County was established in 1864, a couple of years after gold was discovered in Whiskey Flat near present day Canyon City. This led to a spike in population in the Canyon City / John Day area. Along with this was an influx of Chinese immigrants. The Kam Wah Chung State Heritage Site in John Day explores the legacy of the Chinese workforce in Oregon. The site is based in a rustic building that was constructed as a trading post along The Dalles Military Road in the mid-1800s.[42] This tiny, unassuming

[42] Oregon Blue Book https://sos.oregon.gov/blue-book/Pages/facts/history/state-chinese.aspx

building became home to two Chinese immigrants, Ing "Doc" Hay and Lung On in 1888. Both became locally famous: Lung On as a general store proprietor and businessman, and "Doc" Hay as a practitioner of herbal medicine. For over 60-some years the building was a social, medical, and religious center for Oregon's Chinese community.[43]

The Kam Wah Chung Heritage Site is located along Canyon Creek, but outside the FEMA designated floodplain.

Figure 6: Kam Wah Chung Heritage Site, John Day, Oregon

Source: Oregon State Parks.

The John Day Fossil Beds National Monument is a U.S. National Monument in Wheeler and Grant counties. Located within the John Day River basin and managed by the National Park Service, the park is known for its well-preserved layers of fossil plants and mammals that lived in the region between the late Eocene, about 45 million years ago, and the late Miocene, about 5 million years ago. The monument consists of three geographically separate units: Sheep Rock, Painted Hills, and Clarno. The Sheep Rock Unit is the only one of the three located in Grant County.

[43] Oregon Parks web page on Kam Wah Chung, https://oregonstateparks.org/index.cfm?do=parkPage.dsp_parkPage&parkId=5

The units cover a total of 13,944 acres (5,643 ha) of semi-desert shrublands, riparian zones, and colorful badlands. About 210,000 people visited the park in 2016 to engage in outdoor recreation or to visit the Thomas Condon Paleontology Center or the James Cant Ranch Historic District.

Before the arrival of Euro-Americans in the 19th century, the John Day basin was frequented by Sahaptin people who hunted, fished, and gathered roots and berries in the region. After road-building made the valley more accessible, settlers established farms, ranches, and a few small towns along the river and its tributaries. Paleontologists have been unearthing and studying the fossils in the region since 1864, when Thomas Condon, a missionary and amateur geologist, recognized their importance and made them known globally. Parts of the basin became a National Monument in 1975.

Averaging about 2,200 feet (670 m) in elevation, the monument has a dry climate with temperatures that vary from summer highs of about 90 °F (32 °C) to winter lows below freezing. The monument has more than 80 soil types that support a wide variety of flora, ranging from willow trees near the river to grasses on alluvial fans to cactus among rocks at higher elevations. Fauna include more than 50 species of resident and migratory birds. Large mammals like elk and smaller animals such as raccoons, coyotes, and voles frequent these units, which are also populated by a wide variety of reptiles, fish, butterflies, and other creatures adapted to particular niches of a mountainous semi-desert terrain (Wikipedia).

The park headquarters and main visitor center are both in the Sheep Rock Unit.

Figure 7: John Day Fossil Bed National Monument, Sheep Rock Unit

Source: John Day Fossil Beds National Monument, Wikipedia, 2019.

The other prominent historic sites in Grant County include the Advent Christian Church in John Day, the James Cant Ranch Historic District, the St. Thomas Episcopal Church in Canyon City and the Sumpter Valley Railway and Historic District that extends from Prairie City to Baker City.

4. Infrastructure

Roads & Bridges

Surface transportation in Grant County is handled mainly by two US highways: Highway 26 and Highway 395. These highways are used predominantly by through traffic traveling across the state. Local traffic volumes are higher in the urban areas of cities. Highway 26 moves traffic east and west through the center of the county, providing access to the larger cities of Prineville, Madras, and Bend (via Highway 97) to the west and the cities of Baker City (via Highway 7) and Ontario to the east. Highway 395 is oriented in a north-south direction also through the center of the county, providing access to Pendleton to the north and Burns and Hines to the south. These two highways intersect each other, tying together the cities of Dayville, Mt. Vernon, John Day, Prairie City, Dale, Long Creek, Fox, Canyon City, and Seneca. On a local level, these highways serve as the principal corridors along which each of these cities is situated.

The Kimberly-Long Creek Highway (Highway 402) is a relatively short highway that begins and ends in Grant County. This highway connects the town of Kimberly with the cities of Monument, Hamilton, and Long Creek. It runs between Highways 19 and 395.

Portions of two other state highways are also present in Grant County. A section of Highway 19, roughly 19 miles in length, is located along the western border of the county line, which provides access to the town of Kimberly, Highway 207 to the northwest (Spray to Heppner), and Highway 26 to the south. Highway 7 is another highway which deviates from Highway 26 in a northeast direction toward Baker City in the eastern part of the county, providing the shortest connection to I-84.

In addition to the state highways, a network of county roads runs throughout the study area. County roads serve many purposes. They provide access to residences in rural areas around the incorporated cities. They also serve other smaller rural communities. County roads often connect to agricultural areas, recreational areas, and national forests.

Many of the county roads connect with the state highway system while others connect with city streets. Connections to the highways are generally located in the rural areas, although some direct connections are made within the city urban areas. The county roads in the John Day River valley are relatively short roads while longer and more extensive county roads serve other parts of the county.

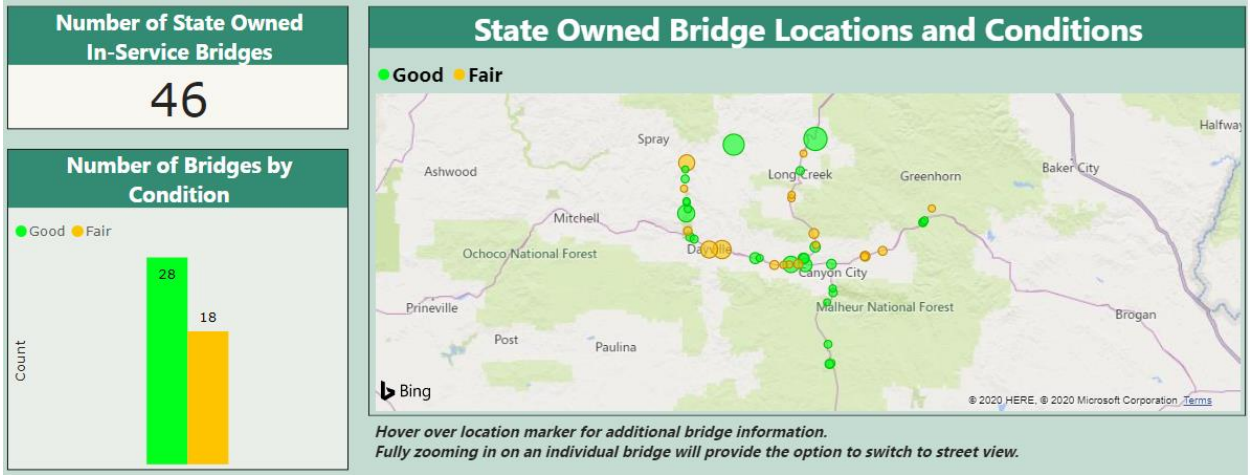
Some county roads provide alternate routes to state highways, allowing shorter, and more direct travel between some communities. County Road #63 from Highway 395 west to Highway 380 provides a parallel route to both Highway 26 and 20.

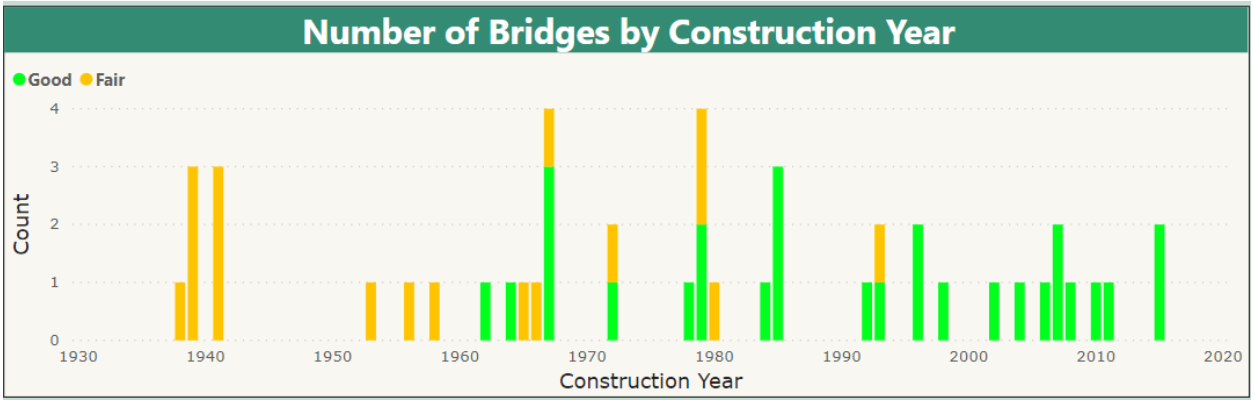
Public usage roads and USFS roads also play a role in Grant County. They generally provide access to the Malheur, Umatilla, and Ochoco National Forests and other public lands.[44]

[44] Grant County Comprehensive Plan 1997

The Oregon Department of Transportation (ODOT) inventories and assesses the condition of bridges in Oregon. According to the 2019 Interactive Bridge Condition Report[45] provided by ODOT, no bridges in Grant County are in Poor or Very Poor Condition. All bridges on OR 26 along the John Day River are in Good or Fair Condition. The same goes for the bridge across the North Fork of the John Day River along Route 402 near Monument.

Figure 9. Report on Grant County bridge conditions from Oregon Department of Transportation





Source: Oregon Department of Transportation 2019 Interactive Bridge Conditions Report

Public Transportation

The Grant County Transportation District operates a regional bus service known as The People Mover. In 2018, it transported 37,450 total passengers. The People Mover has a paid staff of 1.5 dispatchers, 10 drivers and a district manager.

[45] 2019 ODOT Bridge Condition Report, https://www.oregon.gov/ODOT/Bridge/Pages/BCR.aspx, consulted May 2020

Service includes the Red Line, a deviated fixed route that circulates through John Day and Canyon City every hour from 7am to 6pm. Another deviated fixed route runs between Prairie City and Mt. Vernon four times a day. Both of these routes are free. The People Mover offers free medical transportation to eligible Grant County veterans and non-emergent medical transportation through a contract with Greater Oregon Behavioral Health Inc.

It also provides transportation for the Long Creek, Monument and Kimberly areas to John Day, Bend, Burns and Walla Walla with reservations. On demand service is available from 8 a.m. to 6 p.m. Mondays through Fridays and from 9 a.m. to 4 p.m. Saturdays.

The People Mover staff has applied for grants to add the following:

- a 25-passenger ADA-compliant bus,
- a bus shelter at Grant Union high school, in coordination with Oregon Department of Transportation and Safe Routes to School,
- a weekly bus route from John Day to Ontario,
- and vehicle hardware and software that would allow real-time communication and tracking of vehicles as well as automated stop announcements and other features.[46]

Railroads

No passenger or freight rail lines currently pass through Grant County. The nearest operating service is the Class I Union Pacific line that runs from Portland, through the Columbia Gorge, Pendleton, La Grande, and Baker City. Amtrak passenger service operates between Portland, OR and Spokane, WA on the Washington State side of the Columbia River. The nearest Amtrak stops to Grant County are in Wishram, WA (181 miles from John Day) and Pasco, WA (193 miles from John Day).

Airports & Emergency Rotary Landing Zones

Grant County has two public use airports, the Grant County Regional Airport and the Monument Municipal Airport. The Grant County Regional Airport (GCRA), also known as Ogilvie Field, is a 335 acre county-owned, public use airport with two runways.

The Grant County Regional Airport serves as a lifeline to this isolated part of the state and it is also a base for fighting wildfires. Access to the airport is good with a location on a high plateau just above the county's largest urban center of John Day/Canyon City. The Risk Assessment contained in Volume I: Basic Plan shows that this area is located in an area of Very High Landslide Susceptibility. Until updated landslide hazard mapping is completed, the risk of landslide should be considered when planning the additional runway and other improvements contemplated in the Grant County Regional Airport Master Plan.

The GCRA is also the helibase and training center for the United States Forest Service (USFS) Malheur Rappel Crew of firefighters. The Malheur Rappel Crew (MRC) is a Type One 29 person crew that specializes in initial attack and helicopter operations.[47] GCRA has become the national training center

[46] Blue Mountain Eagle, June 27, 2019, https://www.bluemountaineagle.com/specialsections/progress/progress-the-people-mover-expands-with-free-routes/article_5aad6902-8d5f-11e9-9e25-bb6436b87bb2.html

[47] https://www.fs.usda.gov/detail/malheur/landmanagement/resourcemanagement/?cid=fsbdev3_033854

for all USFS rappel crews. To facilitate crew training, the USFS have a rappel training tower located near the Terminal building.[48] It is staffed year around with peak operations generally occurring from May through October.

The US Forest Services and the Oregon Department of Forestry (ODF) use part of the Terminal Building for firefighting operations. They use approximately 39 percent of the building for offices, operation room, crew quarters, and hangar space. They also use an old apron adjacent to the Terminal for vehicle parking. The USFS owns two storage buildings south of the Terminal (chainsaw shop and helicopter rigging shop).

In addition, a Single Engine Air Tanker (SEAT) base is located at the northeast corner of the corporate apron as shown on Figure 2-8. It is used and maintained by the USFS and ODF for SEAT operations, including fire retardant refilling and parking. The current area has a single loading pit, one 10,000 retardant tank, one 6,000 water tank as well as one temporary trailer office and multiple storage sheds. The current space allows for two SEAT tie-down locations. The USFS and ODF use the airport helipads described in Section 2.4.4 for helicopter parking. Throughout the season, 2 to 9 additional landing areas are used for helicopters.

The Monument Municipal Airport (12S) is owned by the City of Monument and consists of a single 2,104 x 29 ft. asphalt runway.

The County also has three private airstrips which could be used in a natural disaster. The Cerny Airport (710R) 10 miles northwest of Seneca has a 1500 x 25 ft. turf runway, the Silvies Valley Ranch Airport (OG14) 7 miles south of Seneca has a 5,000' x 50 ft. asphalt runway, and the Longview Ranch Airport (OG39) 7 miles south of Kimberly has a 5,335 x 75 ft. asphalt runway[49] (www.airnav.com). The Grant County Emergency Manager reported that there are eight emergency landing zones for helicopters in Grant County as listed in Table 8 below.

Table 8. Emergency Rotary Landing Zones in Grant County

Location	Latitude/Longitude	Nearby Hazard
East Baseball Field, North of John Day River, John Day, OR	44.422190N / 118.945895W	Power lines near field
Prairie High School Football Field, Prairie City, OR	44.454823 / 118.709282W	Goal posts
Marked Helipad in Seneca, OR. Pad is immediately south of N. Bridge Rd. near intersection with John Day-Burns Hwy. NW of town.	44.140283N / 118.975109W	Large building just east of the landing zone

[48] Grant County Regional Airport Master Plan, December 2018

[49] www.airnav.com consulted November 2019

Dayville High School football Field, Dayville, OR.	44.462297N / 119.530166W	Goal posts
Monument High School Football Field, Monument, OR	44.821567N / 119.419852W	Goal posts
Mt. Vernon Old School - helipad, Mt. Vernon, OR	44.418879N / 119.116613W	Large building SW of landing zone
Long Creek School – open field east of the school and football field, Long Creek, OR	44.712977N / 119.097086W	Wire fence, Keen Forks Rd just north of landing zone
Granite Helipad (Jupiter Rd), Granite, OR	44.808764N / 118.423455W	Power lines, pine trees nearby. Use only in winter

Source: Grant County Department of Emergency Management, October 16, 2019.

5. Utilities

Electricity is provided to Grant County from three separate cooperatives which are described below:

Oregon Trail Electric Cooperative

Oregon Trail Electric Cooperative (OTEC) is one of Oregon's largest distribution cooperatives. Headquartered in Baker City, Oregon, with district offices in La Grande, John Day, and Burns, OTEC serves approximately 31,000 customers in Baker, Grant, Harney and Union counties with a network of overhead and underground lines over 3,000 miles long. OTEC's distribution system represents an investment of more than $153 million[50] (Oregon Trail Cooperative website).

Central Electric Cooperative

The Central Electric Cooperative (CEC) is another of Oregon's 18 member-owned cooperative electric utilities. CEC is a transmission and distribution cooperative. Its source of wholesale electricity is the federal power marketing agency, the Bonneville Power Administration. Central Electric Cooperative obtains this supply through Portland, Oregon based PNGC Power, a generation and transmission cooperative owned by 14 Northwest electric distribution cooperative utilities, including CEC. CEC provides electric service to portions of Deschutes, Crook, Jefferson, Grant, Linn, Wasco and Lake counties, in central and eastern Oregon. [51]

[50] Oregon Trail Electric Cooperative, https://otec.coop/

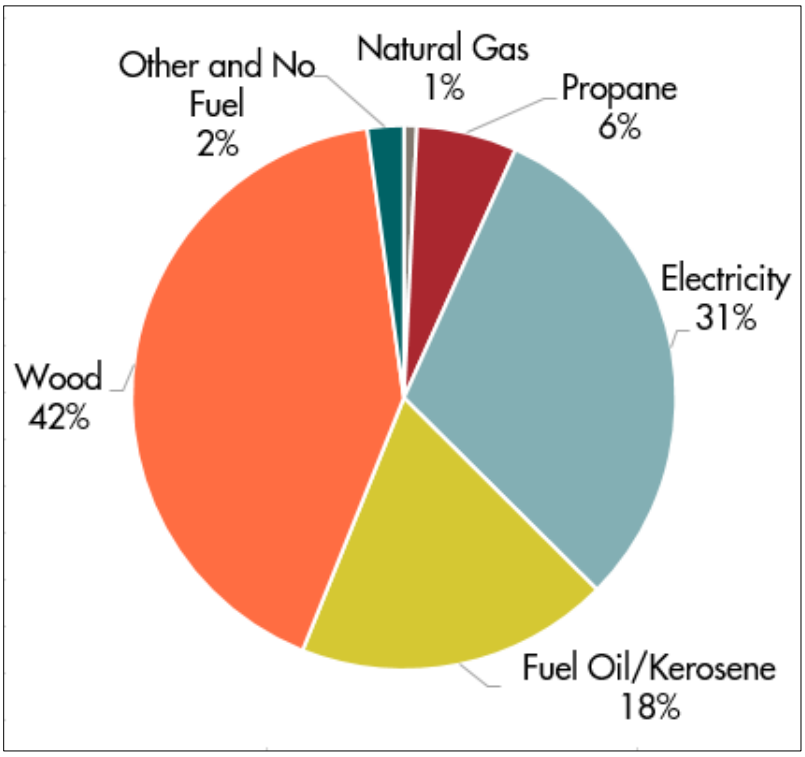
[51] Central Electric Cooperative, https://www.cec.coop/

Columbia Power Cooperative Association

Columbia Power Cooperative Association is located in Monument, Oregon. This organization has been in operation for 70 years in the electric power distribution industry.

Although just over thirty percent of Grant County residents use electricity to heat their homes, wood is the source of heat for forty-two percent of Grant County residents followed by fuel oil.

Figure 10: Home Heating Fuel Use in Grant County.



Source: Oregon Department of Energy, 2018 Biennial Energy Report.

6. Communications

Cellular service in Grant County is provided by Verizon Wireless and AT&T. There are 11 cellular towers in Grant County. There locations are as follows:

- 2 towers are located one mile north of John Day, at 44.4342N / -118.9589W
- 2 towers are located north of Hwy 26 at township and range address: T18S R30E Section 22.
- 2 towers are located in Prairie City.
- 1 tower is located 7.5 kilometers south/southeast of the town of Ritter, Oregon.
- 1 tower is located in Dayville, Oregon.

- 1 tower is located on Aldrich Mtn. approximately 8 miles SE of Dayville at 44.3772N / 119.4508W
- 1 tower is located near Indian School Rd.
- 1 tower is located on Eagles Peak.

The internet provider in Grant County is Century Link and the phone provider is Oregon Telephone Corporation.

7. Water and Waste Water Systems

John Day: John Day has emergency power to its # 3 well and portable emergency power to all other wells and to its water treatment plant. Reservoir capacity will serve up to four days of normal use. John Day and Canyon City water lines are tied together and can supply water to each other. The water distribution system includes three deep wells and a natural spring. The three wells are located on the north side of the John Day River while Long Gulch Spring is located on the south side of the John Day River along the east side of Highway 395 between John Day and Canyon City.

Canyon City: Canyon City has two systems; a high level system that feeds the upper level residents and a low level gravity system to the lower residents. There is currently no backup power for the water treatment plant which services Canyon City.

Seneca: Most of Seneca's water is power dependent with no emergency backup, however it does have a gravity fed system that can supply water for a few days. Water reservoir capacity is approximately 100,000 gallons.

Prairie City: Nearly 98 % of Prairie City's water is supplied by gravity fed springs. Wells are only used during summer and when there are shortages. The City currently has 2 active wells. The city's water and sewage treatment plants have backup emergency power. Water reservoir capacity is approximately 1,000,000 gals, approximately 2- 3 days of normal use. When tank capacity is reduced to 20 ft. Level firefighting capability may be compromised. Upper tank has approximately 82,000 gals of potable water.

Mount Vernon: Emergency power for the water supply is a diesel generator. The water reservoir can supply approximately 2 days of normal use. The water treatment plant has emergency power.

Dayville: Dayville water is supplied by 4 springs and a well that was drilled in 2008. The springs provide 14-18 gallons of water per minute and are supplemented by the well when necessary. Storage consists of a 124,000 gallon steel reservoir. There is a control building that has Chlorination room and a control and telemetry monitoring room. The water distribution line is total gravity fed. Estimated 2-4 days water of normal use.

Monument: The city of Monument does not have emergency power backup. Water reservoir capacity is approximately 3 days.

Granite: The town of Granite has no emergency power back-up. Has 1 well and 1 water storage tank. Unknown capacity

Appendix B: Planning and Public Process

A. Purpose

This Appendix describes the process of updating the plan, how the plan was prepared, who was involved and specific changes made to the *2014 Northeast Oregon Multi-jurisdictional Natural Hazards Mitigation Plan (2014 NHMP)* during the plan update process.

B. Background

The Disaster Mitigation Act of 2000 requires communities to update their mitigation plans every five years to remain eligible for Pre-Disaster Mitigation (PDM) program funding, Flood Mitigation Assistance (FMA) program funding, and Hazard Grant Mitigation Program (HMGP) funding. Grant County was a participant in the *2014 NHMP* that expired during the update process. In 2018 the Department of Land Conservation and Development was awarded an HMGP grant by FEMA to assist Grant County with its NHMP update. Grant County partnered with the Oregon Department of Land Conservation and Development (DLCD staff over the next year and a half to update the *NHMP* producing this document, the *2020 Grant County Multi-jurisdictional Natural Hazard Mitigation Plan.*

DLCD staff worked with Grant County's Emergency Manager, Ted Williams, to form the Grant County 2020 NHMP Steering Committee (Steering Committee) representative of the whole community. Initially the DLCD Natural Hazard Planner, Jason Gately, managed the project and met with members of the SC four times and conducted individual phone conversations and email conversation to guide SC work on the plan update. From late July through mid-September, FEMA was concurrently conducting a Risk MAP process that involved risk assessment and mitigation strategy development. These meetings are included in the NHMP update process. In January 2020 Katherine Daniel took up the project management and writing of the NHMP update and met with the Steering Committee an addition three times.

The Steering Committee includes representatives from Grant County and from the Cities of John Day, and Canyon City, the Grant Education Service District, the Grant School District #3, the Grant Soil and Water Conservation District, and Blue Mountain Hospital. Meetings were attended by a number of individuals representing other small cities in the county and representatives of private non-profits as well as citizens at large. Below is a list of the Steering Committee members and other participants who signed in at meetings.

C. 2020 NHMP Public Participation Process

1. 2020 NHMP Update

Grant County is dedicated to directly involving the public in the review and update of the natural hazard mitigation plan. Although members of the 2020 NHMP Steering Committee represent the public to some extent, the residents of Grant County, the Cities of John Day, Canyon City, Monument, Granite, Dayville, Prairie City, and Seneca were notified about opportunities to provide feedback about the NHMP through personal communication, public notices, Facebook posts and meetings. As described in Volume I: Section 4 - Plan Implementation and Maintenance, the NHMP will undergo formal review once per year.

Grant County Emergency Manager posted notification of steering committee meetings on the Grant County website and the Emergency Management Facebook page along with posted flyers in prominent locations. The project manager prepared a press release on March 19, 2019 to advertise the kickoff meeting. Later in the process, Grant County, the City of John Day, Grant ESD and Grant SWCD made the completed draft *2020 Grant County MJ NHMP* available via their websites prior to the final meeting for public comment on March 19, 2019. The Blue Mountain Eagle published two articles about the public process of updating the NHMP during the course of the project.

2. Public Involvement Summary

Keeping in mind the importance of representing the whole community, the 2020 Grant County NHMP Steering Committee (the Steering Committee) was assembled by Ted Williams, Grant County Emergency Manager, and Jason Gately, DLCD Natural Hazard Planner. A broad range of jurisdictions and agencies were solicited for potential participation. Opportunity to participate as a member of the steering committee was extended to representatives of all the incorporated cities in the county, local and regional agencies involved in hazard mitigation and agencies that have the authority to regulate development. Emails soliciting participation were sent to representatives from the county and cities, such as the County Judge, City Mayors, City Recorders, Planning Directors, Public Works Department Directors; Soil and Water Conservation and the Blue Mountain Hospital Special District Managers, School District Superintendents; representatives of US and Oregon agencies, such as the Oregon Department of Forestry, Oregon Water Resource Department, the Army Corps of Engineers, the Bureau of Land Management; owners of local businesses; local non-profits and involved citizen leaders.

The members of the Steering Committee volunteered their time to provided edits and updates to the NHMP during publicly advertised meetings and on an individual basis such comments being vetted in a public forum before inclusion in the document. Opportunities for the public to comment were provided at each meeting and through the Emergency Management Facebook page.

Not all those who were invited were able to participate in the NHMP Steering Committee, however, the FEMA Risk MAP webinar meeting and the Discovery meeting were well attended.

Project Steering Committee:

Dept. of Land Conservation & Development Project Managers:

Jason Gately and Katherine Daniel, Natural Hazards Planners

Representatives from the following organizations served as Steering Committee members for the Grant County Natural Hazards Mitigation Plan update process.

Grant County

Convener, Ted Williams	Grant County, Emergency Management
Scott Myers	Grant County Judge
Hilary McNary	Grant County, Planning
Shannon Springer	Grant County, Planning
Haley Walker	Grant County Municipal Airport, Manager

City of John Day

Nicholas Green	City of John Day, City Manager/Lead Planner
Daisy Goebel	City of John Day, Planner

Grant Soil and Water Conservation District

Jason Kehrberg	Grant Soil and Water District
Kyle Sullivan	Grant Soil and Water District

Grant Education Service District

Robert Waltenburg	Grant Education Service District, Superintendent
Bret Uptmor	Grant Education Service District, Superintendent for Grant District #3

Blue Mountain Hospital

Rebekah Rand	Blue Mountain Hospital, Emergency Medical Services Director
Krista Qual	Blue Mountain Hospice aide

Other Participants

Irene Jerome	Community Wildfire Coordinator
Don Mooney	Canyon City Council
Jana Peterson	Oregon Department of Forestry
Mark Webb	Blue Mountain Forest Partners
Barbara Dole	Citizen
Frances Preston	Citizen

The following pages include copies of meeting agendas and sign-in sheets from NHMP Steering Committee meetings, website screenshots, flyers, and other information that demonstrates the outreach that has been done during this NHMP update process.

The Risk MAP Discovery meeting was attended by a number of jurisdiction and agency representatives who did not attend other NHMP Steering Committee meetings. They included the City Manager of the City of Seneca, the City Recorder of the City of Monument, the City Recorder of the City of Long Creek, the Director of Public Works for the City of Dayville, the Director of Public Works and the Fire Chief for the City of Prairie City, the Office Manager for Long Creek Schools and the Outreach Coordinator for the North Fork John Day Watershed Council.

Summary of Outreach

Table 1. **Grant County NHMP Outreach Efforts**

Date	Description of Event/Activity
February 5, 2019	Ted Williams, Grant County Emergency Manager, convened the NHMP Committee to discuss the composition and role of members of the 2020 Grant County NHMP Steering Committee.
February 21, 2019	Flyer distributed around the county in post offices, the County Health Department, and the Courthouse promoting a survey mounted by the Project Manager and the Steering Committee.
March 14, 2019	Ted Williams convenes the first Steering Committee meeting. The responsibilities of all parties are reconfirmed. The Steering

	Committee members accept the lead on public engagement during the NHMP update process.
Spring, 2019	The Percolator, a local business and industry newsletter, profiles Ted Williams and in a separate article highlighted the Firewise Community program providing Irene Jerome's contact information and providing examples of Firewise program activities in Pine Creek, Middle Fork, Ritter and Upper Laycock Creek Road.
May 23, 2019	Ted Williams convenes the second Steering Committee meeting to consider the Risk Assessment phase of the NHMP update and to complete a Hazard Vulnerability Analysis. This meeting was advertised to the public with flyers posted in post offices, and the County Courthouse.
July 18, 2019	Ted Williams convenes the third Steering Committee meeting to begin discussing the Mitigation Strategy. This meeting was advertised to the public with flyers posted in post offices, and the County Courthouse.
July 26 – August 01, 2019	FEMA Risk MAP project initiates Discovery process through Community Information Exchange webinars with communities in Grant County.
August 21, 2019	Flyer distributed around the county in post offices, the County Health Department, and the County Courthouse advertising the results of the risk assessment exercise conducted at the second Steering Committee meeting.
August 22, 2019	Blue Mountain Eagle ran an article entitled "Natural hazards plan update underway" by Richard Hanners that highlighted the process of updating the NHMP and the benefits of doing so.
September 4-26, 2019	Intergovernmental Agreements signed establishing the relationship between DLCD and the plan holders and the expectations of each party.
September 9, 2019	Ted Williams convenes fourth Steering Committee meeting to complete the Mitigation Strategy analysis. This meeting was advertised to the public with flyers posted in post offices, and the County Courthouse.

January 2020	DLCD Project Manager position is filled by Katherine Daniel.
February 14, 2019	Ted Williams convenes fifth Steering Committee meeting to allow K. Daniel to confirm with the Steering Committee the work completed to date with DLCD staff member Jason Gately, who resigned his position in December 2019 including work as Grant County NHMP Project Manager.
March 2020	Emergency Manager Williams resigns his position.
April 10, 2020	Katherine Daniel convenes the sixth Steering Committee meeting.
May 2020	Grant County, the City of John Day, Grant Education Service District, and Grant Soil and Water Conservation District post the draft NHMP on their websites along with information about how to attend the seventh and final Steering Committee meeting.
May 6, 2020	Blue Mountain Eagle publishes an article about the NHMP process and the final Steering Committee meeting.
May 12, 2020	Katherine Daniel convenes the seventh and final Steering Committee meeting.

3. Steering Committee Meeting Agendas and Sign-in Sheets

Figure 1. February 5, 2019 Steering Committee meeting agenda

Grant County NHMP Update
County/DLCD Coordination Meeting

February 5th, 2019
10:00 – 12:00 PM

Grant County Emergency Management Offices
530 E. Main St., John Day, OR

A. Discuss the Intergovernmental Agreement. 10 min

B. Discuss the Scope of Work and revise as necessary or appropriate. 20 min

C. Discuss the current MJNHMP's strengths and opportunities for improvement; 10 min

D. Discuss the Draft Project Schedule and revise as necessary or appropriate; 10 min

E. Discuss Table 1: Allocation of Basic Responsibilities and Tasks and revise as necessary or appropriate. These basic responsibilities and tasks will be performed throughout the duration of the project in addition to other others described and deliverables assigned in Tasks 1 through 16. 20 min

F. Determine the method for and roles of DLCD and the COUNTY in inviting cities and special districts to participate in the planning process and designate SC members and alternates. SC members and alternates must have or have been delegated authority to make decisions and act on behalf of their jurisdictions for the purposes of this project. 10 min

G. Discuss the project initiation letter from DLCD to Grant County. 5 min

H. Draft a list of stakeholders, technical advisors, and other interested parties including at a minimum representatives of FEMA's six "whole community" sectors: 10 min

I. Prepare a draft Public Engagement Program for SC discussion and finalization. 20 min

J. Develop a Communication Protocol. 10 min

Grant County / DLCD Organizational Mtg. Page 1

Figure 2. February 5, 2019 meeting sign-in sheet

Grant County Natural Hazards Mitigation Plan
Project Coordination Meeting
February 5th, 10am-12pm

530E. Main St.

PLEASE SIGN IN (Sign your name or add to the list)			
Full Signature	**Name**	**Title**	**Representing**
	Jason Kolodzey	District Manager Grant SWCD	Grant SWCD
	TED WILLIAMS	BC Emergency Management	Grant Co.
	Shannon Springer	Assistant Planner	Grant Co Planning
	Scott W. Myers	County Judge	Grant Co.
	JASON GATELY	DLCD PLANNER	DLCD

Figure 3. March 14, 2019 Steering Committee meeting agenda

Grant County Natural Hazard Mitigation Plan Update
1st Steering Committee Meeting

Thursday, March 14, 2019, 10:00 to 12:00 PM
Oregon Department of Forestry - John Day Unit Office
415 Patterson Bridge Rd, John Day, OR 97845

OREGON
Department of Land Conservation & Development

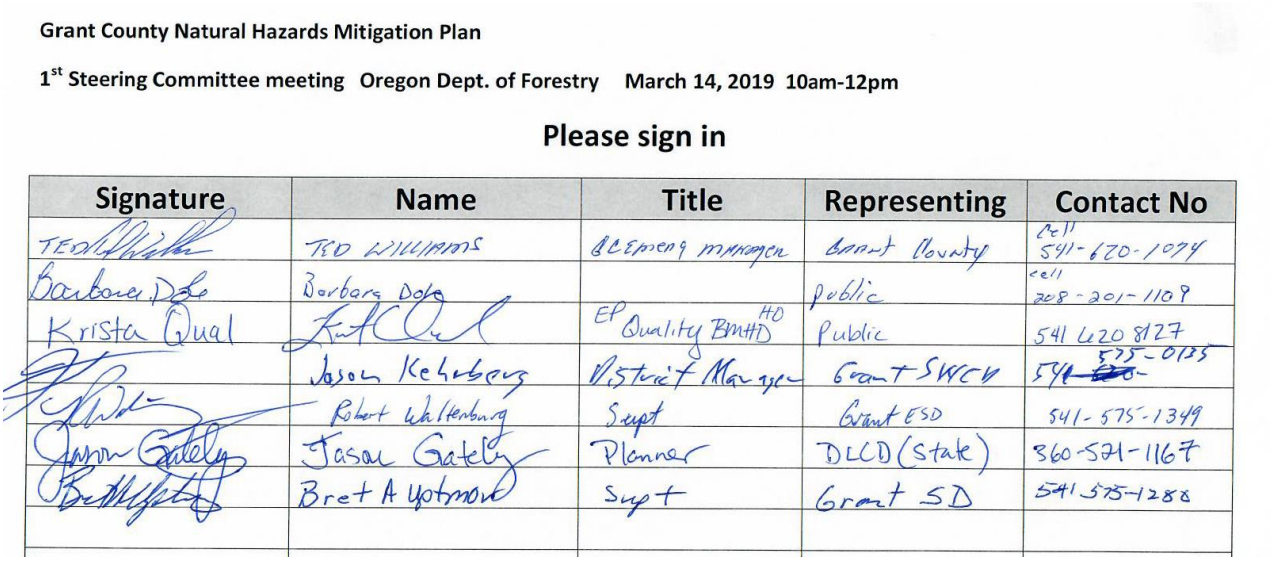
AGENDA

Introduction and Background	**10:00 – 10:10**
▪ Introductions ▪ Meeting Goals and Objectives ▪ Process Overview · Why are We Here?	
Natural Hazards Mitigation Planning Overview	**10:10 - 10:20**
▪ What is Natural Hazards Mitigation Planning? · Plan Elements · Guiding Principles · Funding Overview – Grants & Other Sources	
Review and Discuss the Intergovernmental Agreement (IGA)	**10:20 - 10:30**
▪ Comments or Questions?	
Review and Discuss the Scope of Work and Schedule (SOW)	**10:30 – 11:15**
▪ Go through each task, deliverable and roles and responsibilities ▪ Comments or Questions?	
Review and Discuss Public Engagement Program	**11:15 -11:30**
▪ The Grant County Steering Committee is the lead for public engagement ▪ Venues and formats? Online Survey? ▪ Comments or Questions?	
Review and Discuss Communication Protocol	**11:30 -11:45**
▪ Comments or Questions?	
Natural Hazard / Community Assets Worksheet	**11:45 -12:00**
▪ Homework! Email completed form to: Jason.gately@state.or.us	
Next Steps / Adjourn	**12:00**
▪ Steering Committee Mtg. #2: Risk Assessment – need a date and location. ▪ Action Items	

FEMA Local Mitigation Planning Handbook:
https://www.fema.gov/media-library-data/20130726-1910-25045-9160/fema_local_mitigation_handbook.pdf

Free Hazard Mitigation Planning Tutorials:
http://www.starr-team.com/starr/RegionalWorkspaces/RegionX/mitigationplanning/SitePages/2017_Coffee_Break.aspx

Figure 4. March 14, 2019 meeting sign-in sheet



Grant County Natural Hazards Mitigation Plan

1st Steering Committee meeting Oregon Dept. of Forestry March 14, 2019 10am-12pm

Please sign in

Signature	Name	Title	Representing	Contact No
	TED WILLIAMS	BCEmerg manager	Grant County	cell 541-620-1074
	Barbara Dole		Public	cell 208-201-1109
		EP Quality BMHD HO	Public	541 620 8127
	Jason Kelsberg	District Manager	Grant SWCD	541 575-0135
	Robert Waltenburg	Supt	Grant ESD	541-575-1349
	Jason Gately	Planner	DLCD (State)	360-571-1167
	Bret A Uptmor	Supt	Grant SD	541 575-1288

Figure 5. May 23, 2019 Steering Committee meeting Agenda

Grant County Natural Hazard Mitigation Plan Update
Steering Committee Meeting #2

Risk Assessment

May 23rd, 2019
10:00 to 12:00 PM
Oregon Department of Forestry - John Day Unit Office
415 Patterson Bridge Rd, John Day, OR 97845

AGENDA

Introduction and Background	**10:00 – 10:10**
▪ Introductions ▪ Meeting Goals and Objectives · Review what we are doing and the role of the Steering Committee · Conduct a Risk Assessment for Grant Co.	
Review Planning Process, Schedule, Cost Share and Goals	**10:10 - 10:25**
▪ Schedule Review ▪ IGA & Cost Share ▪ Plan Goals and Mission Statement	
Hazard Vulnerability Analysis (HVA)	**10:25 - 11:40**
▪ Hazard History Review ▪ Community Assets & Vulnerability Review ▪ Hazard Vulnerability Worksheet	
Public Engagement	**11:40 – 11:50**
▪ Opinion Survey ▪ Other Outreach Opportunities? Internet, festivals, senior centers, radio, newspaper, other? ▪ Photos of people and places.	
Next Steps	**11:50 -12:00**
▪ Next Steering Committee Meeting ▪ Action Items	

Figure 6. May 23, 2019 meeting sign-in sheet

Grant County Natural Hazards Mitigation Plan

1st Steering Committee meeting Oregon Dept. of Forestry May 23, 2019 10am-12pm

RISK ASSESSMENT –

Please sign in

Signature	Name	Title	Representing	Contact No
	Tamborine Williams	Alternate Mo Emergency Manager	Grant Co	541-575-1074
	Rebekah Rand	EMS & HEPP	BMHD	541-575-4159
	Don Mooney	Canyon City Council	Canyon City	541-792-9214
	Jason Kekuewa	Grant SWCD District Manager	Grant SWCD	541-575-0135
	Robert Walkenborg	Superintendent	Grant ESD	541-575-1349
	Haley Walker	GC Regional Airport Manager	GCRA	541-575-1151
	Bret A Upthegrove	Superintendent	Grnt SD	541-575-1280
	Krista Cheal	Quality, EP	BMHD - HH/HO	541-575-1648
	Nick Green	John Day City Mgr	John Day	541 575 0028
	Scott W. Myers	Grant County Judge	Grant County	(541) 575-0059
	Jana Peterson	Unit Forester	ODF	541-575-1139
	Shannon Springer	Asst Planner	Grant Co	541-575-1519

Figure 7. July 18, 2019 Steering Committee meeting agenda

Grant County Natural Hazard Mitigation Plan Update
Steering Committee Meeting #3

Mitigation Strategy

July 18, 2019
9:00 to 11:00 PM
Oregon Department of Forestry - John Day Unit Office
415 Patterson Bridge Rd, John Day, OR 97845

AGENDA

Introduction and Background	**9:00 – 9:10**
▪ Introductions ▪ Meeting Goals and Objectives · Review and Assess Past Mitigation Actions · Develop and Assess New Mitigation Actions at Next Meeting	
Updates	**9:10 - 9:20**
▪ Schedule Review ▪ Public Outreach / Survey / Flyer ▪ Cost Share	
Mitigation Strategy	**9:20 - 10:50**
▪ Review Risk Assessment Findings ▪ Review Plan Goals & Mission Statement ▪ Review and Assess Past Mitigation Actions	
Next Steps	**10:50 – 11:00**
▪ Action Items ▪ Fill Out and Turn In Cost Share Form.	

Add 7/18/19 sign-in sheet

Figure 8. September 9, 2019 Steering Committee meeting agenda

Grant County Natural Hazard Mitigation Plan Update
Steering Committee Meeting #4

Mitigation Strategy

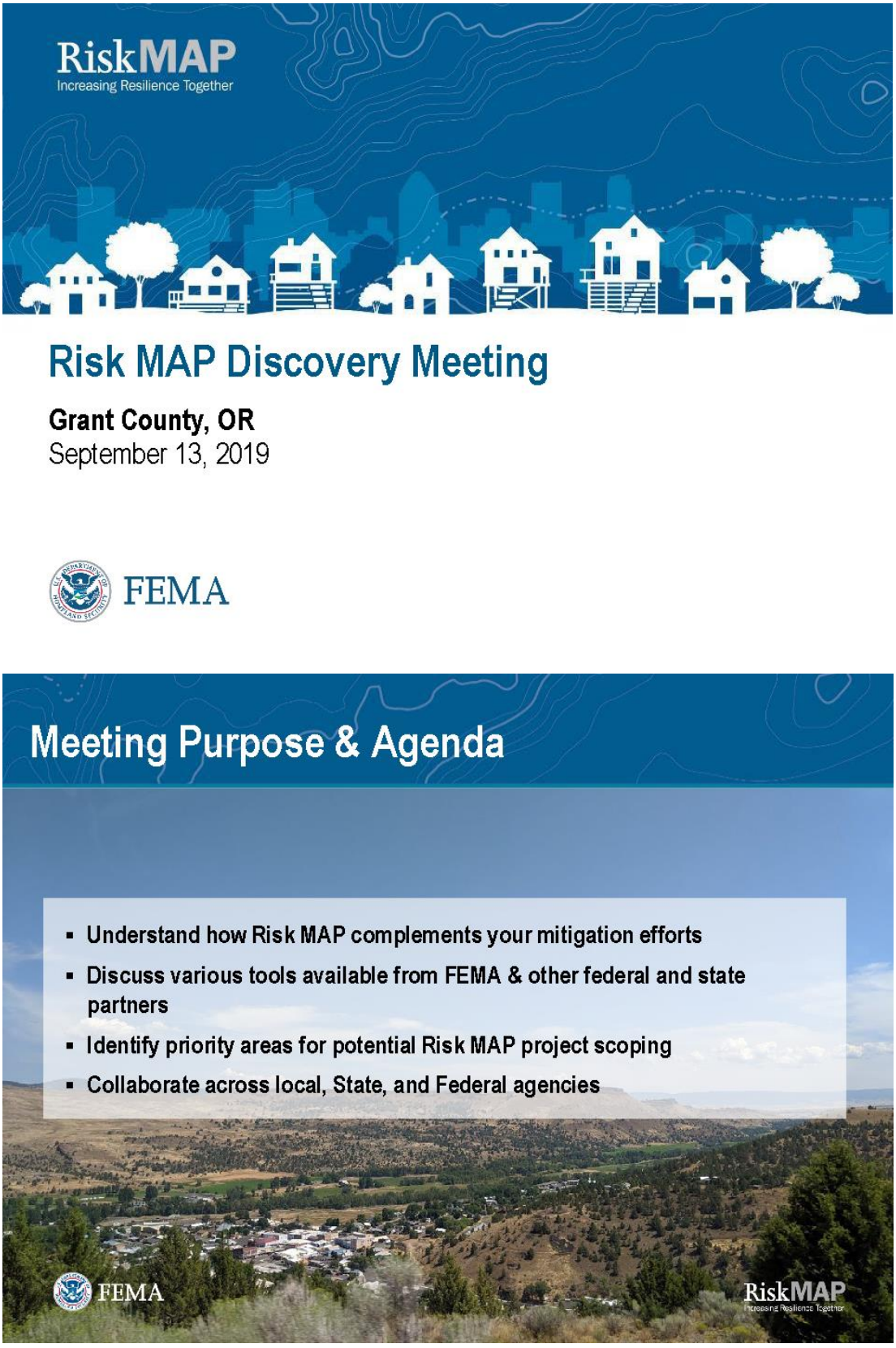
September 9, 2019
9:00 to 11:00 PM
Oregon Department of Forestry - John Day Unit Office
415 Patterson Bridge Rd, John Day, OR 97845

AGENDA

Introduction and Background	**9:00 – 9:10**
▪ Introductions ▪ Meeting Goals and Objectives · Review and Assess Updated Mitigation Actions List	
Updates	**9:10 - 9:40**
▪ DOGAMI Risk Assessment - Matt Williams, Geohazards Analyst (971-940-4908) ▪ Schedule Review ▪ Public Outreach / Survey / Flyer ▪ Cost Share ▪ IGA ▪ Risk MAP Discovery	
Mitigation Strategy	**9:40 - 10:30**
▪ Review and Assess Updated Mitigation Actions List	
Next Steps	**10:30 – End of Mtg.**
▪ Action Items ▪ Fill Out and Turn In Cost Share Form.	

Add 9/9/19 sign in sheet

Figure 9. FEMA Risk MAP notification



GRANT COUNTY & COMMUNITIES

DISCOVERY MEETING SIGN-IN | September 13, 2019

NAME	TITLE	COMMUNITY (COUNTY/CITY/AGENCY)	EMAIL
Hilary McNary	Planning Director	Grant County	mcnaryh@grantcounty-or.gov
Shannon Springer	Planning Assistant	Grant Co	geplan2 grantcounty-or.gov
Marsie Watson	City Recorder	Long Creek	citylc @ centurytel.net
Jason Gately	Natural Hazard Planner	State of Oregon	jason.gately@state.or.us
RAAMIN BARRELL	CITY MANAGER	CITY OF SENECA	ADMIN@SENECAOREGON.COM
Bret Uptmor	Superintendent	Grant school District #3	Uptmorb@Grant3SD.K12.OR.US
Nick Green	City Manager	John Day	greenn@grantcounty-or.gov
JOSEPH MURRAY	PLANNER	CMG-OFFICE OF EMERGENCY MNGT.	joseph-murray@mil.state.or.us
TED WILLIAMS	Grant Co Emergency Management	Grant County	twilliams1@grantcounty-on.gov
Vali Hettrick	Dayville		Vhettrick@msn.com

GRANT COUNTY & COMMUNITIES

DISCOVERY MEETING SIGN-IN | September 13, 2019

NAME	TITLE	COMMUNITY (COUNTY/CITY/AGENCY)	EMAIL
David Hand	City of Dayville Pblk Works Maintenance	Grant / Dayville	handdavid1@yahoo.com
CHRIS CAMARENA	DIRECTOR of PUBLIC WORKS	City of prineville City	pworks@ortelco.net
Marvin Pearson	Fire Chief Prairie City outreach Coordinator	City of Prairie City	pcfdmarvin@gmail.com
Kristian Thornton		city of Long Creek	Kris@nfjduc.org
Jennifer Garinger	Office Manager LC School EMS/Fire Long Creek	Long Creek	garingerj@grantesd.k12.or.us
Mark Webb	EED Blue Mountains Forest Partners	county-wide	bmfp06@gmail.com

GRANT COUNTY & COMMUNITIES

DISCOVERY MEETING SIGN-IN | September 13, 2019

NAME	TITLE	COMMUNITY (COUNTY/CITY/AGENCY)	EMAIL
Doug Jodan	City Recorder	City of Monument	cityofmonument@centurytel.Net

Figure 10. February 14, 2020 Steering Committee meeting agenda

Grant County Natural Hazard Mitigation Plan Update
Steering Committee Meeting #5

Risk Assessment Draft Review

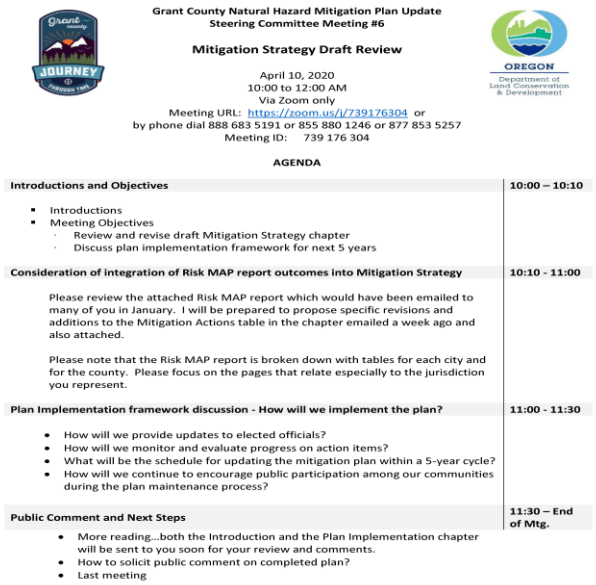
February 14, 2020
10:00 to 12:00 PM
Oregon Department of Forestry - John Day Unit Office
415 Patterson Bridge Rd, John Day, OR 97845

AGENDA

Introduction and Background	**10:00 – 10:10**
▪ Introductions ▪ Meeting Goals and Objectives · Review and revise draft Risk Assessment chapter	
Updates	**10:10 - 10:30**
▪ Schedule Review ▪ Public Outreach ▪ Cost Share	
Risk Assessment Chapter review	**10:30 - 11:30**
▪ Review and Revise Risk Assessment Chapter	
Next Steps	**11:30 – End of Mtg.**
▪ Review Mitigation Actions ▪ Draft Mitigation Chapter ▪ Set meeting for review of Mitigation Chapter ▪ Public Outreach on Risk Assessment and Mitigation Actions ▪ Public Comment	

Add 2/14/20 Sign in sheet

Figure 11. April 10, 2020 Steering Committee agenda



Grant County Natural Hazard Mitigation Plan Update
Steering Committee Meeting #6

Mitigation Strategy Draft Review

April 10, 2020
10:00 to 12:00 AM
Via Zoom only
Meeting URL: https://zoom.us/j/739176304 or
by phone dial 888 683 5191 or 855 880 1246 or 877 853 5257
Meeting ID: 739 176 304

AGENDA

Introductions and Objectives ▪ Introductions ▪ Meeting Objectives · Review and revise draft Mitigation Strategy chapter · Discuss plan implementation framework for next 5 years	**10:00 – 10:10**
Consideration of integration of Risk MAP report outcomes into Mitigation Strategy Please review the attached Risk MAP report which would have been emailed to many of you in January. I will be prepared to propose specific revisions and additions to the Mitigation Actions table in the chapter emailed a week ago and also attached. Please note that the Risk MAP report is broken down with tables for each city and for the county. Please focus on the pages that relate especially to the jurisdiction you represent.	**10:10 - 11:00**
Plan Implementation framework discussion - How will we implement the plan? • How will we provide updates to elected officials? • How will we monitor and evaluate progress on action items? • What will be the schedule for updating the mitigation plan within a 5-year cycle? • How will we continue to encourage public participation among our communities during the plan maintenance process?	**11:00 - 11:30**
Public Comment and Next Steps • More reading…both the Introduction and the Plan Implementation chapter will be sent to you soon for your review and comments. • How to solicit public comment on completed plan? • Last meeting	**11:30 – End of Mtg.**

Add April 10th meeting attendees, May 12th agenda and attendees

4. Grant County Outreach Materials and Media

A public engagement strategy was developed early in the process as illustrated in the 2020 Grant County Public Engagement Strategy document below. Flyers were prepared and utilized to educate Steering Committee members to promote public engagement. These flyers were posted in public locations until March 2020, when public engagement was restricted to notices posted online. Press releases stimulated interest in the NHMP process by reports at the local newspaper, the Blue Mountain Eagle. Two articles were published by the Blue Mountain Eagle over the course of the project. In the final months of the process, the plan holding jurisdictions and special districts posted the draft NHMP on their websites and steering committee meetings were held via video conference. The links to these video conference meetings were included in flyers and agendas posted regarding these meetings.

Figure 12. Public Engagement Strategy

2020 Grant County NHMP Public Engagement Strategy

Public engagement is a cornerstone of the NHMP Update. It may include such things as: scheduling, preparing for and staffing public outreach events, posting documents online and gathering comments, organizing mailers, meeting one on one with key stakeholders, or delivering a presentation to stakeholders. Public engagement for the update of the Grant County NHMP will consist of engaging three tiers (groups) of people at various times during the planning process. Grant County will be the lead for this task.

Public Engagement Objectives

Provide an opportunity for all citizens – the whole community - of Grant County to be involved in the planning process, to educate the citizens of Grant County on the risks of natural hazards in their community, to give the planning team a solid understanding of community concerns and values so that they can be reflected in the plan, and to ensure that the whole community clearly understands that their thoughts and concerns will be listened and responded to.

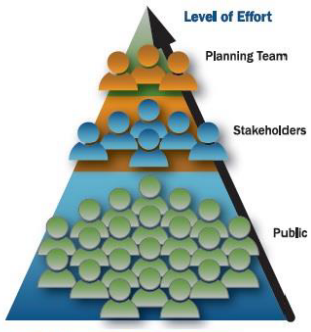


Figure 3.1: Outreach strategy framework

Tier One: The Planning Team

The Planning Team consists of the Grant County Project Conveyor, the Steering Committee and the DLCD Project Manager.

When to provide information and seek input

- At Steering Committee Meetings;
- When a draft of the Risk Assessment has been completed;
- When a draft of the Mitigation Strategy has been completed; and
- When a draft plan and a final have been completed.

How to provide information and seek input

- See the Communication Protocol for the Steering Committee (attached).

Tier Two: Stakeholders

Stakeholders, as defined by FEMA, are individuals or groups that can affect or can be affected by a mitigation action or policy. This may include: elected officials, business leaders, government agencies, cultural institutions, non-profit organizations, neighborhood groups, and academic institutions.

When to provide information and seek input

- At the beginning of the project to let people know what is happening and why;
- When a draft of the Risk Assessment has been completed;
- When a draft of the Mitigation Strategy has been completed; and
- When a draft plan has been completed.

How to provide information and seek input

- Via an internet based county wide opinion survey;
- Through presentations to specific groups;
- In one on one briefings and interviews;

- At well attended county events (fairs, rodeos, etc.);
- Through the news media (television, radio, online and print);
- On relevant social media sites, including jurisdiction web pages, Facebook and Twitter.

Tier Three: General Public

The general public is of all other citizens in Grant County.

When to seek input

- At the beginning of the project to let people know what is happening and why;
- When a draft of the Risk Assessment has been completed;
- When a draft of the Mitigation Strategy has been completed; and
- When a draft plan has been completed.

How to provide information and seek input

- Via an internet based county wide opinion survey;
- Through presentations to business and civic groups;
- In one on one briefings and interviews;
- At key county events (fairs, rodeos, etc.);
- Through the news media (television, radio, online and print); and
- On relevant social media sites, including jurisdiction web pages, Facebook and Twitter.

Other Things to Consider

Develop clear and consistent messages that align with community values

- Consider the overarching goals and values of the community and how they align with reducing the impacts of future hazards and disasters. Then, personalize talking points for discussions with different audiences and develop messages that appeal to them. For example, if a gold-medal trout stream or historic downtown is important to a community's identity and economy, then frame mitigation messages to emphasize these assets and the need for their long-term protection.

Evaluate and incorporate feedback from outreach activities

- The feedback you receive through outreach activities, such as completed questionnaires and surveys, comments at meetings, and comments on plan drafts, should be evaluated and incorporated into the planning team's decision making process and the final plan. Clearly communicate to stakeholders and the public how the planning team uses their feedback to inform the plan. Develop a process for organizing and evaluating the comments received, as well as documenting them in the final plan.

Document the Public Engagement Process

- The plan must document how the public was given the opportunity to be involved in the planning process and how their feedback was incorporated into the plan. The opportunity for participation must occur during the plan's development, which is prior to the comment period on the final plan and prior to plan adoption and approval.

Figure 13. Initial NHMP Public Engagement flyer

2020 Grant County
Natural Hazards Mitigation Plan Update

Wildfires, Floods, Drought, Winter Storms
What Concerns You?

Grant County is collaborating with the Oregon Department of Land Conservation and Development (DLCD) to update the counties plan for natural hazards. A Steering Committee, chaired by the Emergency Manager, is meeting now. The NHMP is targeted for completion by Fall 2020.

Please see the back of this flyer for how to get involved.

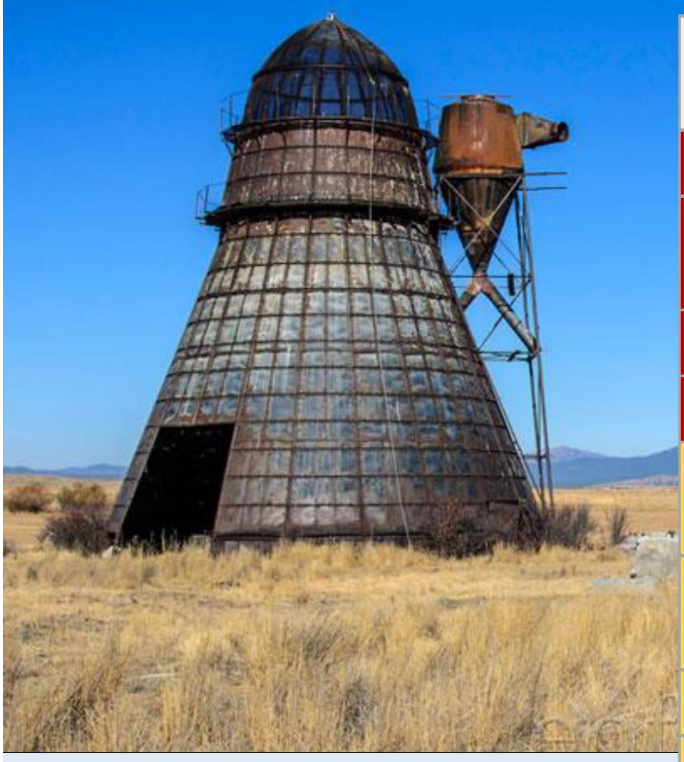
Project Contact:
Jason Gately, Project Manager | DLCD
#503-934-0043
Email: Jason.Gately@state.or.us

Why engage in natural hazard mitigation planning?

To avoid disasters by reducing or eliminating long-term risk to people, property, and the environment from natural hazards.

To maintain eligibility for federal disaster related funding.

To increase safety and resiliency by integrating hazard mitigation into the plans, programs, and policies



Grant County's Natural Hazards

Hazard	Risk Score	Risk Level (H-M-L)
Wildfire	240	High
Winter Storms	229	High
Floods	224	High
Droughts	216	High
Volcanic Events	158	Medium
Wind Storms	123	Medium
Landslides	120	Medium
Earthquake	84	Medium

How to Get Involved:

Check the Grant County Website and Facebook page for meeting dates and times, documents to review and an Online survey to complete; and

Call or Email the Project Manager for more information at 503-934-0043 or Jason.Gately@state.or.us

Figure 14. The second page of the second flyer was slightly revised to promote participation in the online survey and to promote attendance at meetings

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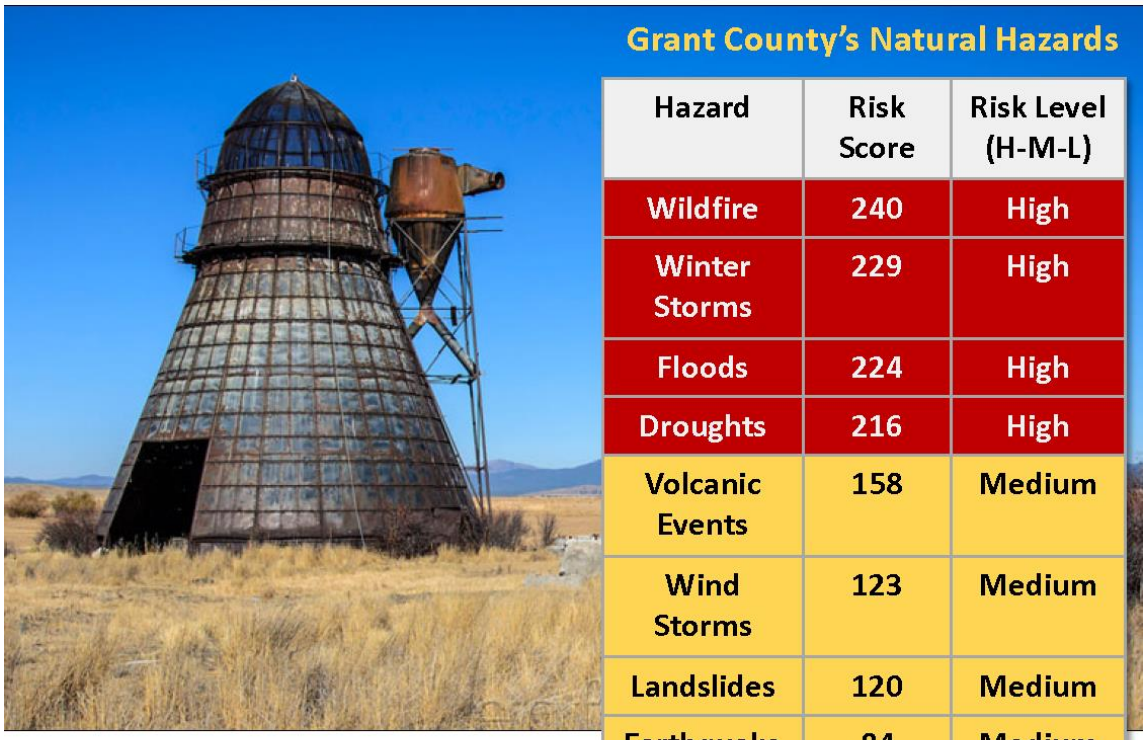

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Earthquake	84	Medium

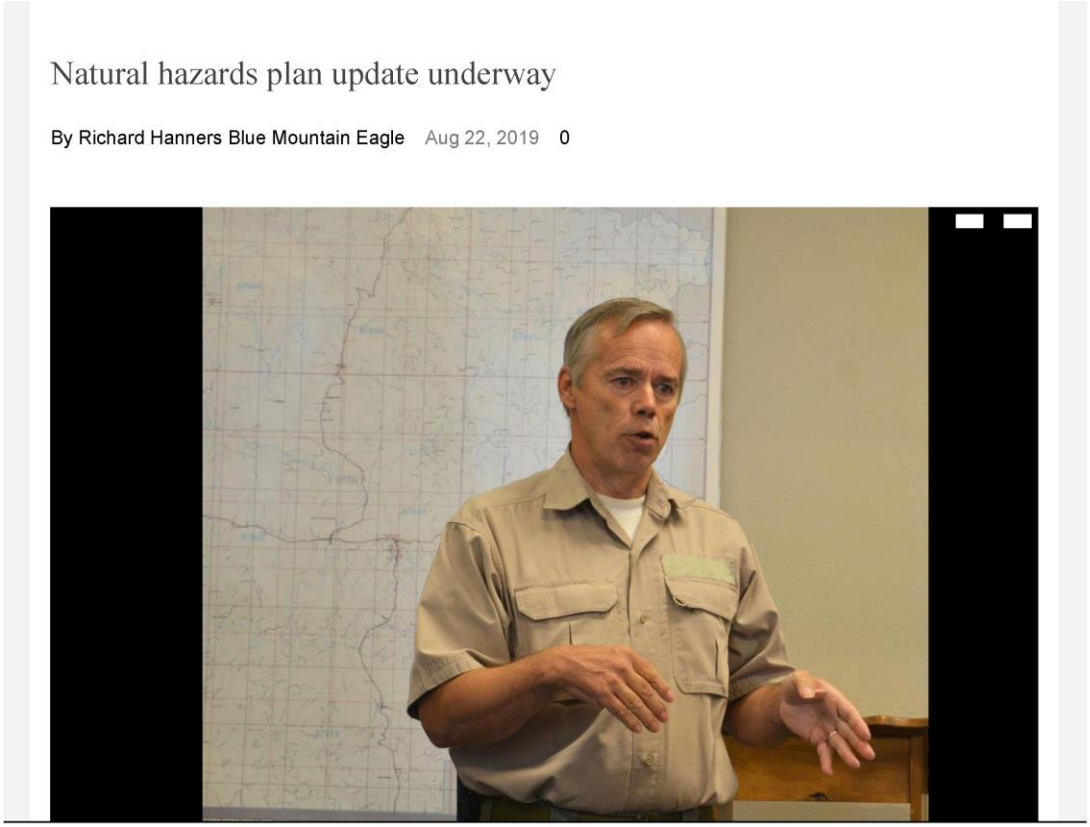
How to Get Involved:

Check the Grant County Website and Facebook page for meeting dates and times and documents to review.

Take the Natural Hazards Survey!
Copy and paste into your browser
https://forms.gle/qkMsiNnaa1e94XVd7

A press release was prepared and sent to the local media. As a result, an article appeared in the Blue Mountain Eagle, the principle local hard copy and online newspaper.

Figure 15. Blue Mountain Eagle article published August 22, 2019



Natural hazards plan update underway

By Richard Hanners Blue Mountain Eagle Aug 22, 2019 0

The public is being asked to provide input for an update to a Natural Hazards Mitigation Plan for Grant County.

The revised plan will not only include updated information for emergency planning but will focus on Grant County rather than be regional in scope, Grant County Emergency Management Coordinator Ted Williams told the Eagle.

The goals of natural hazard mitigation planning are to avoid disasters by reducing or eliminating long-term risk to people, property and the environment; to maintain eligibility for federal disaster-related funding; and to increase safety and resiliency by integrating hazard mitigation into plans, programs and policies.

Eight natural hazards have been broadly identified. At the top in priority are wildfires, severe winter storms, floods and drought, followed by volcanic activity, wind storms, landslides and earthquakes.

Work on the plan update is being funded with an Oregon Department of Land Conservation and Development grant, Williams said. A steering committee to work on the update currently has 24 members, including state and county officials, city representatives, school officials, local fire chiefs and first-responders.

Based on the results of the steering committee's analysis, mitigation actions will be developed to help make Grant County more resilient to these natural hazards. Mitigation actions can include local plans and regulations, structure and infrastructure projects, natural systems protections, education programs and awareness programs.

Some of these mitigation activities may be eligible for future Federal Emergency Management Administration funding, such as localized flood reduction measures, property acquisition and relocation,

infrastructure retrofits, creating defensible space around homes and businesses for wildfires and even weatherizing homes to help make homes more resilient to climate fluctuations, such as hotter summers and colder winters.

The steering committee will meet from 9-11 a.m. Monday, Sept. 9, at the Oregon Department of Forestry building in John Day. The meeting is open to the public.

Residents and interested parties can also provide input through a public opinion survey online at https://forms.gle/XGt2ewvYLhieAKzs8. Williams can be contacted at 541-575-0990 or williamst@grantcounty-or.gov.

In separate but parallel work, a FEMA Risk MAP meeting will be held in Grant County on Sept. 13, with some of the same steering committee members in attendance. The meeting is not open to the public.

"It is what they call a discovery meeting," Grant County Planning Director Hilary McNary told the Eagle. "Essentially they are in the process of understanding (discovering) what risks face our community and how they can help."

McNary said her primary interest is updating flood maps for the county that will be accurate and reflect the actual risk of a flood event for a specific property. The FEMA meeting will also cover wildfires, landslides and other hazards.

Tags

Ted Williams | Management | Computer Science | Emergency | Plan | Public | Natural | Hazard | Williams | Steering Committee | Politics | Company | Social Services | Update | Fire Chief | Official | First Responder | Grant County | Mitigation | Program | Work | Risk | Welfare | Planning | Hilary Mcnary | Building Industry

Richard Hanners
Reporter
Richard Hanners is a reporter for the Blue Mountain Eagle. He can be contacted at rick@bmeagle.com or 541-575-0710.

Figure 16. Second article published by the Blue Mountain Eagle May 5, 2020

Final planning session for Grant County Natural Hazard Mitigation Plan

By Rudy Diaz Blue Mountain Eagle May 5, 2020 Updated 15 hrs ago 0

1 of 3

Planning for the updated Grant County Natural Hazard Mitigation Plan comes to an end in May as the committee moves on to the final conference call for planning.

On May 12, there will be a virtual meeting from 11 a.m. to 1 p.m., and this will likely be the final steering committee meeting prior to future meetings to adopt the plan. The link for the meeting is https://us02web.zoom.us/j/99172788386pwd=UHk5MWNFWG9EZ2Jpb3E4aE82alhiZz(The meeting ID is 991 7278 8386. The password is 433574.

This plan is created from an assessment from the community and their perceptions of the risks faced from a range of natural hazards, according to Katherine Daniel from the Oregon Department of Land Conservation and Development.

MOST POPULAR

Articles

- Governor's office proposes guidelines for reopening Oregon businesses
- Deputy on paid leave for more than a year pleads guilty to DUII
- New draft guidelines posted for reopening Oregon salons, restaurants
- Man dies Saturday in crash near Mt. Vernon
- Former deputy pleads not guilty to attempted rape, other charges
- Eastern Oregon counties developing plans to reopen economy
- 9th Circuit rejects lawsuit against Malheur National Forest grazing authorizations
- Unanimous jury verdicts now required in Oregon; Albany defense attorney celebrates Supreme Court decision
- Teamsters: Labor Dispute Looming at Hood River Distillers!
- Grant County economic reopening plan call scheduled at 4 p.m. Tuesday

Another benefit is the opportunity to work with the Oregon Department of Geology and Mineral Industries, which provides an analysis of the structures and people at risk from floods, fires or other hazards.

"The goal of this is to reduce the damage to property and the risk to lives," Daniel said.

The mitigation plan focuses on eight hazards in the county, which are wildfires, severe winter storms, floods and drought, followed by volcanic activity, wind storms, landslides and earthquakes.

Daniel said that this plan is an update to an existing plan from 2014 that focused on the northeastern part of Oregon and included four counties. The current work is updating the plan with a focus on Grant County.

The Federal Emergency Management Agency sets the planning process and provides grant money for the DLCD to participate in writing a plan. FEMA also sets expectations for the county to be as involved as possible. After the planning process concludes, the plan will be submitted to the Oregon Emergency Management for review, and then FEMA will look at the plan for approval and comments before the next phase.

"I want to emphasize that one of the big benefits of having a mitigation plan that's been approved by FEMA is that it opens the door to FEMA mitigation grant funding, so the community doesn't have to support the whole bill, but they have to be supportive of the plan as a whole so their elected officials have the authority to go forward and seek grants that'll be necessary for some of the mitigation plans," Daniel said.

She said the average homeowner can provide a unique perspective and may also be aware of hazards they are subject to and assist in providing a full picture of what the community will support when the process of adoption begins.

"In the end, community resources may be required to put forth some of these mitigation actions," Daniel said.

Ted Williams, the former Grant County emergency management coordinator, was central to planning as he helped build the steering committee with Jason Gatley from the DLCD, prior to Daniel. Williams had the responsibility to make people aware of the meetings and what the content would be, according to Daniel.

The steering committee is formed from people from the state and county officials, city representatives, school officials, local fire chiefs and first responders.

Even with the resignation of Williams from his position, the steering committee continues to plan and work, but the open position will need to be addressed for the next phase.

"I think Ted laid a really great groundwork and did a great job at putting together a cohesive group that would show up and participate," Daniel said.

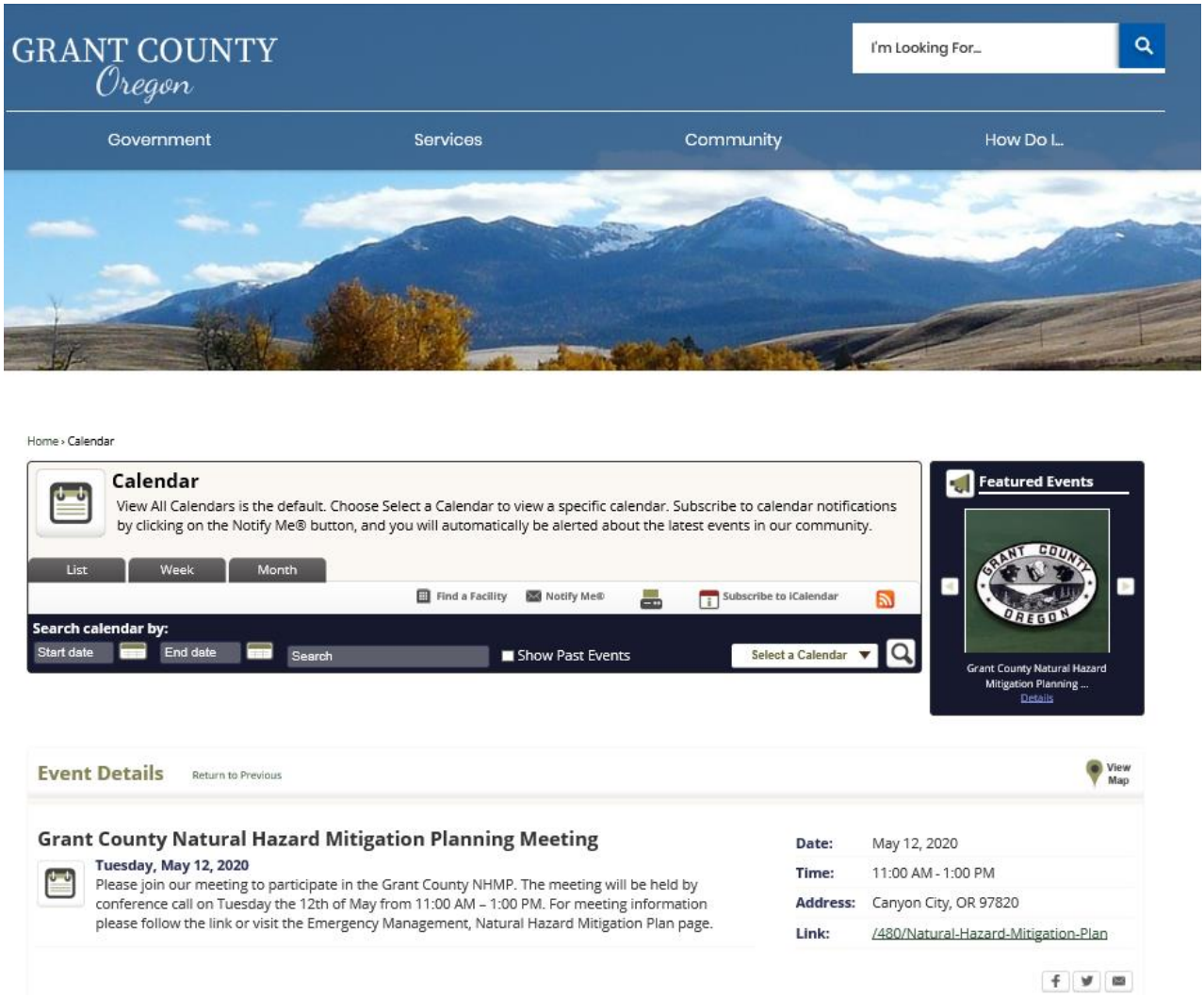
As the committee concludes the plan, which will be effective for five years, the next phase is to implement the mitigation actions. Daniel said the individual who would build the implementation committee would be the emergency manager.

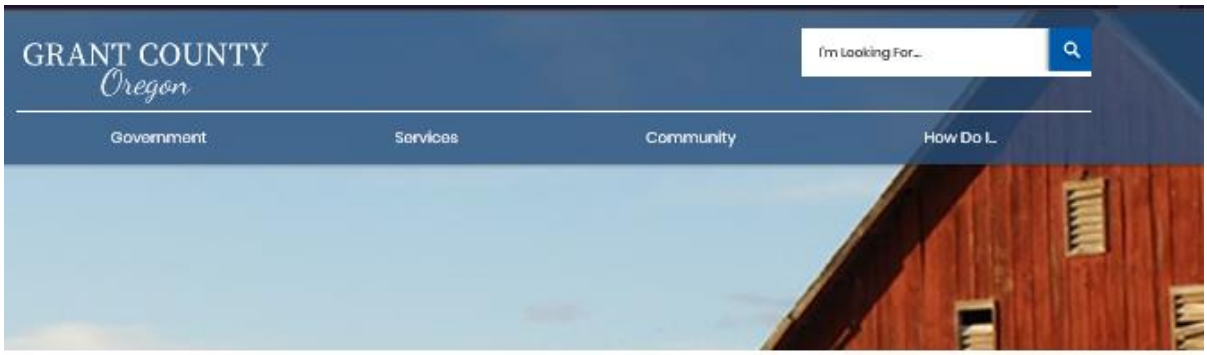
"The steering committee made the decision at the last meeting that the implementation committee should meet every year," Daniel said. "They also decided that the emergency manager, when in place, would be the convener of that committee," Daniel said.

Currently, the temporary emergency manager is Dave Dobler until the COVID-19 pandemic subsides, according to Grant County Judge Scott Myers.

"The writing of the plan may be nearly done, but being involved in educating yourselves or your neighbors about how Grant County residents can avoid the devastation from floods or wildfires is important," Daniel said. "It's important to be engaged with your government and be aware that the county has a whole separate plan that relates only to wildfire."

Figure 17. Grant County Webpage May 2020





COVID-19 INFORMATION

Letter from Board of Commissioners

Alertsense

Community Emergency Response Team (CERT) +

Disaster Preparedness +

Flood Preparedness +

Overview +

Wildfires

Natural Hazard Mitigation Plan

Home › Government › Departments A-H › Emergency Management › Natural Hazard Mitigation Plan

NATURAL HAZARD MITIGATION PLAN

Grant County Natural Hazard Mitigation Planning Meeting

Please join our meeting to participate in the Grant County NHMP. The meeting will be held by conference call on

Tuesday the 12th of May from 11:00 AM – 1:00 PM

The public is encouraged to participate.

The completed draft will be available through the websites of Grant County, the City of John Day, the Grant Education Service District and the Grant Soil and Water Conservation District.

This is likely to be the final Steering Committee meeting. Additional meetings to adopt the plan will take place in Grant County, the City of John Day, the Grant Soil and Water Conservation District and the Grant Education Service District following FEMA's approval of the plan.

Join Zoom Meeting

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Meeting ID: 991 7278 8386

Password: 433574

OR

Join by Telephone: 877 853 5257 or 888 683 5191 or 855 880 1246 (All #'s are Toll Free)

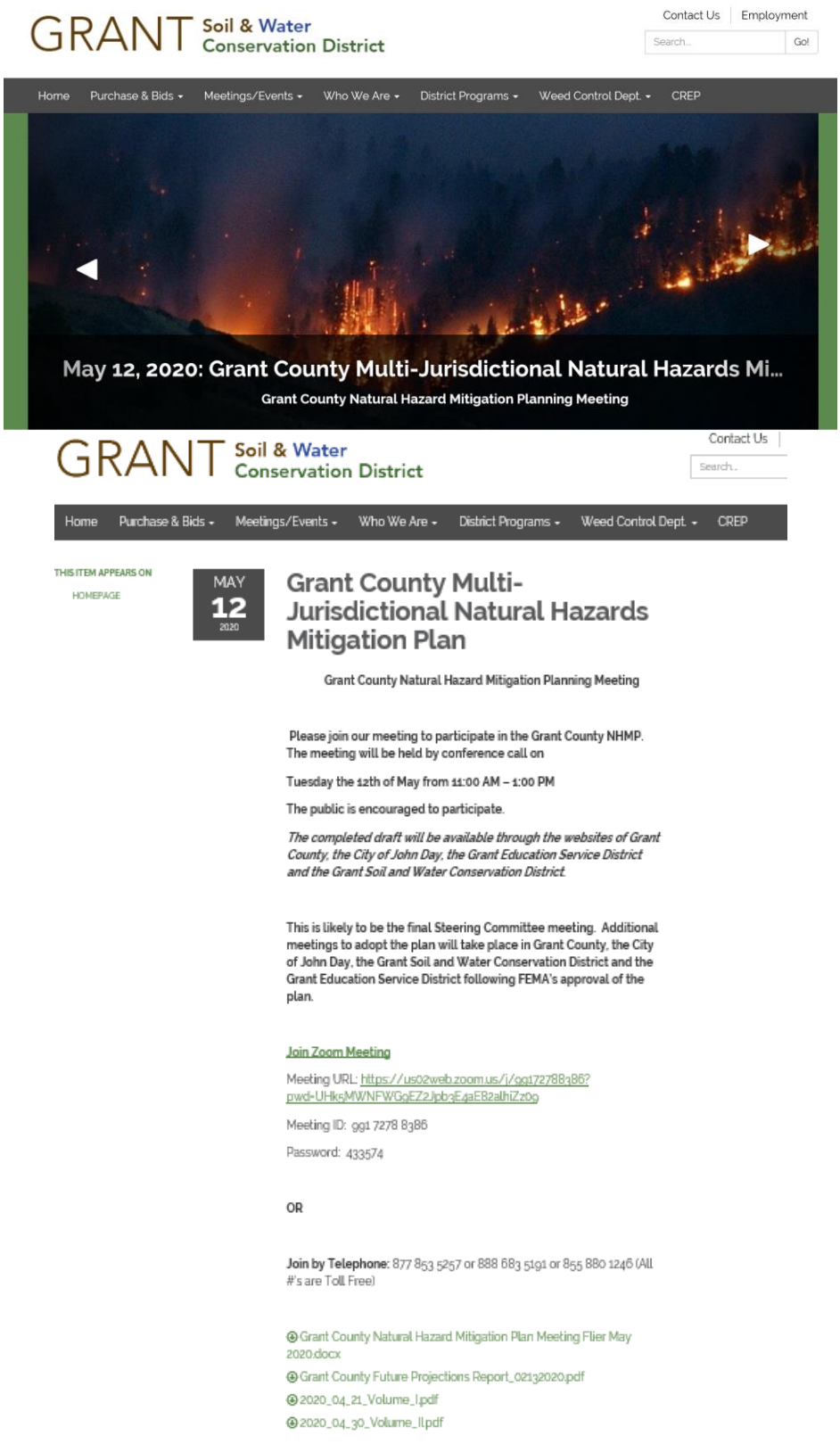
RELATED DOCUMENTS

- 2020_04_21_Volume_I
- 2020_04_30_Volume_II
- Grant County Future Projections Report_02132020

Figure 18. John Day Facebook Page

Figure 19. John Day website posting May 2020

Figure 20. Grant Soil and Water Conservation District Webpage posting May 2020



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May 12, 2020: Grant County Multi-Jurisdictional Natural Hazards Mi...

Grant County Natural Hazard Mitigation Planning Meeting

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THIS ITEM APPEARS ON

HOMEPAGE

MAY 12 2020

Grant County Multi-Jurisdictional Natural Hazards Mitigation Plan

Grant County Natural Hazard Mitigation Planning Meeting

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Grant County Natural Hazard Mitigation Plan Meeting Flier May 2020.docx

Grant County Future Projections Report_02132020.pdf

2020_04_21_Volume_I.pdf

2020_04_30_Volume_II.pdf

5. 2020 Plan Update Changes

The entire *2014 Northeast Oregon Multi-Jurisdictional NHMP* has been revised and updated. While the basic format of the existing NHMP was retained, substantial changes have been. Generally, the *2020 Grant County Multi-Jurisdictional Natural Hazard Mitigation Plan* provides updated statistics and attempts to make the document more readable by removing repetition and focusing on the most salient aspects of hazard identification, risk assessment and mitigation actions. The document style has been revised to match other NHMPs prepared by DLCD beginning with the Tillamook County NHMP so as to make this work recognizable as such.

Cover and Front Pages

The cover and the front pages orient the reader of the NHMP to what the NHMP contains.

- A new NHMP cover was created in the style noted above. The photos for the cover were taken by Grant County and DLCD staff. Photos were also added to the Volume I,II, and III covers.
- The FEMA Approval Pending Adoption (APA) and final approval letter as well as the County and Cities resolutions of adoption are included in the final document (when available).
- The Acknowledgements have been updated to include the 2019-2020 Steering Committee members.

Volume I: Basic Plan

Volume I includes the cover, approval letters, jurisdictional resolutions, the Table of Contents, and the Executive Summary. It provides the overall plan framework for the *2019 Malheur County NHMP*. It also contains Section 1: Introduction; Section 2: Risk Assessment; Section 3: Mitigation Strategy; and Section 4: Plan Implementation and Maintenance.

Executive Summary

The *2020 Grant County NHMP* includes an Executive Summary that provides information about the purpose of natural hazards mitigation planning and describes how the plan will be implemented.

Section 1: Introduction

Section 1 introduces the concept of natural hazards mitigation planning and answers the question, "Why develop a mitigation plan?" Additionally, Section 1 summarizes the 2020 plan update process, and provides an overview of how the plan is organized.

The principle change to this section, as with the entire NHMP, is that information from the focus on Grant County alone has allowed the plan to drill down to focus on the incorporated cities in Grant County allowing a more granular view of hazard mitigation in the county. Rather than having separate addenda for the Cities, the Cities are included in the main body of the NHMP. Where applicable, the Cities are specifically called out for their unique situations.

Section 2: Risk Assessment

Section 2, Risk Assessment, consists of three phases: natural hazard identification, vulnerability assessment, and risk analysis. Hazard identification involves the identification of hazard geographic extent, its intensity, and probability of occurrence. The second phase combines the information from the hazard identification with an inventory of the existing (or planned) property and population exposed to a hazard, then attempts to predict how different types of property and population groups will be affected by the hazard. The third phase involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over a period of time.

Changes to Section 2 include:

- Format changes to the document to match the style referenced above.
- The incorporation of the information from the cities along with the information concerning Grant County to create a cohesive Risk Assessment section.
- Hazard identification, characteristics, history, probability, vulnerability, and hazard specific mitigation activities were updated. Discussion of the community Hazard Vulnerability Analysis was moved up to Volume I: Section 2 – Risk Assessment. More detailed information about each hazard was moved back to Volume II: Hazard Annexes
- NFIP information was updated.
- The Grant County NHMP Steering Committee performed a new Hazard Vulnerability Analysis/Assessment (HVA), resulting in new scores for the identified hazards of drought, earthquake, flood, landslide, winter storms, wind storms, volcanic events, and wildfire.

Section 3: Mitigation Strategy

This section provides the basis and justification for the mission, goals, and mitigation actions identified in the NHMP. Changes to Section 3 include the following:

- The NHMP Steering Committee opted to prioritize mitigation actions as described in the section above, using the HVA risk levels. All the multi-hazard mitigation actions were identified as high priority while hazard specific mitigation actions are high, high-medium, medium, and low.
- The mission statement and the goals were reviewed and re-confirmed by the 2020 Steering Committee without any changes.
- The mitigation actions from the *2014 Northeast Oregon Multi-Jurisdictional NHMP* were reviewed. Actions were deleted, retained as is, or retained in a modified fashion. New mitigation actions were established.

Section 4: Plan Implementation and Maintenance

The Grant County NHMP convener is the Emergency Manager; this person will form and facilitate an Implementation Committee for maintaining, updating, and implementing the NHMP. The Implementation Committee will be composed of members of the NHMP Steering Committee and other members of the community. The Implementation Committee plans to meet formally at least once per year based on the framework set out in Section 4 Plan Implementation and Maintenance to implement the Mitigation Strategy contained in Section 3 of the Basic Plan.

Volume II: Hazard Annexes

All hazard specific annexes were reformatted and updated to include new history, data, maps, vulnerability information, and resources as available. Cross references to other information in the NHMP has been updated. Information about climate change has been integrated into the hazard specific annexes and added as Appendix D: Future Climate Projections Reports.

Volume III: Mitigation Resources

All of the appendices have been revised and updated to focus uniquely on Grant County and its incorporated cities. The appendices have been reorganized slightly placing the Community Profile in Appendix A and the Action Items in Appendix C to follow a more logical progression. Data contained in the Community Profile has been updated with the most recent census information. Appendix D now contains the Future Climate Projection Grant County report prepared by OCCRI while the Appendix previously titled Economic Analysis of Natural Hazards has been located in Appendix E and renamed to better reflect its contents, that being a method of evaluating mitigation actions based on benefit/cost analysis. The remaining appendix includes resources for hazard mitigation grants and program resources. The appendix containing the Regional Household Preparedness Survey was deleted because it was no longer relevant.

Appendix C: Mitigation Action Worksheets

Each High or Medium Priority (non-routine) Mitigation Action has a corresponding action item worksheet describing the activity, identifying the rationale for the project, identifying potential ideas for implementation, and assigning coordinating and partner organizations. The action item worksheets can assist the community in pre-packaging potential projects for grant funding. The worksheet components are described below. These action item worksheets are located in Appendix A Action Item Forms.

Mitigation Action Title

Each mitigation action item includes a title and a brief description of the proposed action.

Alignment with Plan Goals

The plan goals addressed by each mitigation action are identified as a means for monitoring and evaluating how well the mitigation plan is achieving its goals, following implementation.

Affected Jurisdiction

Many of the mitigation actions within this plan apply to all of the participating Cities and Malheur County; however, some actions are specific. The list of affected jurisdictions is provided on the right side of the matrix. The action item form in Appendix A provides more detailed information.

Alignment with Existing Plans / Policies

Identify any existing community plans and policies where the mitigation action can be incorporated. Incorporating the mitigation action into existing plans and policies, such as comprehensive plans, will increase the likelihood that it will be implemented.

Rationale or Key Issues Addressed

Mitigation actions should be fact-based and tied directly to issues or needs identified throughout the planning process. Mitigation actions can be developed at any time during the planning process and can come from a number of sources, including participants in the planning process, noted deficiencies in local capability, or issues identified through the risk assessment. The rationale for proposed mitigation actions is based on the information documented in Section 2 Risk Assessment and Volume II Hazard Annexes.

Implementation through Existing Programs

For each mitigation action, the Mitigation Action Item form asks for some ideas for implementation, which serve as the starting point for taking action. This information offers a transition from theory to practice. Ideas for implementation could include: (1) collaboration with relevant organizations, (2) alignment with the community priority areas, and (3) applications to new grant programs.

The ideas for implementation offer a transition from theory to practice and serve as a starting point for this plan. This component of the mitigation action is dynamic, since some ideas may prove to not be

feasible, and new ideas may be added during the plan maintenance process. Ideas for implementation include such things as: collaboration with relevant organizations, grant programs, tax incentives, human resources, education and outreach, research, and physical manipulation of buildings and infrastructure. When an action is implemented, more work may be needed to determine the exact course of action.

The *2019 Malheur County NHMP* includes a range of mitigation actions that, when implemented, will reduce loss from hazard events in the County. Within the NHMP, FEMA requires the identification of existing programs that might be used to implement these action items. Malheur County and the participating cities currently address statewide planning goals and legislative requirements through their comprehensive land use plans, capital improvements plans, mandated standards and building codes. Plans and policies already in existence have support from local residents, businesses, and policy makers. Many land use, comprehensive, and strategic plans are updated regularly, and can adapt easily to changing conditions and needs.[1] Implementing the NHMP's action items through such plans and policies increases their likelihood of being supported and implemented. The jurisdictions will work to incorporate the mitigation actions into existing programs and procedures.

Coordinating Organization

The coordinating organization is the public agency with the regulatory responsibility to address natural hazards, or that is willing and able to organize resources, find appropriate funding, or oversee activity implementation, monitoring and evaluation.

The Coordinating Organization and main contact for the Malheur County NHMP is the Malheur County Emergency Manager, Rich Harriman, and the Emergency Management Team (EMT) which is also known as Local Emergency Planning Committee (LEPC). The EMT/LEPC members doubled as the NHMP Steering Committee for the *2019 Malheur County NHMP*.

Internal and External Partners

The internal and external partner organizations listed in the Mitigation Actions Table 2018 NHMP included below and in the Action Item Worksheets, located in Appendix A, are potential partners recommended by the Steering Committee but not necessarily contacted during the development of the plan. The coordinating organization should contact the identified partner organizations to see if they are capable of and interested in participation. This initial contact is also to gain a commitment of time and/or resources toward completion of the action items.

Internal partner organizations are departments within the County or other participating jurisdiction that may be able to assist in the implementation of action items by providing relevant resources to the coordinating organization.

External partner organizations can assist the coordinating organization in implementing the action items in various functions and may include local, regional, state, or federal agencies, as well as local and regional public and private sector organizations.

Potential Funding Sources

Where possible, identify potential funding sources for the mitigation action. Example funding sources can include: the federal Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM) and

[1] Ibid

Flood Mitigation Assistance (FMA) Programs; state funding sources such as the Oregon Seismic Rehabilitation Grant Program; or local funding sources such as capital improvement or general funds. A mitigation action may have multiple funding sources. The funding sources are identified general as short- or long-term (see below) and includes an element of funding capacity of the jurisdiction for that action. Appendix A Action Item Forms includes the more detailed description of each mitigation action; funding sources are included there. See Appendix E Grant Programs and Resources for additional information on funding opportunities.

Estimated Cost

Where possible, an estimate of the cost for implementing the mitigation action is included.

Timeline

Action items include both short- and long-term activities. Each action item includes an estimate of the timeline for implementation.

- *Short-term action items* (ST) are activities that may be implemented with existing resources and authorities in one to two years.
- *Long-term action items* (LT) may require new or additional resources and/or authorities, and may take from one to five years to implement.
- *Ongoing* action items signify that work has begun and will either exist over an indefinite timeline, or an extended timeline. These are successful mitigation actions that have often been well integrated into the practices of the jurisdiction. These on-going activities are ones the community continues to prioritize each year. This is a very good accomplishment to have mitigation integrated as a priority.

Status

As mitigation actions are implemented or new ones are created, it is important to indicate the status of the action item—whether it is ongoing, complete, no longer included – and to create new actions. Documenting the status of the action will make reviewing and updating mitigation plan easier during the plan's five-year update, and can be used as a benchmark for progress.

Priority

The priority designations for the mitigation actions are described below in the Mitigation Actions Tables section to clarify the importance of these mitigation actions for the affected jurisdictions.

Action Item Worksheets to be added

Appendix C:
Future Climate Projection Grant County

Future Climate Projections
Grant County

February 2020

A Report to the Oregon Department of Land Conservation and Development

Prepared by
The Oregon Climate Change Research Institute

Photo credit: Grant County, U.S. Highway 395 North of Burns, Oregon by Ken Lund, https://flic.kr/p/zn1ZaQ, Creative Commons License (CC BY-SA 2.0)

OCCRI

DLCD

Future Climate Projections: Grant County

A report to the Oregon Department of Land Conservation and Development

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February 2020

Table of Contents

Executive Summary

Climate change is expected to increase the occurrence of most climate-related risks considered in this report. The risks of heat waves are projected to increase with very high confidence due to strong evidence in published literature, model consensus, and robust theoretical principles for continued increasing temperatures. The majority of risks expected to increase with climate change have high or medium confidence due to moderate to strong evidence and consensus yet they are influenced by multiple secondary factors in addition to increasing temperatures. Risks with low confidence, while important, show relatively little to no changes due to climate change or the level of evidence is limited. The projected direction of change along with the level of confidence in the direction of change for each climate change-related risk is summarized in Table 1.

Table 1 Summary of projected direction of change along with the level of confidence in climate change-related risk of natural hazard occurrence. Very high confidence means all models agree on the direction of change and there is strong evidence in the published literature. High confidence means most models agree on the direction of change and there is strong to medium evidence in the published literature. Medium confidence means that there is medium evidence and consensus on the direction of change with some caveats. Low confidence means the direction of change is small compared to the range of model responses or there is limited evidence in the published literature.

	Low Confidence	Medium Confidence	High Confidence	Very High Confidence
Risk Increasing ↑	Poor Air Quality	Drought Increased Invasive Species Risk	Heavy Rains Flooding Wildfire Loss of Wetland Ecosystems	Heat Waves
Risk Unchanging =	Windstorms			
Risk Decreasing ↓	Dust Storms			Cold Waves

This report presents future climate projections for Grant County relevant to specific natural hazards for the 2020s (2010–2039 average) and 2050s (2040–2069 average) relative to the 1971–2000 average historical baseline. The projections were analyzed for a lower greenhouse gas emissions scenario as well as a higher greenhouse gas emissions scenario, using multiple global climate models. This summary lists only the projections for the 2050s under the higher emissions scenario. Projections for both time periods and both emissions scenarios can be found within relevant sections of the main report.

Heat Waves

Extreme heat events are expected to increase in frequency, duration, and intensity due to continued warming temperatures.

In Grant County, the frequency of hot days per year with temperatures at or above 90°F is projected to increase on average by 27 days, with a range of about 10 to 38 days, by the 2050s under the higher emissions scenario relative to the historical baselines. This average increase represents a more than tripling of hot days relative to the average historical baseline.

In Grant County, the temperature of the hottest day of the year is projected to increase on average by nearly 8°F, with a range of about 3 to 11°F, by the 2050s under the higher emissions scenario relative to the historical baselines.

Cold Waves

Cold extremes are still expected to occur from time to time, but with much less frequency and intensity as the climate warms.

In Grant County, the frequency of cold days per year at or below freezing is projected to decrease on average by 16 days, with a range of about 9 to 23 days, by the 2050s under the higher emissions scenario relative to the historical baselines. This average decrease represents a future about a third of the cold days per year relative to the average historical baseline.

In Grant County, the temperature of the coldest night of the year is projected to increase on average by 9°F, with a range of about 1 to 16°F, by the 2050s under the higher emissions scenario relative to the historical baselines.

Heavy Rains

The intensity of extreme precipitation events is expected to increase slightly in the future as the atmosphere warms and is able to hold more water vapor.

In Grant County, the frequency of days with at least ¾" of precipitation is not projected to change substantially. However, the magnitude of precipitation on the wettest day and wettest consecutive five days per year is projected to increase on average by about 16% (with a range of 7% to 25%) and 12% (with a range of -3% to 24%), respectively, by the 2050s under the higher emissions scenario relative to the historical baselines.

In Grant County, the frequency of days exceeding a threshold for landslide risk, based on 3-day and 15-day precipitation accumulation, is not projected to change substantially. However, landslide risk depends on a variety of factors and this metric may not reflect all aspects of the hazard.

River Flooding

Mid- to low-elevation areas in Grant County's Blue Mountains that are near the freezing level in winter, receiving a mix of rain and snow, are projected to experience an increase in winter flood risk due to warmer winter temperatures causing precipitation to fall more as rain and less as snow.

Drought

Drought conditions, as represented by low summer soil moisture, low spring snowpack, low summer runoff, and low summer precipitation are projected to become more frequent in Grant County by the 2050s relative to the historical baseline.

By the end of the 21st century, summer low flows are projected to decrease in the Blue Mountains region putting some sub-basins at high risk for summer water shortage associated with low streamflow.

Wildfire

Wildfire risk, as expressed through the frequency of very high fire danger days, is projected to increase under future climate change. In Grant County, the frequency of very high fire danger days per year is projected to increase on average by about 39% (with a range of -10 to +98%) by the 2050s under the higher emissions scenario compared to the historical baseline.

Air Quality

Under future climate change, the risk of wildfire smoke exposure is projected to increase in Grant County. The number of "smoke wave" days—days with high concentrations of wildfire-specific particulate matter—is projected to increase by 39% and the intensity of "smoke waves" is projected to increase by 105% by 2046–2051 under a medium emissions scenario compared with 2004–2009.

Windstorms

Limited research suggests very little, if any, change in the frequency and intensity of windstorms in the Pacific Northwest as a result of climate change.

Dust Storms

Limited research suggests that the risk of dust storms in summer would decrease in eastern Oregon under climate change in areas that experience an increase in vegetation cover from the carbon dioxide fertilization effect.

Increased Invasive Species Risk

Warming temperatures, altered precipitation patterns, and increasing atmospheric carbon dioxide levels increase the risk for invasive species, insect and plant pests for forest and rangeland vegetation, and cropping systems.

Loss of Wetland Ecosystems

Freshwater wetland ecosystems are sensitive to warming temperatures and altered hydrological patterns, such as changes in precipitation seasonality and reduction of snowpack.

Introduction

Industrialization has given rise to increasing amounts of greenhouse gas emissions worldwide, which is causing the Earth's climate to warm (IPCC, 2013). The effects of which are already apparent here in Oregon (Dalton *et al.*, 2017; Mote *et al.*, 2019). Climate change is expected to influence the likelihood of occurrence of existing natural hazard events such as heavy rains, river flooding, drought, heat waves, cold waves, wildfire, air quality, and coastal erosion and flooding.

Oregon's Department of Land Conservation and Development (DLCD) contracted with the Oregon Climate Change Research Institute (OCCRI) to perform and provide analysis of the influence of climate change on natural hazards. The scope of this analysis is limited to the geographic area encompassed by the four Oregon counties that are part of the Pre-Disaster Mitigation (PDM) 17 grants DLCD received from FEMA. Those counties include: Lincoln, Clatsop, Baker, and Grant. Outcomes of this analysis include county-specific data, graphics, and text summarizing climate change projections for climate metrics related to each of the natural hazards listed in Table 2. This information will be integrated into the Natural Hazards Mitigation Plan (NHMP) updates for the four counties, and can be used in other county plans, policies, and programs. In addition to the county reports, sharing of data, and other technical assistance will be provided to the counties. This report covers climate change projections related to natural hazards relevant to Grant County.

Table 2 Natural hazards and related climate metrics evaluated in this project.

Heavy Rains Wettest Day ◆Wettest Five Days Landslide Threshold Exceedance	**Heat Waves** Hottest Day ◆ Warmest Night "Hot" Days ◆ "Warm" Nights
River Flooding Annual maximum daily flows Atmospheric Rivers Rain-on-Snow Events	**Cold Waves** Coldest Day ◆ Coldest Night "Cold" Days ◆ "Cold" Nights
Drought Summer Flow ◆ Spring Snow Summer Soil Moisture Summer Precipitation	**Air Quality** Unhealthy Smoke Days
Wildfire Fire Danger Days	**Dust Storms**
Windstorms	**Loss of Wetland Ecosystems**
Increased Invasive Species Risk	

Future Climate Projections Background

Introduction

The county-specific future climate projections prepared by OCCRI are derived from 10–20 global climate models (GCM) and two scenarios of future global greenhouse gas emissions. Future climate projections have been "downscaled"—that is, made locally relevant—and summaries of projected changes in the climate metrics in Table 2 are presented for an early 21st century period and a mid 21st century period relative to a historical baseline. (Read more about the data sources in the Appendix.)

Global Climate Models

Global climate models are sophisticated computer models of the Earth's atmosphere, water, and land and how these components interact over time and space according to the fundamental laws of physics (Figure 1). GCMs are the most sophisticated tools for understanding the climate system, but while highly complex and built on solid physical principles, they are still simplifications of the actual climate system. There are several ways to implement such simplifications into a GCM, which results in each one giving a slightly different answer. As such, it is best practice to use at least ten GCMs and look at the average and range of projections across all of them. (Read more about GCMs and uncertainty in the Appendix.)

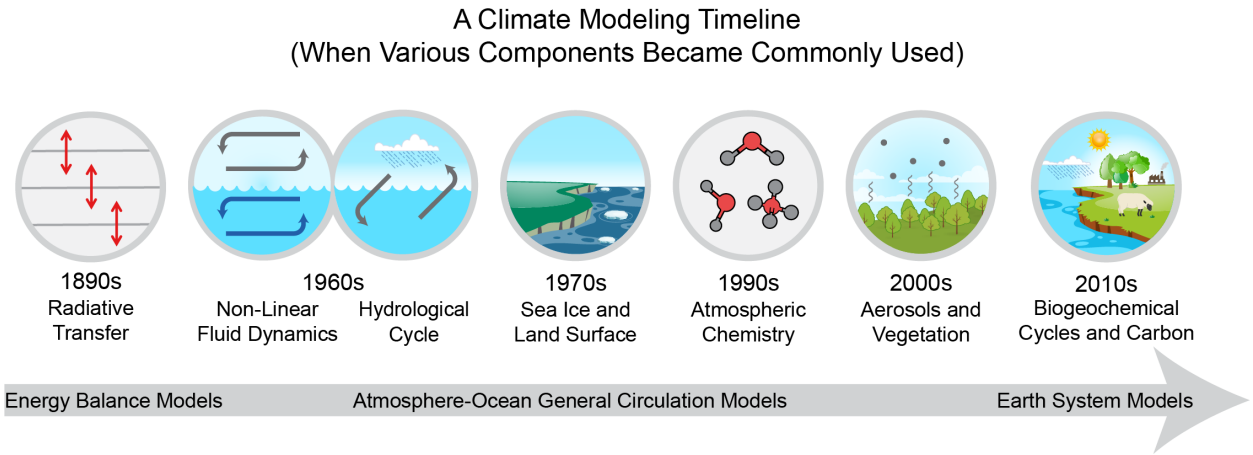

Figure 1 As scientific understanding of climate has evolved over the last 120 years, increasing amounts of physics, chemistry, and biology have been incorporated into calculations and, eventually, models. This figure shows when various processes and components of the climate system became regularly included in scientific understanding of global climate calculations and, over the second half of the century as computing resources became available, formalized in global climate models. (Source: science2017.globalchange.gov)

Greenhouse Gas Emissions

When used to project future climate, scientists give the GCMs information about the quantity of greenhouse gases that the world would emit, then the GCMs run simulations of what would happen to the air, water, and land over the next century. Since the precise amount of greenhouse gases the world will emit over the next century is unknown, scientists use several scenarios of different amounts of greenhouse gas emissions based on

plausible societal trajectories. The future climate projections prepared by OCCRI uses emissions pathways called Representative Concentration Pathways (RCPs). There are several RCPs and the higher global emissions are, the greater the expected increase in global temperature (Figure 2). OCCRI considers a lower emissions scenario (RCP 4.5) and a higher emissions scenario (RCP 8.5) because they are the most commonly used scenarios in published literature and the downscaled data is available for these scenarios. (Read more about emissions scenarios in the Appendix.)

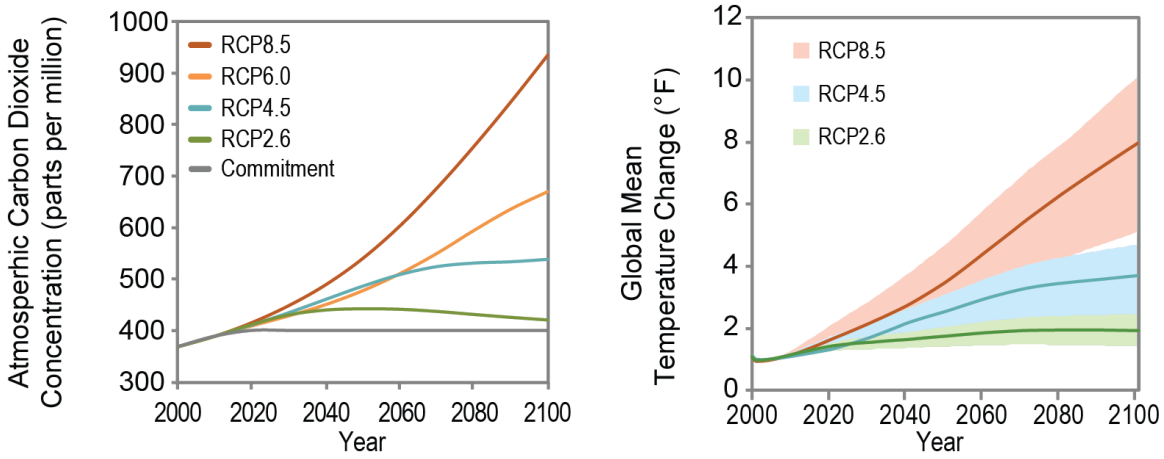

Figure 2 Future scenarios of atmospheric carbon dioxide concentrations (left) and global temperature change (right) resulting from several different emissions pathways, called Representative Concentration Pathways (RCPs), which are considered in the fourth and most recent National Climate Assessment. (Source: science2017.globalchange.gov)

Downscaling

Global climate models simulate the climate across adjacent grid boxes the size of about 60 by 60 miles. To make this coarse resolution information locally relevant, GCM outputs have been combined with historical observations to translate large-scale patterns into high-resolution projections. This process is called statistical downscaling. The future climate projections produced by OCCRI were statistically downscaled to a resolution with grid boxes the size of about 2.5 by 2.5 miles (Abatzoglou and Brown, 2012). (Read more about downscaling in the Appendix.)

Future Time Periods

When analyzing global climate model projections of future climate, it is best practice to compare the average across at least a 30-year period in the future simulations to an average across at least a 30-year period in the historical simulations. The average over a 30-year period in the historical simulations is called the *historical baseline*. For the future climate projections in this report, two 30-year future periods are analyzed in comparison with a 30-year historical baseline (Table 3).

Each of the twenty global climate models simulates historical and future climate slightly differently. Thus, each global climate model has a different historical baseline from which future projections are compared. Because each climate model's historical baseline is slightly different, this report presents the average and range of projected *changes* in the

variables relative to each model's own historical baseline (rather than the average and range of future projected absolute values). The average of the twenty historical baselines, called the *average historical baseline*, is also presented to aid in understanding the relative magnitude of projected changes. The average historical baseline can be combined with the average projected future change to infer the average projected future absolute value of a given variable. However, the average historical baseline cannot be combined with the range of projected future changes to infer the range of projected future absolute values.

Table 3 Historical and future time periods for presentation of future climate projections

Historical Baseline	Early 21st Century "2020s"	Mid 21st Century "2050s"
1971–2000	2010–2039	2040–2069

How to Use the Information in this Report

Given the changing climate, anticipating future outcomes by considering only past trends may become increasingly unreliable. Future projections from GCMs provide an opportunity to explore a range of plausible outcomes taking into consideration the climate system's complex response to increasing concentrations of greenhouse gases. It is important to be aware that GCM projections should not be thought of as predictions of what the weather will be like at some specified date in the future, but rather viewed as projections of the long-term statistical aggregate of weather, in other words, "climate", if greenhouse gas concentrations follow some specified trajectory.[1]

The projections of climate variables in this report, both in the direction and magnitude of change, are best used in reference to the historical climate conditions under which a particular asset or system is designed to operate. For this reason, considering the projected changes between the historical and future periods allows one to envision how current systems of interest would respond to climate conditions that are different from what they have been. In some cases, the projected change may be small enough to be accommodated within the existing system. In other cases, the projected change may be large enough to require adjustments, or adaptations, to the existing system. However, engineering or design projects would require a more detailed analysis than what is available in this report.

The information in this report can be used to:

- Explore a range of plausible future outcomes taking into considering the climate system's complex response to increasing greenhouse gases
- Envision how current systems may respond under climate conditions different from those the systems were designed to operate under
- Evaluate potential mitigation actions to accommodate future conditions
- Influence the risk assessment in terms of the likelihood of a particular climate-related hazard occurring.

[1] Read more: https://nca2014.globalchange.gov/report/appendices/faqs#narrative-page-38784

Average Temperature

Oregon's average temperature warmed at a rate of 2.2°F per century during 1895–2015. Average temperature is expected to continue warming during the 21st century under scenarios of continued global greenhouse gas emissions; the rate of warming depends on the particular emissions scenario (Dalton *et al.*, 2017). By the 2050s (2040–2069) relative to the 1970–1999 historical baseline, Oregon's average temperature is projected to increase by 3.6 °F with a range of 1.8°–5.4°F under a lower emissions scenario (RCP 4.5) and by 5.0°F with a range of 2.9°F–6.9°F under a higher emissions scenario (RCP 8.5) (Dalton *et al.*, 2017). Furthermore, summers are projected to warm more than other seasons (Dalton *et al.*, 2017).

Average temperature in Grant County is projected to warm during the 21st century at a similar rate to Oregon as a whole (Figure 3). Projected increases in average temperature in Grant County relative to each global climate model's 1971–2000 historical baseline range from 1.1–3.9°F by the 2020s (2010–2039) and 1.9–7.6°F by the 2050s (2040–2069), depending on emissions scenario and climate model (Table 4).

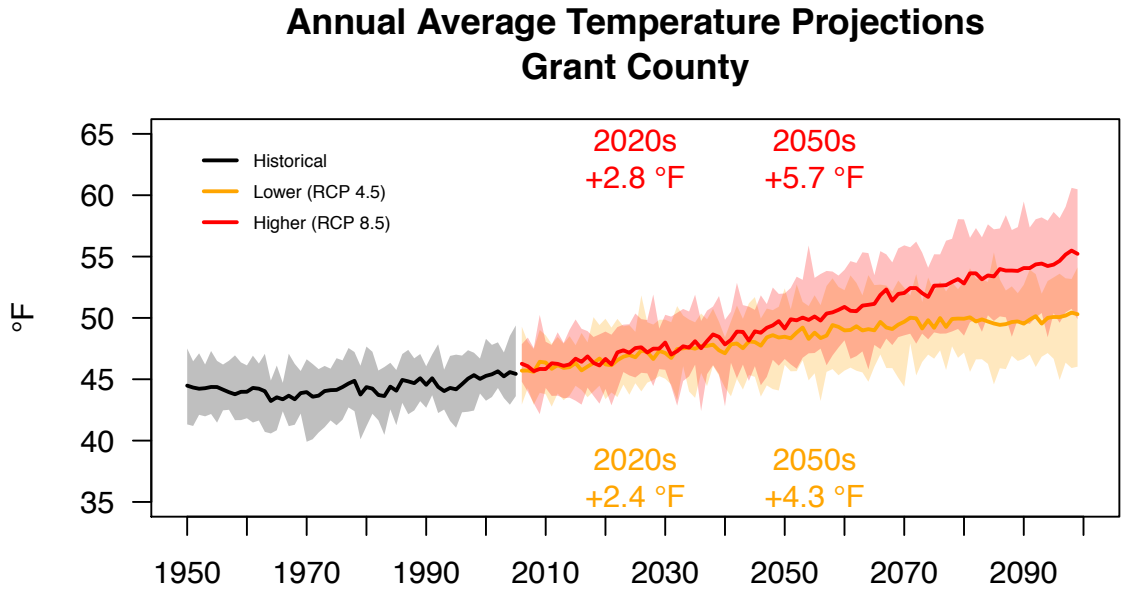

Figure 3 Annual average temperature projections for Grant County as simulated by 20 downscaled global climate models under a lower (RCP 4.5) and a higher (RCP 8.5) greenhouse gas emissions scenario. Solid line and shading depicts the 20-model mean and range, respectively. The multi-model mean differences for the 2020s (2010–2039 average) and the 2050s (2040–2069 average) relative to the average historical baseline (1971–2000 average) are shown.

Table 4 Average and range of projected future changes in Grant County's average temperature relative to each global climate model's (GCM) historical baseline (1971–2000 average) for the 2020s (2010–2039 average) and 2050s (2040–2069 average) under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario based on 20 GCMs.

	Change by Early 21st Century "2020s"	Change by Mid 21st Century "2050s"
Higher (RCP 8.5)	+2.8°F (1.6 to 3.9)	+5.7°F (3.0 to 7.6)
Lower (RCP 4.5)	+2.4°F (1.1 to 3.9)	+4.3°F (1.9 to 6.1)

Heat Waves

Extreme heat events are expected to increase in frequency, duration, and intensity in Oregon due to continued warming temperatures. In fact, the hottest days in summer are projected to warm more than the change in mean temperature over the Pacific Northwest (Dalton *et al.*, 2017). This report presents projected changes for three metrics of heat extremes for both daytime (maximum temperature) and nighttime (minimum temperature) (Table 5).

Table 5 Heat extreme metrics and definitions

Metric	Definition
Hot Days	Number of days per year maximum temperature is greater than or equal to 90°F
Warm Nights	Number of days per year minimum temperature is greater than or equal to 65°F
Hottest Day	Annual maximum of maximum temperature
Warmest Night	Annual maximum of minimum temperature
Daytime Heat Waves	Number of events per year with at least 3 consecutive days with maximum temperature greater than or equal to 90°F
Nighttime Heat Waves	Number of events per year with at least 3 consecutive days with minimum temperature greater than or equal to 65°F

In Grant County, all the extreme heat metrics in Table 5 are projected to increase by the 2020s (2010–2039) and 2050s (2040–2069) under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios (Table 6). For example, for the 2050s under the higher emissions scenario climate models project that the number of hot days greater than or equal to 90°F per year, relative to each model's 1971–2000 historical baseline, would increase by as little as 10 days to as much as 38 days. The average projected increase in the number of hot days per year is 27 days above the average historical baseline of about 10 days. This represents a projected more than tripling in the frequency of hot days by the 2050s under the higher emissions scenario.

Likewise, the temperature of the hottest day of the year is projected to increase by as little as 3.1°F to as much as 10.5°F by the 2050s under the higher emissions scenario relative to the models' historical baselines. The average projected increase is 7.8°F above the average historical baseline of 93.6°F. The frequency of daytime heat waves is projected to increase by nearly three events per year on average relative to the average historical baseline of one event. In other words, hot days are projected to become more frequent and the hottest days are projected to become even hotter.

Projected changes in the frequency of extreme heat days (i.e., Hot Days and Warm Nights) are shown in Figure 4. Projected changes in the magnitude of heat records (i.e., Hottest Day

and Warmest Night) are shown in Figure 5. Projected changes in the frequency of extreme heat events (i.e., Daytime Heat Waves and Nighttime Heat Waves) are shown in Figure 6.

Table 6 Mean and range of projected future changes in extreme heat metrics for Grant County relative to each global climate model's (GCM) historical baseline (1971–2000 average) for the 2020s (2010–2039 average) and 2050s (2040–2069 average) under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario based on 20 GCMs. The average historical baseline across the 20 GCMs is also presented and can be combined with the average projected future change to infer the average projected future absolute value of a given variable. However, the average historical baseline cannot be combined with the range of projected future changes to infer the range of projected future absolute values.

		Change by Early 21st Century "2020s"		Change by Mid 21st Century "2050s"	
	Average Historical Baseline	Lower	Higher	Lower	Higher
Hot Days	9.7 days	+9.1 days (2.9–14.0)	+11.1 days (4.3–15.6)	+18.7 days (6.6–27.1)	+27.4 days (9.8–38.3)
Warm Nights	0.2 days	+0.5 days (0.0–1.2)	+0.6 days (0.2–1.2)	+1.7 days (0.1–4.0)	+4.2 days (1.0–9.6)
Hottest Day	93.6°F	+3.2°F (1.2–5.1)	+3.8°F (1.8–5.2)	+5.8°F (2.5–8.2)	+7.8°F (3.1–10.5)
Warmest Night	59.7°F	+2.6°F (1.0–4.2)	+2.9°F (1.5–4.2)	+4.5°F (1.3–7.3)	+6.5°F (3.6–9.6)
Daytime Heat Waves	1.4 events	+1.2 events (0.6–1.9)	+1.5 events (0.8–2.0)	+2.2 events (1.1–3.6)	+2.9 events (1.5–4.2)
Nighttime Heat Waves	0.0 events	+0.1 events (0.0–0.2)	+0.1 events (0.0–0.2)	+0.2 events (-0.0–0.5)	+0.5 events (0.1–1.1)

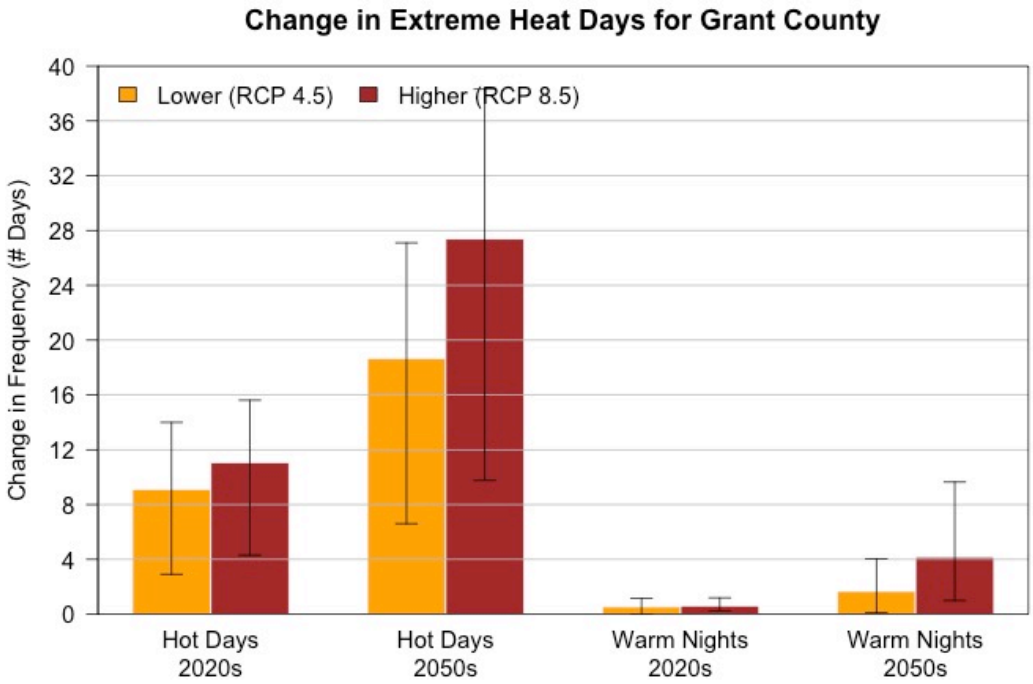

Figure 4 Projected future changes in the number of hot days (left two sets of bars) and number of warm nights (right two sets of bars) for Grant County relative to the historical baseline (1971–2000 average) for the 2020s (2010–2039 average) and 2050s (2040–2069 average) under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario based on 20 global climate models (GCMs). The bars and whiskers display the mean and range, respectively, of changes across the 20 GCMs relative to each GCM's historical baseline. Hot days are defined as days with maximum temperature of at least 90°F; warm nights are defined as days with minimum temperature of at least 65°F.

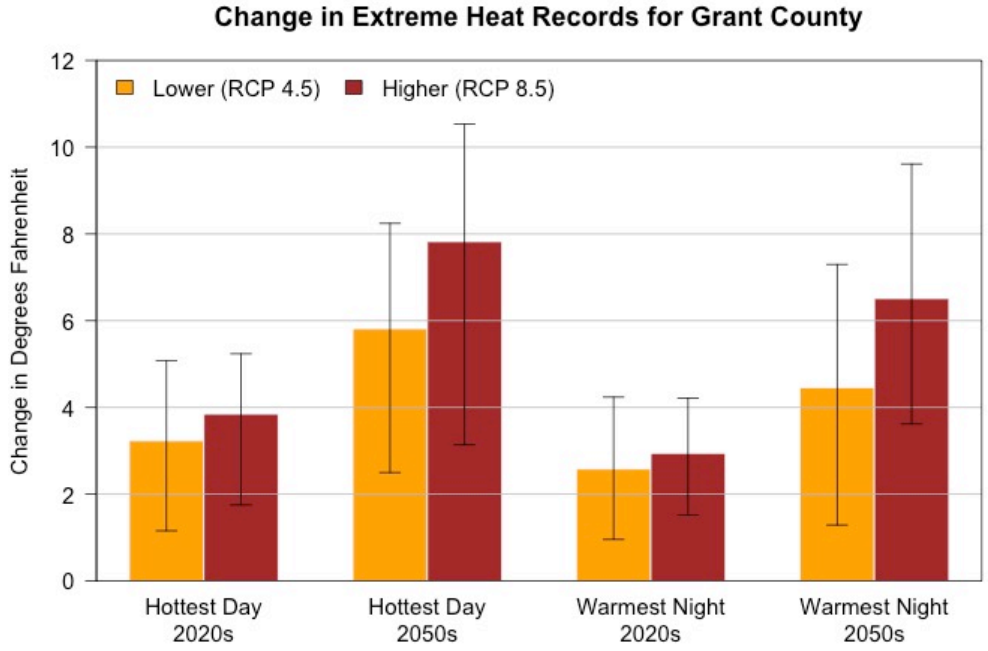

Figure 5 Projected future changes in the hottest day of the year (left two sets of bars) and warmest night of the year (right two sets of bars) for Grant County relative to the historical baseline (1971–2000 average) for the 2020s (2010–2039 average) and 2050s (2040–2069 average) under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario based on 20 global climate models (GCMs). The bars and whiskers display the mean and range, respectively, of changes across the 20 GCMs relative to each GCM's historical baseline.

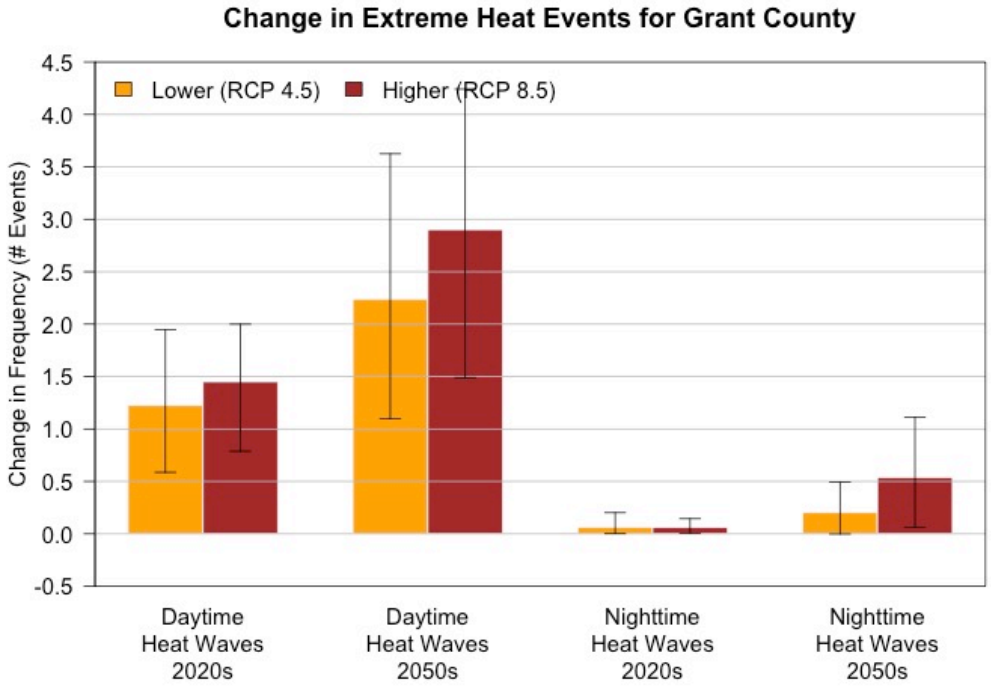

Figure 6 Projected future changes in the number of daytime heat waves (left two sets of bars) and number of nighttime heat waves (right two sets of bars) for Grant County relative to the historical baseline (1971–2000 average) for the 2020s (2010–2039 average) and 2050s (2040–2069 average) under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario based on 20 global climate models (GCMs). The bars and whiskers display the mean and range, respectively, of changes across the 20 GCMs relative to each GCM's historical baseline. Daytime heat waves are defined as events with three or more consecutive days with maximum temperature of at least 90°F; nighttime heat waves are defined as events with three or more consecutive days with minimum temperature of at least 65°F.

Key Messages:

⇒ Extreme heat events are expected to increase in frequency, duration, and intensity due to continued warming temperatures.

⇒ In Grant County, all the extreme heat metrics in Table 5 are projected to increase by the 2020s and 2050s under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios (Table 6).

⇒ In Grant County, the frequency of hot days per year with temperatures at or above 90°F is projected to increase on average by 27 days, with a range of about 10 to 38 days, by the 2050s under the higher emissions scenario relative to the historical baselines. This average increase represents a more than tripling of hot days relative to the average historical baseline.

⇒ In Grant County, the temperature of the hottest day of the year is projected to increase on average by nearly 8°F, with a range of about 3 to 11°F, by the 2050s under the higher emissions scenario relative to the historical baselines.

Cold Waves

Over the past century, cold extremes have become less frequent and severe in the Northwest; this trend is expected to continue under future global warming of the climate system (Vose *et al.*, 2017). This report presents projected changes for three metrics of cold extremes for both daytime (maximum temperature) and nighttime (minimum temperature) (Table 7).

Table 7 Cold extreme metrics and definitions

Metric	Definition
Cold Days	Number of days per year maximum temperature is less than or equal to 32°F
Cold Nights	Number of days per year minimum temperature is less than or equal to 0°F
Coldest Day	Annual minimum of maximum temperature
Coldest Night	Annual minimum of minimum temperature
Daytime Cold Waves	Number of events per year with at least 3 consecutive days with maximum temperature less than or equal to 32°F
Nighttime Cold Waves	Number of events per year with at least 3 consecutive days with minimum temperature less than or equal to 0°F

In Grant County, the extreme cold metrics in Table 7 are projected to become less frequent or less cold by the 2020s (2010–2039) and 2050s (2040–2069) under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios (Table 8). For example, for the 2050s under the higher emissions scenario climate models project that the number of cold days less than or equal to 32°F per year, relative to each model's 1971–2000 historical baseline, would decrease by at least 9 to as much as 23 days. The average projected decrease in the number of cold days per year is 16 days relative to the average historical baseline of 25 days. This represents a future with about a third of the cold days as before by the 2050s under the higher emissions scenario.

Likewise, the temperature of the coldest night of the year is projected to increase by at least 0.5°F to at most 15.9°F relative to the models' historical baselines. The average projected increase is 9.0°F above the average historical baseline of -2.7°F. The frequency of daytime cold waves is projected to decrease by two events per year on average relative to the average historical baseline of about three events. In other words, cold days are projected to become less frequent and the coldest nights are projected to become warmer.

Projected changes in the frequency of extreme cold days (i.e., Cold Days and Cold Nights) are shown in Figure 7. Projected changes in the magnitude of cold records (i.e., Coldest Day and Coldest Night) are shown in Figure 8. Projected changes in the frequency of extreme cold events (i.e., Daytime Cold Waves and Nighttime Cold Waves) are shown in Figure 9.

Table 8 Mean and range of projected future changes in extreme cold metrics for Grant County relative to each global climate model's (GCM) historical baseline (1971–2000 average) for the 2020s (2010–2039 average) and 2050s (2040–2069 average) under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario based on 20 GCMs. The average historical baseline across the 20 GCMs is also presented and can be combined with the average projected future change to infer the average projected future absolute value of a given variable. However, the average historical baseline cannot be combined with the range of projected future changes to infer the range of projected future absolute values.

		Change by Early 21st Century "2020s"		Change by Mid 21st Century "2050s"	
	Average Historical Baseline	Lower	Higher	Lower	Higher
Cold Days	24.8 days	-7.9 days (-15.1 to -0.4)	-9.6 days (-15.2 to -2.2)	-13.3 days (-18.1 to -5.3)	-15.6 days (-22.8 to -8.5)
Cold Nights	2.5 days	-0.9 days (-2.3 to 0.3)	-1.2 days (-2.3 to -0.3)	-1.7 days (-2.9 to -0.3)	-1.8 days (-2.6 to -0.4)
Coldest Day	18.5°F	+1.9°F (-2.3 to 5.1)	+3.3°F (-0.2 to 7.1)	+5.0°F (0.7 to 8.4)	+6.3°F (1.0 to 11.2)
Coldest Night	-2.7°F	+3.0°F (-1.9 to 10.1)	+4.8°F (0.2 to 11.4)	+7.2°F (0.7 to 12.6)	+9.0°F (0.5 to 15.9)
Daytime Cold Waves	3.2 events	-1.0 events (-1.9 to 0.1)	-1.2 events (-2.0 to -0.3)	-1.7 events (-2.3 to -0.7)	-2.0 events (-2.9 to -0.9)
Nighttime Cold Waves	0.3 events	-0.1 events (-0.3 to 0.1)	-0.1 events (-0.3 to 0.1)	-0.2 events (-0.4 to 0.0)	-0.2 events (-0.4 to -0.0)

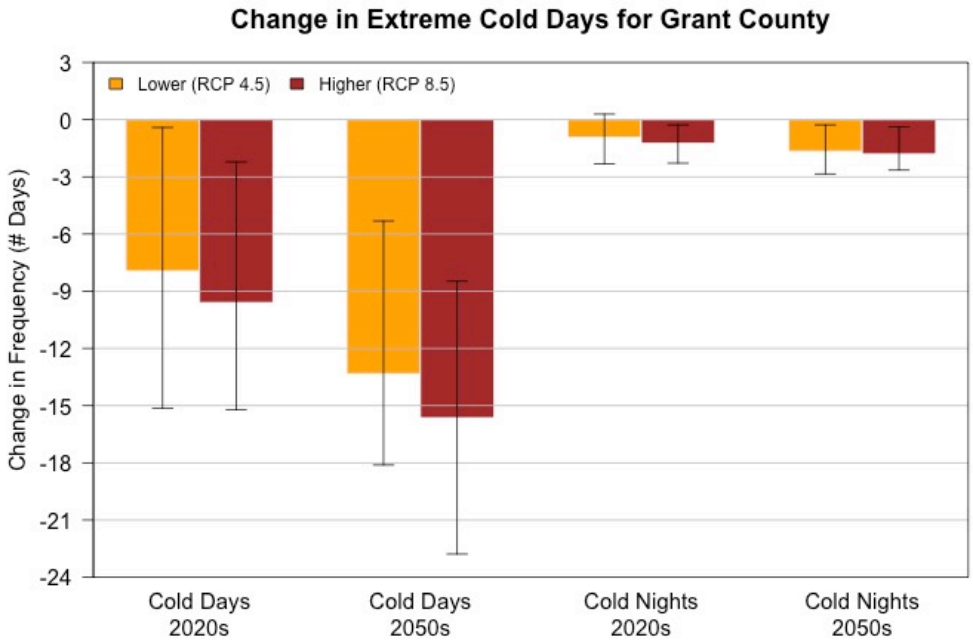

Figure 7 Projected future changes in the number of cold days (left two sets of bars) and number of cold nights (right two sets of bars) for Grant County relative to the historical baseline (1971–2000 average) for the 2020s (2010–2039 average) and 2050s (2040–2069 average) under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario based on 20 global climate models (GCMs). The bars and whiskers display the mean and range, respectively, of changes across the 20 GCMs relative to each GCM's historical baseline. Cold days are defined as days with maximum temperature at or below 32°F; cold nights are defined as days with minimum temperature at or below 0°F.

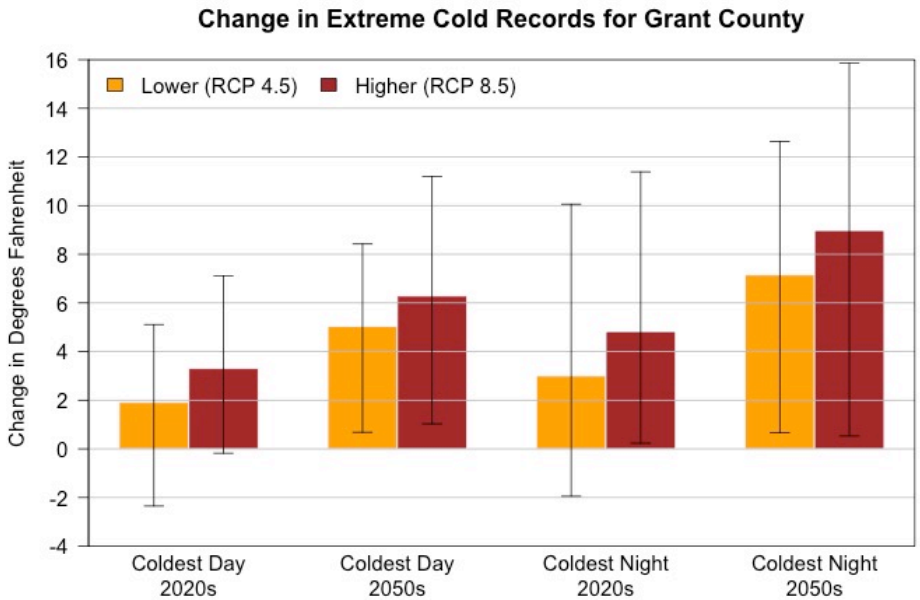

Figure 8 Projected future changes in the coldest day of the year (left two sets of bars) and coldest night of the year (right two sets of bars) for Grant County relative to the historical baseline (1971–2000 average) for the 2020s (2010–2039 average) and 2050s (2040–2069 average) under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario based on 20 global climate models (GCMs). The bars and whiskers display the mean and range, respectively, of changes across the 20 GCMs relative to each GCM's historical baseline.

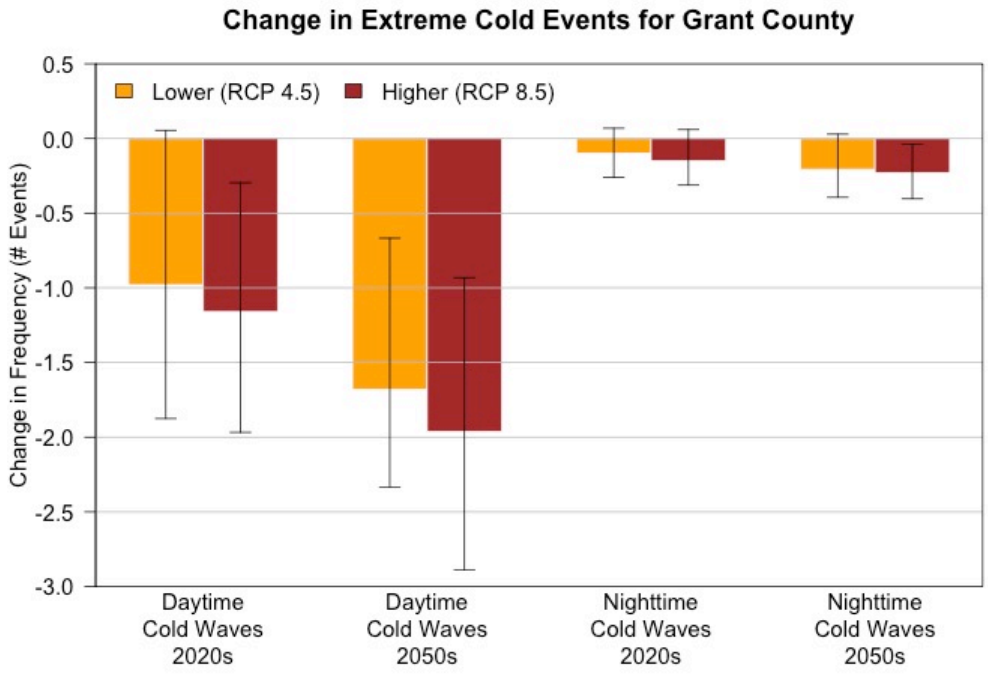

Figure 9 Projected future changes in the number of daytime cold waves (left two sets of bars) and number of nighttime cold waves (right two sets of bars) for Grant County relative to the historical baseline (1971–2000 average) for the 2020s (2010–2039 average) and 2050s (2040–2069 average) under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario based on 20 global climate models (GCMs). The bars and whiskers display the mean and range, respectively, of changes across the 20 GCMs relative to each GCM's historical baseline. Daytime cold waves are defined as events with three or more consecutive days with maximum temperature at or below 32°F; nighttime cold waves are defined as events with three or more consecutive days with minimum temperature at or below 0°F.

Key Messages:

⇒ Cold extremes are still expected to occur from time to time, but with much less frequency and intensity as the climate warms.

⇒ In Grant County, the extreme cold metrics in Table 7 are projected to become less frequent or less cold by the 2020s and 2050s under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios (Table 8).

⇒ In Grant County, the frequency of cold days per year at or below freezing is projected to decrease on average by 16 days, with a range of about 9 to 23 days, by the 2050s under the higher emissions scenario relative to the historical baselines. This average decrease represents a future about a third of the cold days per year relative to the average historical baseline.

⇒ In Grant County, the temperature of the coldest night of the year is projected to increase on average by 9°F, with a range of about 1 to 16°F, by the 2050s under the higher emissions scenario relative to the historical baselines.

Heavy Rains

There is greater uncertainty in future projections of precipitation-related metrics than temperature-related metrics. This is because of the large natural variability in precipitation patterns and the fact that the atmospheric patterns that influence precipitation are manifested differently across GCMs. From a global perspective, mean precipitation is likely to decrease in many dry regions in the sub-tropics and mid-latitudes and increase in many mid-latitude wet regions (IPCC, 2013). That boundary between mid-latitude increases and decreases in precipitation is positioned a little differently for each GCM, which results in some models projecting increases and others decreases in Oregon (Mote *et al.*, 2013).

In Oregon, observed precipitation is characterized by high year-to-year variability and future precipitation trends are expected to continue to be dominated by this large natural variability. On average, summers in Oregon are projected to become drier and other seasons to become wetter resulting in a slight increase in annual precipitation by the 2050s. However, some models project increases and others decreases in each season (Dalton *et al.*, 2017).

Extreme precipitation events in the Pacific Northwest are governed both by atmospheric circulation and by how it interacts with complex topography (Parker and Abatzoglou, 2016). Atmospheric rivers—long, narrow swaths of warm, moist air that carry large amounts of water vapor from the tropics to mid-latitudes—generally result in coherent extreme precipitation events west of the Cascade Range, while closed low pressure systems often lead to isolated precipitation extremes east of the Cascade Range (Parker and Abatzoglou, 2016).[2]

Observed trends in the frequency of extreme precipitation events across Oregon have depended on the location, time frame, and metric considered, but overall the frequency has not changed substantially. As the atmosphere warms, it is able to hold more water vapor that is available for precipitation. As a result, the frequency and intensity of extreme precipitation events are expected to increase in the future (Dalton *et al.*, 2017), including atmospheric river events (Kossin *et al.*, 2017). In addition, regional climate modeling results suggest a weakened rain shadow effect in winter projecting relatively larger increases in precipitation east of the Cascades and smaller increases west of the Cascades in terms of both seasonal precipitation totals and precipitation extremes (Mote *et al.*, 2019).

This report presents projected changes for four metrics of precipitation extremes (Table 9).

[2] Verbatim from the Third Oregon Climate Assessment Report (Dalton *et al.*, 2017)

Table 9 Precipitation extreme metrics and definitions

Metric	Definition
Wettest Day	Annual maximum 1-day precipitation per water year
Wettest Five-Days	Annual maximum 5-day precipitation total per water year
Wet Days	Number of days per year with precipitation greater than 0.75 inches
Landslide Risk Days	Number of days per water year exceeding the USGS landslide threshold[3]: https://pubs.er.usgs.gov/publication/ofr20061064 ○ P3/(3.5-.67*P15)>1, where: ▪ P3 = Previous 3-day precipitation accumulation ▪ P15 = 15-day precipitation accumulation prior to P3

In Grant County, the magnitude of precipitation on the wettest day and wettest consecutive five days is projected to increase on average by the 2020s (2010–2039) and 2050s (2040–2069) under both the lower and higher emissions scenarios (Table 10). However, some models project decreases in some of these metrics for certain time periods and scenarios.

For the 2050s under the higher emissions scenario, climate models project that the magnitude, or amount, of precipitation on the wettest day of the year, relative to each model's 1971–2000 historical baseline, would increase by as little as 7.4% to as much as 25.3%. The average projected percent increase in the amount of precipitation on the wettest day of the year is 16.4% above the average historical baseline of 0.85 inches.

For the magnitude of precipitation on the wettest consecutive five days of the year, some models project decreases by as much as -3.2% while other models project increases by as much as 23.6% for the 2050s under the higher emissions scenario. The average projected percent change in the amount of precipitation on the wettest consecutive five days is an increase of 11.7% above the average historical baseline of nearly two inches.

The average number of days per year with precipitation greater than ¾" is not projected to change substantially given that such days are rare in Grant County with an average historical baseline of only one day per year.

Landslides are often triggered by rainfall when the soil becomes saturated. This report analyzes a cumulative rainfall threshold based on the previous 3-day and 15-day precipitation accumulation as a surrogate for landslide risk. For Grant County, the average number of days per year exceeding the landslide risk threshold is not projected to change substantially given that such days are rare in Grant County with an average historical baseline of only one day per year. Landslide risk depends on a variety of site-specific factors and this metric may not reflect all aspects of the hazard. It is important to note that this particular landslide threshold was developed for Seattle, Washington and may or may not have similar applicability to other locations.

[3] This threshold was developed for Seattle, Washington and may or may not have similar applicability to other locations.

Projected changes in the magnitude of extreme precipitation events (i.e., Wettest Day and Wettest Five-Days) are shown in Figure 10. Projected changes in the frequency of extreme precipitation events (i.e., Wet Days and Landslide Risk Days) are shown in Figure 11.

Table 10 Mean and range of projected future changes in extreme precipitation metrics for Grant County relative to each global climate model's (GCM) historical baseline (1971–2000 average) for the 2020s (2010–2039 average) and 2050s (2040–2069 average) under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario based on 20 GCMs. The average historical baseline across the 20 GCMs is also presented and can be combined with the average projected future change to infer the average projected future absolute value of a given variable. However, the average historical baseline cannot be combined with the range of projected future changes to infer the range of projected future absolute values.

		Change by Early 21st Century "2020s"		Change by Mid 21st Century "2050s"	
	Average Historical Baseline	Lower	Higher	Lower	Higher
Wettest Day	0.85 inches	+12.9% (-0.3 to 32.6)	+10.1% (-4.8 to 25.2)	+13.3% (2.1 to 25.2)	+16.4% (7.4 to 25.3)
Wettest Five-Days	1.98 inches	+7.5% (-2.8 to 26.1)	+6.3% (-15.4 to 23.9)	+7.8% (-3.2 to 15.7)	+11.7% (-3.2 to 23.6)
Wet Days	1.4 days	+0.3 days (-0.1 to 0.7)	+0.3 days (-0.1 to 1.0)	+0.5 days (0.2 to 0.9)	+0.6 days (0.1 to 1.0)
Landslide Risk Days	1.6 days	+0.4 days (-0.1 to 1.0)	+0.3 days (-0.8 to 1.1)	+0.5 days (-0.2 to 1.2)	+0.7 days (-0.3 to 1.6)

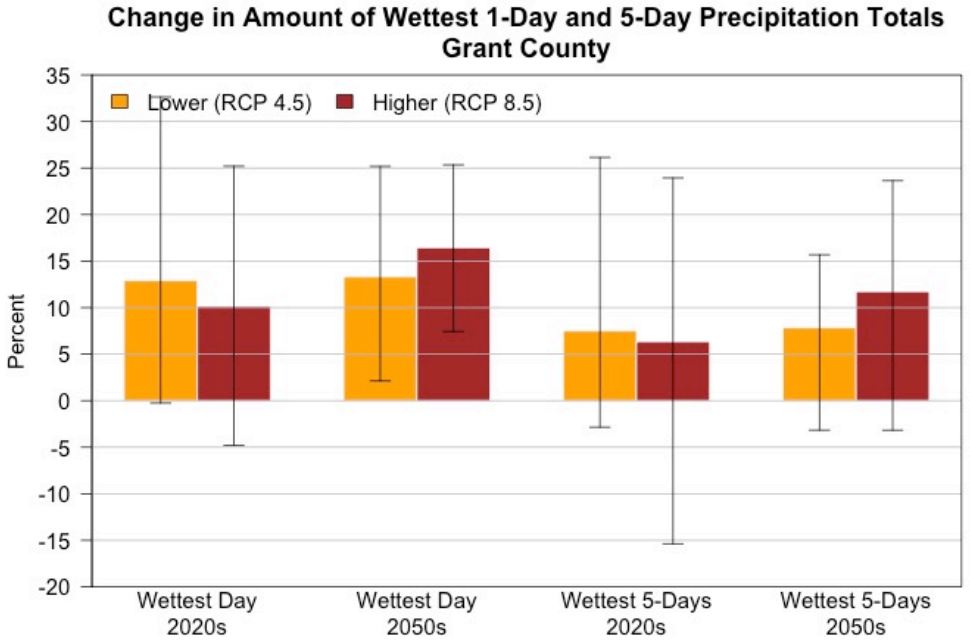

Figure 10 Projected future changes in the wettest day of the year (left two sets of bars) and wettest consecutive five days of the year (right two sets of bars) for Grant County relative to the historical baseline (1971–2000 average) for the 2020s (2010–2039 average) and 2050s (2040–2069 average) under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario based on 20 global climate models (GCMs). The bars and whiskers display the mean and range, respectively, of changes across the 20 GCMs relative to each GCM's historical baseline.

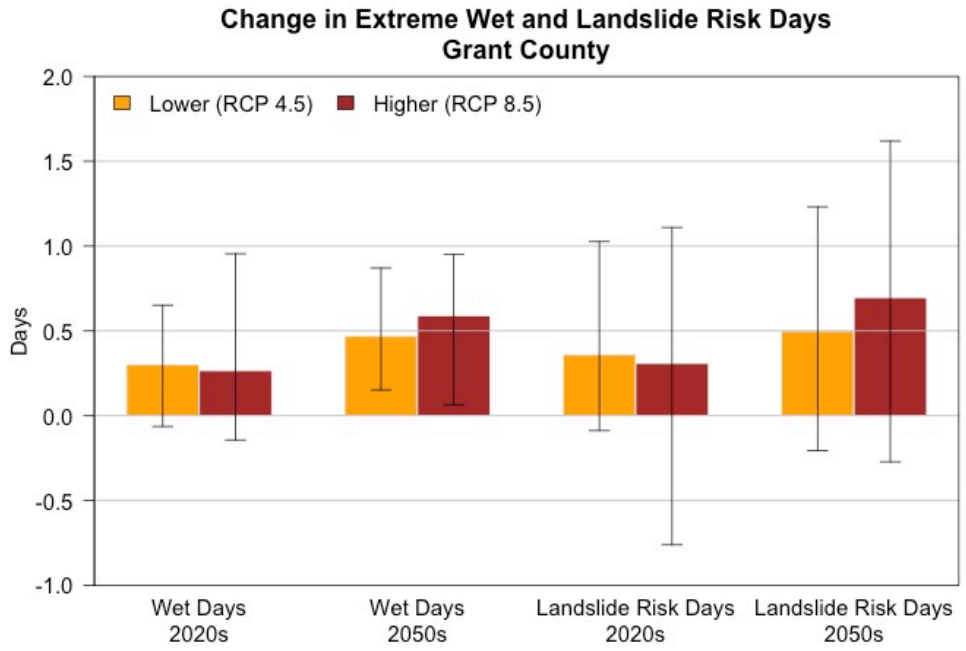

Figure 11 Projected future changes in the frequency of wet days (left two sets of bars) and landslide risk days (right two sets of bars) for Grant County relative to the historical baseline (1971–2000 average) for the 2020s (2010–2039 average) and 2050s (2040–2069 average) under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario based on 20 global climate models (GCMs). The bars and whiskers display the mean and range, respectively, of changes across the 20 GCMs relative to each GCM's historical baseline.

Key Messages:

⇒ The intensity of extreme precipitation events is expected to increase slightly in the future as the atmosphere warms and is able to hold more water vapor.

⇒ In Grant County, the frequency of days with at least ¾" of precipitation is not projected to change substantially. However, the magnitude of precipitation on the wettest day and wettest consecutive five days per year is projected to increase on average by about 16% (with a range of 7% to 25%) and 12% (with a range of -3% to 24%), respectively, by the 2050s under the higher emissions scenario relative to the historical baselines.

⇒ In Grant County, the frequency of days exceeding a threshold for landslide risk, based on 3-day and 15-day precipitation accumulation, is not projected to change substantially. However, landslide risk depends on a variety of factors and this metric may not reflect all aspects of the hazard.

River Flooding

Future streamflow magnitude and timing in the Pacific Northwest is projected to shift toward higher winter runoff, lower summer and fall runoff, and an earlier peak runoff, particularly in snow-dominated regions (Raymondi *et al.*, 2013; Naz *et al.*, 2016).[4] These changes are expected to result from warmer temperatures causing precipitation to fall more as rain and less as snow, in turn causing snow to melt earlier in the spring; and in combination with increasing winter precipitation and decreasing summer precipitation (Dalton *et al.*, 2017; Mote *et al.*, 2019).

Warming temperatures and increased winter precipitation are expected to increase flood risk for many basins in the Pacific Northwest, particularly mid- to low-elevation mixed rain-snow basins with near freezing winter temperatures (Tohver *et al.*, 2014). The greatest changes in peak streamflow magnitudes are projected to occur at intermediate elevations in the Cascade Range and the Blue Mountains (Safeeq *et al.*, 2015). Recent advances in regional hydro-climate modeling support this expectation, projecting increases in extreme high flows for most of the Pacific Northwest, especially west of the Cascade Crest (Salathé *et al.*, 2014; Najafi and Moradkhani, 2015; Naz *et al.*, 2016). One study, using a single climate model, projects flood risk to increase in the fall due to earlier, more extreme storms, including atmospheric river events, and to a shift of precipitation from snow to rain (Salathé *et al.*, 2014).[5] Across the western US, the 100-year and 25-year peak flow magnitudes—major flooding events—are projected to increase at a majority of streamflow sites by the 2070–2099 period compared to the 1971–2000 historical baseline under the higher emissions scenario (RCP 8.5) (Maurer *et al.*, 2018).

In parts of the Blue Mountains (the Wallowa Mountains, Hells Canyon Wilderness Area, and northeast Wallowa-Whitman National Forest), flood magnitude for the 1.5-year return period event is expected to increase by the end of the 21st century under a medium emission scenario (SRES-A1B)[6], particularly in mid-elevation areas, as precipitation falls more as rain and less as snow (Clifton *et al.*, 2018) (Figure 12). The 1.5-year return period event has a 67% probability of occurrence in a given year and is indicative of flooding levels that can begin to cause damage to roads. An increase in flood magnitude for a specified flood frequency implies an increase in flood frequency for a given flood magnitude. Figure 12 shows projections of flood magnitude change for the 1.5-year return period event for the 2080s compared to a historical baseline. Unfortunately, quantitative information about flood risk in Grant County is not available for the 2020s and 2050s.

Some of the Pacific Northwest's largest floods occur when copious warm rainfall from atmospheric rivers combine with a strong snowpack, resulting in rain-on-snow flooding events (Safeeq *et al.*, 2015). [7] The frequency and intensity—amount of transported moisture—of atmospheric river events is projected to increase along the West Coast in response to rising atmospheric temperatures (Kossin *et al.*, 2017). This larger moisture transport of atmospheric rivers would lead to greater likelihoods of flooding along the

[4] Verbatim from the Third Oregon Climate Assessment Report (Dalton *et al.*, 2017)

[5] Verbatim from the Third Oregon Climate Assessment Report (Dalton *et al.*, 2017)

[6] The medium emissions pathway (SRES-A1B) is from an earlier generation of emissions scenarios and it is most similar to RCP 6.0 from Figure 2.

[7] Verbatim from the Third Oregon Climate Assessment Report (Dalton *et al.*, 2017)

West Coast (Konrad and Dettinger, 2017).

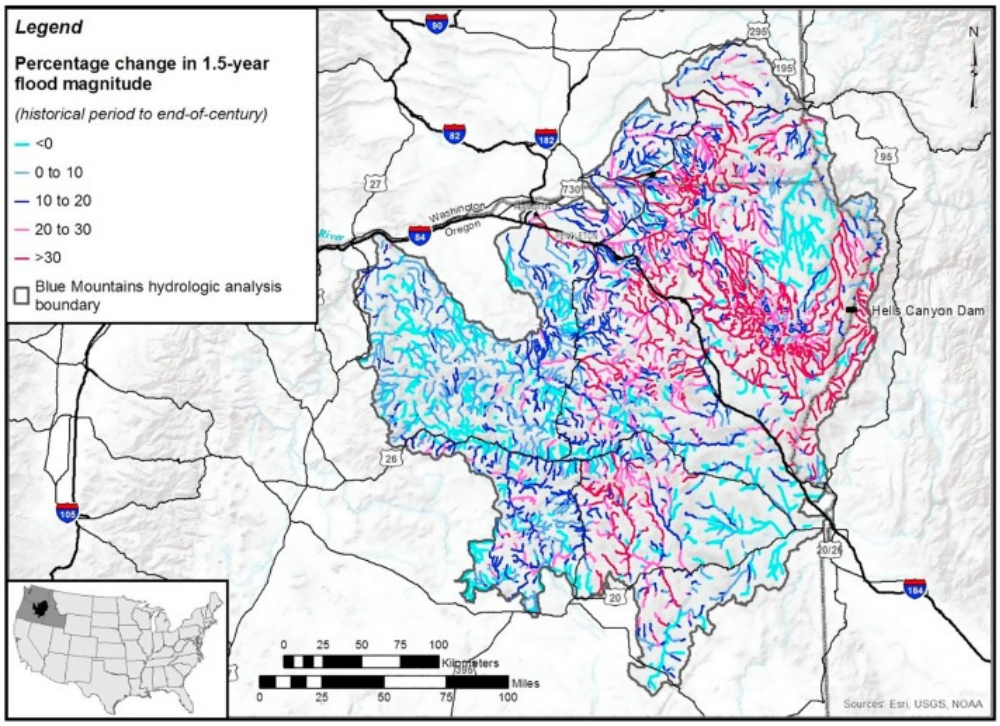

Figure 12 Projected change in the 1.5-year return interval daily flow magnitude between the historical period (1970–1999) and the 2080s (2070–2099) under a medium emissions scenario (SRES-A1B)[8] for the Blue Mountains region. (Source: Clifton et al., 2018)

Future changes in rain-on-snow events as a result of climate warming depend on elevation. At lower elevations, the frequency of rain-on-snow events is projected to decrease due to decreasing snowpack, whereas at high elevations the frequency of rain-on-snow events is projected to increase due to the shift from snowy to rainy days (Surfleet and Tullos, 2013; Safeeq *et al.*, 2015; Musselman *et al.*, 2018). How such changes in rain-on-snow frequency would affect high streamflow events is varied. For example, projections for the Santiam River, OR, show an increase in annual peak daily flows with moderate return intervals (<10 years) but a decrease at higher (> 10-year) return intervals (Surfleet and Tullos, 2013). In the John Day River Basin in northeast Oregon, the total volume and intensity of the top ten rain-on-snow events is projected to increase in the future due to precipitation falling more as rain and less as snow (Musselman *et al.*, 2018).

Key Messages:

⇒ Mid- to low-elevation areas in Grant County's Blue Mountains that are near the freezing level in winter, receiving a mix of rain and snow, are projected to experience an increase in winter flood risk due to warmer winter temperatures causing precipitation to fall more as rain and less as snow.

[8] The medium emissions pathway (SRES-A1B) is from an earlier generation of emissions scenarios and it is most similar to RCP 6.0 from Figure 2.

Across the western US, mountain snowpack is projected to decline leading to reduced summer soil moisture in mountainous environments (Gergel *et al.*, 2017). Climate change is expected to result in lower summer streamflows in historically snow-dominated basins across the Pacific Northwest as snowpack melts off earlier due to warmer temperatures and summer precipitation decreases (Dalton *et al.*, 2017; Mote *et al.*, 2019).

This report presents future changes in five variables indicative of drought conditions—low spring snowpack, low summer soil moisture[9], low summer runoff, low summer precipitation, and high summer evaporation—in terms of a change in the frequency of the historical baseline 1-in-5 year event (that is, an event having a 20% chance of occurrence in any given year). The future projections, displayed in the orange and brown bars of Figure 13, are the frequency in the future period of the magnitude of the event that has a 20% frequency in the historical period.

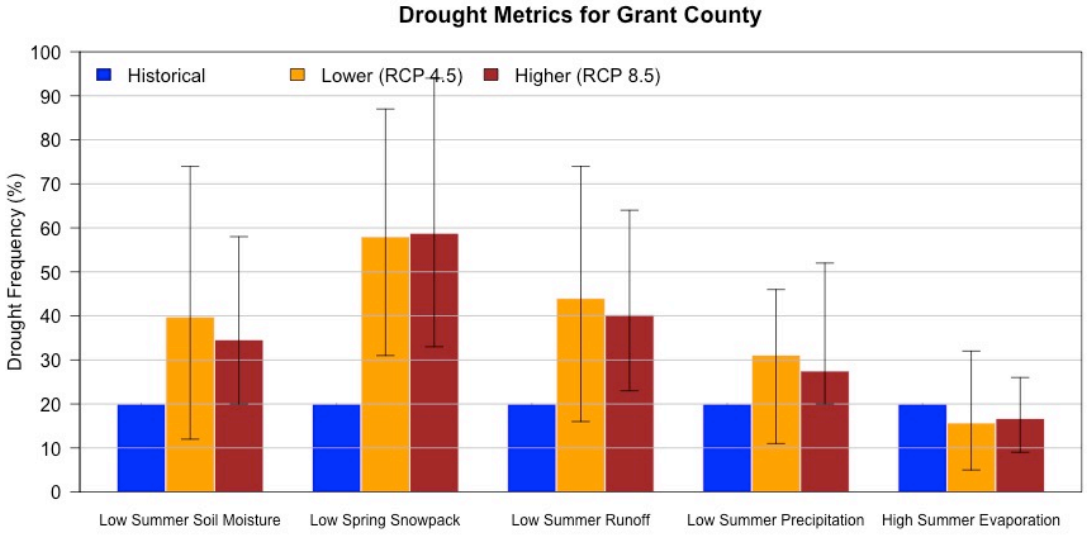

Figure 13 Frequency of the historical baseline (1971–2000) 1-in-5 year event (by definition 20% frequency) of low summer soil moisture (average of June-July-August), low spring snowpack (April 1 snow water equivalent), low summer runoff (total of June-July-August), low summer precipitation (total for June-July-August), high summer evaporation (total for June-July-August) for the future period 2040–2069 for lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios. The bar and whiskers depict the mean and range across ten global climate models. (Data Source: Integrated Scenarios of the Future Northwest Environment, https://climate.northwestknowledge.net/IntegratedScenarios/)

In Grant County, spring snowpack (that is, the snow water equivalent on April 1), summer runoff, summer soil moisture, and summer precipitation are projected to decline under both lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios by the 2050s (2040–2069). This leads to the magnitude of low summer soil moisture, low spring snow pack, low summer runoff, and low summer precipitation expected with a 20% chance in any given year of the historical period being projected to occur more frequently by the 2050s under both emissions scenarios (Figure 13). Of the five metrics, climate change shows the strongest impact on spring snowpack and summer runoff in Grant County. By the 2050s

[9] Soil moisture projections are for the total moisture in the soil column from the surface to 140 cm below the surface.

under the higher emissions scenario the 1-in-5 year events for low spring snowpack and low summer runoff are projected to become roughly a 1-in-1.7 year event and 1-in-2.5 year event, respectively. The projected changes in the 1-in-5 year events for the other variables are smaller and less certain given that some models project an increase and others a decrease. The 2020s (2010–2039) were not evaluated in this drought analysis due to data limitations, but can be expected to be similar but of smaller magnitude to the changes for the 2050s.

Some areas in northeast Oregon are more sensitive to changes in spring snowpack and summer streamflow than others. A recent climate vulnerability analysis for the Blue Mountains region indicates that declines in spring snowpack are projected to be largest in low to mid-elevation locations, but even some locally higher elevation ranges, such as the Strawberry Mountains and Monument Rock Wilderness, and mid-elevations in the North Fork John Day, and Hells Canyon Wilderness would have relatively high sensitivity to snow losses (Clifton *et al.*, 2018). Summer streamflow in about half of the perennial streams in the Blue Mountains are projected to decrease by less than 10%, while areas more sensitive to changing low flows, such as the Wallowa Mountains and Elkhorn Mountains, are projected to see decreases in summer streamflow of more than 30% by the late 21st century (Clifton *et al.*, 2018) (Figure 14). Sub-basins with high risk for summer water shortage associated with low streamflow include the Burnt, Powder, Upper Grande Ronde, Silver, Silvies, Upper John Day, Wallowa, and Willow sub-basins (Clifton *et al.*, 2018).

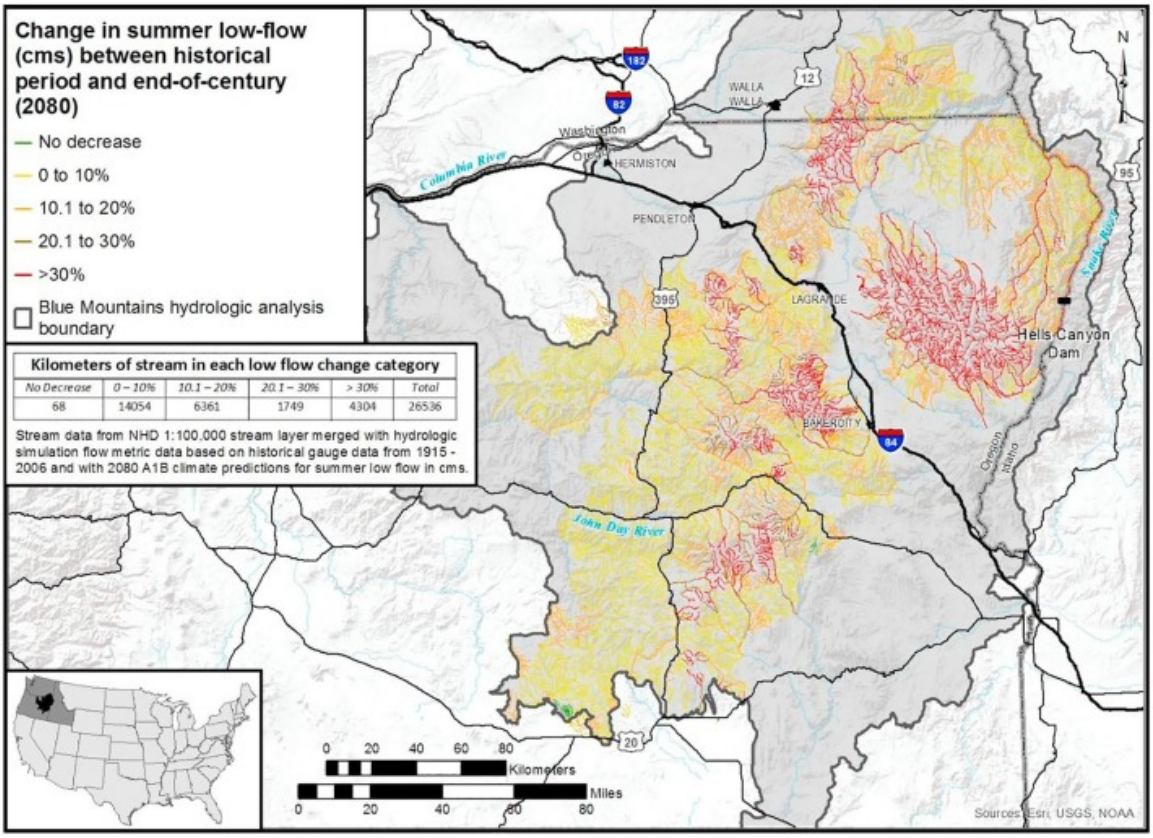

Figure 14 Projected change in mean summer streamflow from the historic time period (1970–1999) to the 2080s (2070–2099) under a medium emissions scenario[10] for streams in the Blue Mountains region. Note, the 0 to 10%, 10.1 to 20%, etc. all indicate decreases in flow. (Source: Clifton et al., 2018)

Key Messages:

⇒ Drought conditions, as represented by low summer soil moisture, low spring snowpack, low summer runoff, and low summer precipitation are projected to become more frequent in Grant County by the 2050s relative to the historical baseline.

⇒ By the end of the 21st century, summer low flows are projected to decrease in the Blue Mountains region putting some sub-basins at high risk for summer water shortage associated with low streamflow.

[10] The medium emissions pathway (SRES-A1B) is from an earlier generation of emissions scenarios and it is most similar to RCP 6.0 from Figure 2.

Wildfire

Over the last several decades, warmer and drier conditions during the summer months have contributed to an increase in fuel aridity and enabled more frequent large fires, an increase in the total area burned, and a longer fire season across the western United States, particularly in forested ecosystems (Dennison *et al.*, 2014; Jolly *et al.*, 2015; Westerling, 2016; Williams and Abatzoglou, 2016). The lengthening of the fire season is largely due to declining mountain snowpack and earlier spring snowmelt (Westerling, 2016). Recent wildfire activity in forested ecosystems is partially attributed to human-caused climate change: during the period 1984–2015, about half of the observed increase in fuel aridity and 4.2 million hectares (or more than 16,000 square miles) of burned area in the western United States were due to human-caused climate change (Abatzoglou and Williams, 2016). Under future climate change, wildfire frequency and area burned are expected to continue increasing in the Pacific Northwest (Barbero *et al.*, 2015; Sheehan *et al.*, 2015).[11]

As a proxy for wildfire risk, this report considers a fire danger index called 100-hour fuel moisture (FM100), which is a measure of the amount of moisture in dead vegetation in the 1–3 inch diameter class available to a fire. It is expressed as a percent of the dry weight of that specific fuel. FM100 is a common index used by the Northwest Interagency Coordination Center to predict fire danger. A majority of climate models project that FM100 would decline across Oregon by the 2050s (2040–2069) under the higher (RCP 8.5) emissions scenario (Gergel *et al.*, 2017). This drying of vegetation would lead to greater wildfire risk, especially when coupled with projected decreases in summer soil moisture. This report defines a "very high" fire danger day to be a day in which FM100 is lower (i.e., drier) than the historical baseline 10th percentile value. By definition, the historical baseline has 36.5 very high fire danger days annually. The future change in wildfire risk is expressed as the average annual number of additional "very high" fire danger days for two future periods under two emissions scenarios compared with the historical baseline (Figure 15). The impacts of wildfire on air quality are discussed in the following section on Air Quality.

[11] Verbatim from the Third Oregon Climate Assessment Report (Dalton *et al.*, 2017)

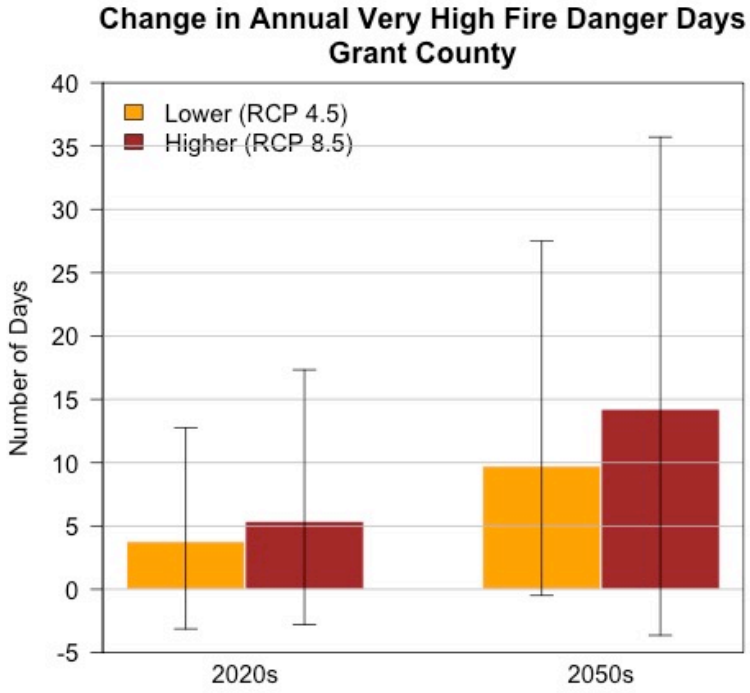

Figure 15 Projected future changes in the frequency of very high fire danger days for Grant County from the historical baseline (1971–2000 average) for the 2020s (2010–2039 average) and 2050s (2040–2069 average) under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario based on 18 global climate models. The bars and whiskers display the mean and range, respectively, of changes across the 18 GCMs. (Data Source: Northwest Climate Toolbox, climatetoolbox.org/tool/Climate-Mapper)

Key Messages:

⇒ Wildfire risk, as expressed through the frequency of very high fire danger days, is projected to increase under future climate change in Grant County.

⇒ In Grant County, the frequency of very high fire danger days per year is projected to increase on average by about 14 days (with a range of -4 to +36 days) by the 2050s under the higher emissions scenario compared to the historical baseline.

⇒ In Grant County, the frequency of very high fire danger days per year is projected to increase on average by about 39% (with a range of -10 to +98%) by the 2050s under the higher emissions scenario compared to the historical baseline.

Air Quality

Climate change is expected to worsen outdoor air quality. Warmer temperatures may increase ground level ozone pollution, more wildfires may increase smoke and particulate matter, and longer, more potent pollen seasons may increase aeroallergens. Such poor air quality is expected to exacerbate allergy and asthma conditions and increase respiratory and cardiovascular illnesses and death (Fann *et al.*, 2016).[12] In addition to increasing health risks, wildfire smoke impairs visibility and disrupts outdoor recreational activities (Nolte *et al.*, 2018). This report presents quantitative projections of future air quality measures related to fine particulate matter (PM2.5) from wildfire smoke.

Climate change is expected to result in a longer wildfire season with more frequent wildfires and greater area burned (Sheehan *et al.*, 2015). Wildfires are primarily responsible for days when air quality standards for PM2.5 are exceeded in western Oregon and parts of eastern Oregon (Liu *et al.*, 2016), although woodstove smoke and diesel emissions are also main contributors (Oregon DEQ, 2016). Across the western United States, PM2.5 levels from wildfires are projected to increase 160% by mid-century under a medium emissions pathway[11] (SRES A1B) (Liu *et al.*, 2016). This translates to a greater risk of wildfire smoke exposure through increasing frequency, length, and intensity of "smoke waves"—that is, two or more consecutive days with high levels of PM2.5 from wildfires (Liu *et al.*, 2016).[13]

The change in risk of poor air quality due to wildfire-specific PM2.5 is expressed as the number of "smoke wave" days within a six-year period and the average intensity—concentration of particulate matter—of smoke wave days in the present (2004–2009) and mid-century (2046–2051) under a medium emissions pathway[14] (Figure 16). See Appendix for description of methodology and access to the Smoke Wave data. In Grant County the frequency and intensity of "smoke wave" days is expected to increase.

[12] Verbatim from the Third Oregon Climate Assessment Report (Dalton *et al.*, 2017)

[13] Verbatim from the Third Oregon Climate Assessment Report (Dalton *et al.*, 2017)

[14] The medium emissions pathway used is from an earlier generation of emissions scenarios. Liu et al. (2016) used SRES-A1B, which is most similar to RCP 6.0 from Figure 2.

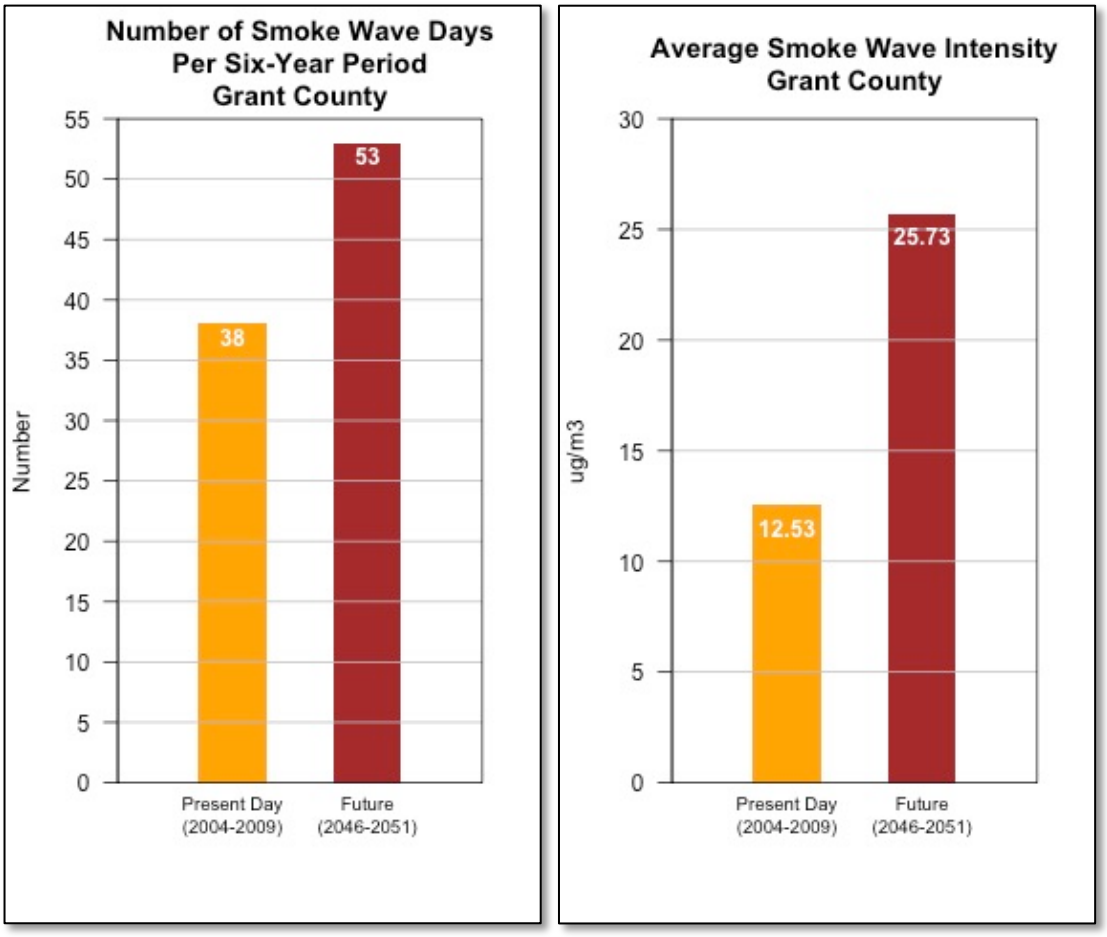

Figure 16 Simulated present day (2004–2009) and future (2046–2051) frequency (left) and intensity (right) of "smoke wave" days for Grant County under a medium emissions scenario[11]. The bars display the mean across 15 GCMs. (Data source: Liu et al. 2016, https://khanotations.github.io/smoke-map/)

Key Messages:

⇒ Under future climate change, the risk of wildfire smoke exposure is projected to increase in Grant County.

⇒ In Grant County, the number of "smoke wave" days is projected to increase by 39% and the intensity of "smoke waves" is projected to increase by 105% by 2046–2051 under a medium emissions scenario compared with 2004–2009.

Windstorms

Climate change has the potential to alter surface winds through changes in the large-scale free atmospheric circulation and storm systems, and through changes in the connection between the free atmosphere and the surface. West of the Cascade Mountains in the Pacific Northwest, changes in surface wind speeds tend to follow changes in upper atmosphere winds associated with extratropical cyclones (Salathé *et al.*, 2015). East of the Cascades, cool air pooling is common which can impede the transport of wind energy from the free atmosphere to the surface. Changes in this factor are likely important for understanding future changes in windstorms (Salathé *et al.*, 2015). However, this is not yet well studied.

Winter extratropical storm frequency in the northeast Pacific exhibited a positive, though statistically not significant, trend since 1950 (Vose *et al.*, 2014). However, there is a high degree of uncertainty in future projections of extratropical cyclone frequency (IPCC, 2013). Future projections indicate a slight northward shift in the jet stream and extratropical cyclone activity, but there is as yet no consensus on whether or not extratropical storms (Vose *et al.*, 2014; Seiler and Zwiers, 2016; Chang, 2018) and associated extreme winds (Kumar *et al.*, 2015) will intensify or become more frequent along the Northwest coast under a warmer climate. Therefore, no descriptions of future changing conditions are included in this report.

Key Messages:

⇒ Limited research suggests very little, if any, change in the frequency and intensity of windstorms in the Pacific Northwest as a result of climate change.

Dust Storms

Climate, through precipitation and winds, and vegetation coverage can influence the frequency and magnitude of dust events, or dust storms, which primarily concern parts of eastern Oregon. Periods of low precipitation can dry out the soils increasing the amount of soil particulate matter available to be entrained in high winds. In addition, the amount of vegetation cover can influence the amount of soil susceptible to high winds.

One study found that in eastern Oregon, precipitation is the dominant factor affecting dust event frequency in the spring whereas vegetation cover is the dominant factor in the summer (Pu and Ginoux, 2017). The same study projected that in the summertime in eastern Oregon, dust event frequency would decrease largely due to a decrease in bareness (or an increase in vegetation cover) (Pu and Ginoux, 2017). There were no clear projected changes in other seasons or locations in Oregon. These projections compare the 2051–2100 average under a higher emissions scenario (RCP 8.5) with the 1861–2005 average.

Another study found that wind erosion in Columbia Plateau agricultural areas is projected to decrease by mid-century under a lower emissions scenario (RCP 4.5) largely due to increases in biomass production, which retain the soil (Sharratt *et al.*, 2015). The increase in vegetation cover in both studies is likely due to the fertilization effect of increased amounts of carbon dioxide in the atmosphere and warmer temperatures. Tillage practices may also influence the amount of soil available to winds. Therefore, no descriptions of future changing conditions are included in this report.

Key Messages:

⇒ Limited research suggests that the risk of dust storms in summer would decrease in eastern Oregon under climate change in areas that experience an increase in vegetation cover from the carbon dioxide fertilization effect.

Increased Invasive Species Risk

Warming temperatures, altered precipitation patterns, and increasing atmospheric carbon dioxide levels increase the risk for invasive species, insect and plant pests for forest and rangeland vegetation, and cropping systems.

Warming and more frequent drought will likely lead to a greater susceptibility among trees to insects and pathogens, a greater risk of exotic species establishment, more frequent and severe forest insect outbreaks (Halofsky and Peterson, 2016), and increased damage by a number of forest pathogens (Vose *et al.*, 2016). In Oregon and Washington, mountain pine beetle (*Dendroctonus ponderosae*) and western spruce budworm (*Choristoneura freemani*) are the most common native forest insect pests, and both have caused substantial tree mortality and defoliation over the past several decades (Meigs *et al.*, 2015).[15]

Climatic warming has facilitated the expansion and survival of mountain pine beetles, particularly in areas that have historically been too cold for the insect (Littell *et al.*, 2013). Across the western United States, the time between generations among different populations of mountain pine beetles is similar; however, the amount of thermal units required to complete a generation cycle was significantly less for beetles at cooler sites (Bentz *et al.*, 2014). Winter survival and faster generation cycles could be favored under future projections of decreases in the number of freeze days (Rawlins *et al.*, 2016).[16]

Western spruce budworm is a destructive defoliator that sporadically breaks out in interior Oregon Douglas-fir (*Pseudotsuga menziesii*) forests (Flower *et al.*, 2014). An analysis of three hundred years of tree ring data reveals that outbreaks tended to occur near the end of a drought, when trees' physiological thresholds had likely been reached. This analysis suggests that such outbreaks would likely intensify under the more frequent drought conditions that are projected for the future (Flower *et al.*, 2014), unless increasing atmospheric carbon dioxide, which may enhance water use efficiency, mitigates drought stress.[17]

More frequent rangeland droughts could facilitate invasion of non-native weeds as native vegetation succumbs to drought or wildfire cycles, leaving bare ground (Vose *et al.*, 2016). Cheatgrass (*Bromus tectorum L.*), a lower nutritional quality forage grass, facilitates more frequent fires, which reduces the capacity of shrub steppe ecosystem to provide livestock forage and critical wildlife habitat (Boyte *et al.*, 2016). Cheatgrass is a highly invasive species in the rangelands in the West that is projected to expand northward (Creighton *et al.*, 2015) and remain stable or increase in cover in most parts of the Great Basin (Boyte *et al.*, 2016) under climate change.[18]

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[15] Verbatim from the Third Oregon Climate Assessment Report (Dalton *et al.*, 2017), p. 49

[16] Verbatim from the Third Oregon Climate Assessment Report (Dalton *et al.*, 2017), p. 49

[17] Verbatim from the Third Oregon Climate Assessment Report (Dalton *et al.*, 2017), p. 49–50

[18] Verbatim from the Third Oregon Climate Assessment Report (Dalton *et al.*, 2017), p. 70

Crop pests and pathogens may continue to migrate poleward under global warming as has been observed globally for several types since the 1960s (Bebber *et al.*, 2013). Much remains to be learned about which pests and pathogens are most likely to affect certain crops as the climate changes, and about which management strategies will be most effective.[19]

Key Messages:

⇒ Warming temperatures, altered precipitation patterns, and increasing atmospheric carbon dioxide levels increase the risk for invasive species, insect and plant pests for forest and rangeland vegetation, and cropping systems.

[19] Verbatim from the Third Oregon Climate Assessment Report (Dalton *et al.*, 2017), p. 67

Loss of Wetland Ecosystems

Wetlands play key roles in major ecological processes and provide a number of essential ecosystem services: flood reduction, groundwater recharge, pollution control, recreational opportunities, and fish and wildlife habitat, including for endangered species.[20] Climate change stands to affect freshwater wetlands Oregon through changes in the duration, frequency, and seasonality of precipitation and runoff; decreased groundwater recharge; and higher rates of evapotranspiration (Raymondi *et al.*, 2013).

Reduced snowpack and altered runoff timing may contribute to the drying of many ponds and wetland habitats across the Northwest.[21] The absence of water or declining water levels in permanent or ephemeral wetlands would affect resident and migratory birds, amphibians, and other animals that rely on the wetlands (Dello and Mote, 2010). However, potential future increases in winter precipitation may lead to the expansion of some wetland systems, such as wetland prairies.[22]

In Oregon's western Great Basin, changes in climate would alter the water chemistry of fresh and saline wetlands affecting the migratory water birds that depend on them. Hotter summer temperatures would cause freshwater sites to become more saline making them less useful to raise young birds that haven't yet developed the ability to process salt. At the same time, increased precipitation would cause saline sites to become fresher thereby decreasing the abundance of invertebrate food supply for adult water birds (Dello and Mote, 2010).

Key Messages:

⇒ Freshwater wetland ecosystems are sensitive to warming temperatures and altered hydrological patterns, such as changes in precipitation seasonality and reduction of snowpack.

[20] Verbatim from the Oregon Climate Change Adaptation Framework, p. 62

[21] Verbatim from the Climate Change in the Northwest (Dalton *et al.*, 2013), p. 53

[22] Verbatim from the Climate Change in the Northwest (Dalton *et al.*, 2013), p. 53

Appendix

Future Climate Projections Background

Read more about emissions scenarios, global climate models, and uncertainty in the Climate Science Special Report, Volume 1 of the Fourth National Climate Assessment (https://science2017.globalchange.gov).

Emissions Scenarios: https://science2017.globalchange.gov/chapter/4#section-2

Global Climate Models & Downscaling:
https://science2017.globalchange.gov/chapter/4#section-3

Uncertainty: https://science2017.globalchange.gov/chapter/4#section-4

Climate & Hydrological Data

Statistically downscaled GCM output from the Fifth phase of the Coupled Model Intercomparison Project (CMIP5) served as the basis for future projections of temperature, precipitation, and hydrology variables. The coarse resolution of GCMs output (100–300 km) was downscaled to a resolution of about 6 km using the Multivariate Adaptive Constructed Analogs (MACA) method, which has demonstrated skill in complex topographic terrain (Abatzoglou and Brown, 2012). The MACA approach utilizes a gridded training observation dataset to accomplish the downscaling by applying bias-corrections and spatial pattern matching of observed large-scale to small-scale statistical relationships. (For a detailed description of the MACA method see: https://climate.northwestknowledge.net/MACA/MACAmethod.php.)

This downscaled gridded meteorological data (i.e., MACA data) is used as the climate inputs to an integrated climate-hydrology-vegetation modeling project called Integrated Scenarios of the Future Northwest Environment (https://climate.northwestknowledge.net/IntegratedScenarios/). Snow dynamics were simulated using the Variable Infiltration Capacity hydrological model (VIC version 4.1.2.l; (Liang *et al.*, 1994) and updates) run on a $1/16^{th}$ x $1/16^{th}$ (6 km) grid.
Simulations of historical and future climate for the variables maximum temperature (*tasmax*), minimum temperature (*tasmin*), and precipitation (*pr*) are available at the daily time step from 1950 to 2099 for 20 GCMs and 2 RCPs (i.e., RCP4.5 and RCP8.5). Hydrological simulations of snow water equivalent (*SWE*) are only available for the 10 GCMs used as input to VIC. Table 11 lists all 20 CMIP5 GCMs and indicates the subset of 10 used for hydrological simulations. Data for all the models available was obtained for each variable from the Integrated Scenarios data archives in order to get the best uncertainty estimates.

Table 11 The 20 CMIP5 GCMs used in this project. The subset of 10 CMIP5 GCMs used in the Integrated Scenarios: Hydrology dataset are noted with asterisks.

Model Name	Modeling Center
BCC-CSM1-1 BCC-CSM1-1-M*	Beijing Climate Center, China Meteorological Administration
BNU-ESM	College of Global Change and Earth System Science, Beijing Normal University, China
CanESM2*	Canadian Centre for Climate Modeling and Analysis
CCSM4*	National Center for Atmospheric Research, USA
CNRM-CM5*	National Centre of Meteorological Research, France
CSIRO-Mk3-6-0*	Commonwealth Scientific and Industrial Research Organization/Queensland Climate Change Centre of Excellence, Australia
GFDL-ESM2G GFDL-ESM2M	NOAA Geophysical Fluid Dynamics Laboratory, USA
HadGEM2-CC* HadGEM2-ES*	Met Office Hadley Center, UK
INMCM4	Institute for Numerical Mathematics, Russia
IPSL-CM5A-LR IPSL-CM5A-MR* IPSL-CM5B-LR	Institut Pierre Simon Laplace, France
MIROC5* MIROC-ESM MIROC-ESM-CHEM	Japan Agency for Marine-Earth Science and Technology, Atmosphere and Ocean Research Institute (The University of Tokyo), and National Institute for Environmental Studies
MRI-CGCM3	Meteorological Research Institute, Japan
NorESM1-M*	Norwegian Climate Center, Norway

All simulated climate data and the streamflow data have been bias-corrected using quantile-mapping techniques. Only SWE is presented without bias correction. Quantile mapping adjusts simulated values by creating a one-to-one mapping between the cumulative probability distribution of simulated values and the cumulative probability distribution of observed values. In practice, both the simulated and observed values of a variable (e.g., daily streamflow) over the some historical time period are separately sorted and ranked and the values are assigned their respective probabilities of exceedence. The bias corrected value of a given simulated value is assigned the observed value that has the

same probability of exceedence as the simulated value. The historical bias in the simulations is assumed to stay constant into the future; therefore the same mapping relationship developed from the historical period was applied to the future scenarios. For MACA, a separate quantile mapping relationship was made for each non-overlapping 15-day window in the calendar year. For streamflow, a separate quantile mapping relationship was made for each calendar month.

Hydrology was simulated using the Variable Infiltration Capacity hydrological model (VIC; Liang et al. 1994) run on a $1/16^{th}$ x $1/16^{th}$ (6 km) grid. To generate daily streamflow estimates, runoff from VIC grid cells was then routed to selected locations along the stream network using a daily-time-step routing model. Where records of naturalized flow were available, the daily streamflow estimates were then bias-corrected so that their statistical distributions matched those of the naturalized streamflows.

The wildfire danger day metric was computed using the same MACA climate variables to compute the 100-hour fuel moisture content according to the equations in the National Fire Danger Rating System.

Smoke Wave Data

Abstract from Liu et al. (2016):
Wildfire can impose a direct impact on human health under climate change. While the potential impacts of climate change on wildfires and resulting air pollution have been studied, it is not known who will be most affected by the growing threat of wildfires. Identifying communities that will be most affected will inform development of fire management strategies and disaster preparedness programs. We estimate levels of fine particulate matter ($PM_{2.5}$) directly attributable to wildfires in 561 western US counties during fire seasons for the present-day (2004–2009) and future (2046–2051), using a fire prediction model and GEOS-Chem, a 3-D global chemical transport model. Future estimates are obtained under a scenario of moderately increasing greenhouse gases by mid-century. We create a new term "Smoke Wave," defined as ≥2 consecutive days with high wildfire-specific $PM_{2.5}$, to describe episodes of high air pollution from wildfires. We develop an interactive map to demonstrate the counties likely to suffer from future high wildfire pollution events. For 2004–2009, on days exceeding regulatory $PM_{2.5}$ standards, wildfires contributed an average of 71.3 % of total $PM_{2.5}$. Under future climate change, we estimate that more than 82 million individuals will experience a 57 % and 31 % increase in the frequency and intensity, respectively, of Smoke Waves. Northern California, Western Oregon and the Great Plains are likely to suffer the highest exposure to wildfire smoke in the future. Results point to the potential health impacts of increasing wildfire activity on large numbers of people in a warming climate and the need to establish or modify US wildfire management and evacuation programs in high-risk regions. The study also adds to the growing literature arguing that extreme events in a changing climate could have significant consequences for human health.

Data can be accessed here: https://khanotations.github.io/smoke-map/
For the DLCD project, we looked at the variables "Total # of SW days in 6 yrs" and "Average SW Intensity". The first variable tallies all the days within each time period in which the fine particulate matter exceeded the threshold defined as the 98^{th} quantile of the

distribution of daily wildfire-specific $PM_{2.5}$ values in the modeled present-day years, on average across the study area. The second variable computes the average concentration of fine particulate matter across identified "smoke wave" days within each time period. Liu et al. (2016) used 15 GCMs from the Third Phase of the Coupled Model Intercomparison Project (CMIP3) under a medium emissions scenario (SRES-A1B). The data site only offers the multi-model mean value (not the range), which should be understood as the aggregate direction of projected change rather than the actual number expected.

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APPENDIX E: EVALUATION OF NATURAL HAZARD MITIGATION PROJECTS

This appendix was developed by the Oregon Partnership for Disaster Resilience at the University of Oregon's Community Service Center. It has been reviewed and accepted by the Federal Emergency Management Agency as a means of documenting how the prioritization of actions shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

The appendix outlines three approaches for conducting economic analyses of natural hazard mitigation projects. It describes the importance of implementing mitigation activities, different approaches to economic analysis of mitigation strategies, and methods to calculate costs and benefits associated with mitigation strategies. Information in this section is derived in part from: The Interagency Hazards Mitigation Team, *State Hazard Mitigation Plan*, (Oregon Military Department – Office of Emergency Management, 2000), and Federal Emergency Management Agency Publication 331, *Report on Costs and Benefits of Natural Hazard Mitigation*. This section is not intended to provide a comprehensive description of benefit/cost analysis, nor is it intended to evaluate local projects. It is intended to (1) raise benefit/cost analysis as an important issue, and (2) provide some background on how economic analysis can be used to evaluate mitigation projects.

Why Evaluate Mitigation Strategies?

Mitigation activities reduce the cost of disasters by minimizing property damage, injuries, and the potential for loss of life, and by reducing emergency response costs, which would otherwise be incurred. Evaluating possible natural hazard mitigation activities provides decision-makers with an understanding of the potential benefits and costs of an activity, as well as a basis upon which to compare alternative projects.

Evaluating mitigation projects is a complex and difficult undertaking, which is influenced by many variables. First, natural disasters affect all segments of the communities they strike, including individuals, businesses, and public services such as fire, police, utilities, and schools. Second, while some of the direct and indirect costs of disaster damages are measurable, some of the costs are non-financial and difficult to quantify in dollars. Third, many of the impacts of such events produce "ripple-effects" throughout the community, greatly increasing the disaster's social and economic consequences.

While not easily accomplished, there is value, from a public policy perspective, in assessing the positive and negative impacts from mitigation activities, and obtaining an instructive benefit/cost comparison. Otherwise, the decision to pursue or not pursue various mitigation options would not be based on an objective understanding of the net benefit or loss associated with these actions.

What are some Economic Analysis Approaches for Evaluating Mitigation Strategies?

The approaches used to identify the costs and benefits associated with natural hazard mitigation strategies, measures, or projects fall into three general categories: benefit/cost analysis, cost-effectiveness analysis and the STAPLE/E approach. The distinction between the three methods is outlined below:

Benefit/Cost Analysis

Benefit/cost analysis is a key mechanism used by the state Oregon Military Department – Office of Emergency Management (OEM), the Federal Emergency Management Agency, and other state and federal agencies in evaluating hazard mitigation projects, and is required by the Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 93-288, as amended.

Benefit/cost analysis is used in natural hazards mitigation to show if the benefits to life and property protected through mitigation efforts exceed the cost of the mitigation activity. Conducting benefit/cost analysis for a mitigation activity can assist communities in determining whether a project is worth undertaking now, in order to avoid disaster-related damages later. Benefit/cost analysis is based on calculating the frequency and severity of a hazard, avoiding future damages, and risk. In benefit/cost analysis, all costs and benefits are evaluated in terms of dollars, and a net benefit/cost ratio is computed to determine whether a project should be implemented. A project must have a benefit/cost ratio greater than 1 (i.e., the net benefits will exceed the net costs) to be eligible for FEMA funding.

Cost-Effectiveness Analysis

Cost-effectiveness analysis evaluates how best to spend a given amount of money to achieve a specific goal. This type of analysis, however, does not necessarily measure costs and benefits in terms of dollars. Determining the economic feasibility of mitigating natural hazards can also be organized according to the perspective of those with an economic interest in the outcome. Hence, economic analysis approaches are covered for both public and private sectors as follows.

Investing in Public Sector Mitigation Activities

Evaluating mitigation strategies in the public sector is complicated because it involves estimating all of the economic benefits and costs regardless of who realizes them, and potentially to a large number of people and economic entities. Some benefits cannot be evaluated monetarily, but still affect the public in profound ways. Economists have developed methods to evaluate the economic feasibility of public decisions which involve a diverse set of beneficiaries and non-market benefits.

Investing in Private Sector Mitigation Activities

Private sector mitigation projects may occur on the basis of one or two approaches: it may be mandated by a regulation or standard, or it may be economically justified on its own merits. A building or landowner, whether a private entity or a public agency, required to conform to a mandated standard may consider the following options:

1. Request cost sharing from public agencies;
2. Dispose of the building or land either by sale or demolition;
3. Change the designated use of the building or land and change the hazard mitigation compliance requirement; or
4. Evaluate the most feasible alternatives and initiate the most cost effective hazard mitigation alternative.

The sale of a building or land triggers another set of concerns. For example, real estate disclosure laws can be developed which require sellers of real property to disclose known defects and deficiencies in the property, including earthquake weaknesses and hazards to prospective purchases. Correcting deficiencies can be expensive and time consuming, but their existence can prevent the sale of the building. Conditions of a sale regarding the deficiencies and the price of the building can be negotiated between a buyer and seller.

STAPLE/E Approach

Considering detailed benefit/cost or cost-effectiveness analysis for every possible mitigation activity could be very time consuming and may not be practical. There are some alternate approaches for conducting a quick evaluation of the proposed mitigation activities which could be used to identify those mitigation activities that merit more detailed assessment. One of those methods is the STAPLE/E approach.

Using STAPLE/E criteria, mitigation activities can be evaluated quickly by steering committees in a synthetic fashion. This set of criteria requires the committee to assess the mitigation activities based on the Social, Technical, Administrative, Political, Legal, Economic and Environmental (STAPLE/E) constraints and opportunities of implementing the particular mitigation item in your community. The second chapter in FEMA's How-To Guide "Developing the Mitigation Plan – Identifying Mitigation Actions and Implementation Strategies" as well as the "State of Oregon's Local Natural Hazard Mitigation Plan: An Evaluation Process" outline some specific considerations in analyzing each aspect. The following are suggestions for how to examine each aspect of the STAPLE/E approach from the "State of Oregon's Local Natural Hazard Mitigation Plan: An Evaluation Process."

Social: Community development staff, local non-profit organizations, or a local planning board can help answer these questions.

- Is the proposed action socially acceptable to the community?
- Are there equity issues involved that would mean that one segment of the community is treated unfairly?
- Will the action cause social disruption?

Technical: The city or county public works staff, and building department staff can help answer these questions.

- Will the proposed action work?
- Will it create more problems than it solves?
- Does it solve a problem or only a symptom?

- Is it the most useful action in light of other community goals?

Administrative: Elected officials or the city or county administrator, can help answer these questions.

- Can the community implement the action?
- Is there someone to coordinate and lead the effort?
- Is there sufficient funding, staff, and technical support available?
- Are there ongoing administrative requirements that need to be met?

Political: Consult the mayor, city council or city board of commissioners, city or county administrator, and local planning commissions to help answer these questions.

- Is the action politically acceptable?
- Is there public support both to implement and to maintain the project?

Legal: Include legal counsel, land use planners, risk managers, and city council or county planning commission members, among others, in this discussion.

- Is the community authorized to implement the proposed action? Is there a clear legal basis or precedent for this activity?
- Are there legal side effects? Could the activity be construed as a taking?
- Is the proposed action allowed by the comprehensive plan, or must the comprehensive plan be amended to allow the proposed action?
- Will the community be liable for action or lack of action?
- Will the activity be challenged?

Economic: Community economic development staff, civil engineers, building department staff, and the assessor's office can help answer these questions.

- What are the costs and benefits of this action?
- Do the benefits exceed the costs?
- Are initial, maintenance, and administrative costs taken into account?
- Has funding been secured for the proposed action? If not, what are the potential funding sources (public, non-profit, and private?)
- How will this action affect the fiscal capability of the community?
- What burden will this action place on the tax base or local economy?
- What are the budget and revenue effects of this activity?
- Does the action contribute to other community goals, such as capital improvements or economic development?
- What benefits will the action provide? (This can include dollar amount of damages prevented, number of homes protected, credit under the CRS, potential for funding under the HMGP or the FMA program, etc.)

Environmental: Watershed councils, environmental groups, land use planners and natural resource managers can help answer these questions.

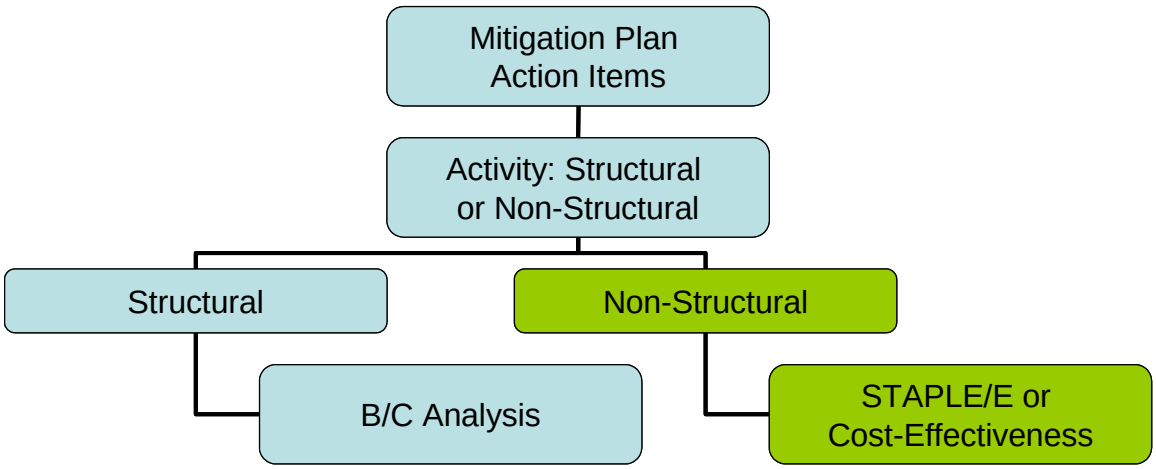
- How will the action impact the environment?
- Will the action need environmental regulatory approvals?
- Will it meet local and state regulatory requirements?
- Are endangered or threatened species likely to be affected?

The STAPLE/E approach is helpful for doing a quick analysis of mitigation projects. Most projects that seek federal funding and others often require more detailed benefit/cost analyses.

When to use the various approaches

It is important to realize that various funding sources require different types of economic analyses. The following figure is to serve as a guideline for when to use the various approaches.

Figure C.1: Economic Analysis Flowchart



Source: Oregon Partnership for Disaster Resilience. 2005.

Implementing the Approaches

Benefit/cost analysis, cost-effectiveness analysis, and the STAPLE/E are important tools in evaluating whether or not to implement a mitigation activity. A framework for evaluating mitigation activities is outlined below. This framework should be used in further analyzing the feasibility of prioritized mitigation activities.

1. Identify the Activities

Activities for reducing risk from natural hazards can include structural projects to enhance disaster resistance, education and outreach, and acquisition or demolition of exposed properties, among others. Different mitigation projects can assist in minimizing risk to natural hazards, but do so at varying economic costs.

2. Calculate the Costs and Benefits

Choosing economic criteria is essential to systematically calculating costs and benefits of mitigation projects and selecting the most appropriate activities. Potential economic criteria to evaluate alternatives include:

- ***Determine the project cost***. This may include initial project development costs, and repair and operating costs of maintaining projects over time.
- ***Estimate the benefits***. Projecting the benefits, or cash flow resulting from a project can be difficult. Expected future returns from the mitigation effort depend on the correct specification of the risk and the effectiveness of the project, which may not be well known. Expected future costs depend on the physical durability and potential economic obsolescence of the investment. This is difficult to project. These considerations will also provide guidance in selecting an appropriate salvage value. Future tax structures and rates must be projected. Financing alternatives must be researched, and they may include retained earnings, bond and stock issues, and commercial loans.
- ***Consider costs and benefits to society and the environment***. These are not easily measured, but can be assessed through a variety of economic tools including existence value or contingent value theories. These theories provide quantitative data on the value people attribute to physical or social environments. Even without hard data, however, impacts of structural projects to the physical environment or to society should be considered when implementing mitigation projects.
- ***Determine the correct discount rate***. Determination of the discount rate can just be the risk-free cost of capital, but it may include the decision maker's time preference and also a risk premium. Including inflation should also be considered.

3. Analyze and Rank the Activities

Once costs and benefits have been quantified, economic analysis tools can rank the possible mitigation activities. Two methods for determining the best activities given varying costs and benefits include net present value and internal rate of return.

- ***Net present value***. Net present value is the value of the expected future returns of an investment minus the value of the expected future cost expressed in today's dollars. If the net present value is greater than the projected costs, the project may be determined feasible for implementation. Selecting the discount rate, and

identifying the present and future costs and benefits of the project calculates the net present value of projects.

- ***Internal rate of return***. Using the internal rate of return method to evaluate mitigation projects provides the interest rate equivalent to the dollar returns expected from the project. Once the rate has been calculated, it can be compared to rates earned by investing in alternative projects. Projects may be feasible to implement when the internal rate of return is greater than the total costs of the project. Once the mitigation projects are ranked on the basis of economic criteria, decision-makers can consider other factors, such as risk, project effectiveness, and economic, environmental, and social returns in choosing the appropriate project for implementation.

Economic Returns of Natural Hazard Mitigation

The estimation of economic returns, which accrue to building or land owners as a result of natural hazard mitigation, is difficult. Owners evaluating the economic feasibility of mitigation should consider reductions in physical damages and financial losses. A partial list follows:

- Building damages avoided
- Content damages avoided
- Inventory damages avoided
- Rental income losses avoided
- Relocation and disruption expenses avoided
- Proprietor's income losses avoided

These parameters can be estimated using observed prices, costs, and engineering data. The difficult part is to correctly determine the effectiveness of the hazard mitigation project and the resulting reduction in damages and losses. Equally as difficult is assessing the probability that an event will occur. The damages and losses should only include those that will be borne by the owner. The salvage value of the investment can be important in determining economic feasibility. Salvage value becomes more important as the time horizon of the owner declines. This is important because most businesses depreciate assets over a period of time.

Additional Costs from Natural Hazards

Property owners should also assess changes in a broader set of factors that can change as a result of a large natural disaster. These are usually termed "indirect" effects, but they can have a very direct effect on the economic value of the owner's building or land. They can be positive or negative, and include changes in the following:

- Commodity and resource prices
- Availability of resource supplies
- Commodity and resource demand changes
- Building and land values
- Capital availability and interest rates
- Availability of labor
- Economic structure
- Infrastructure
- Regional exports and imports
- Local, state, and national regulations and policies
- Insurance availability and rates

Changes in the resources and industries listed above are more difficult to estimate and require models that are structured to estimate total economic impacts. Total economic impacts are the sum of direct and indirect economic impacts. Total economic impact models are usually not combined with economic feasibility models. Many models exist to estimate total economic impacts of changes in an economy. Decision makers should understand the total economic impacts of natural disasters in order to calculate the benefits of a mitigation activity. This suggests that understanding the local economy is an important first step in being able to understand the potential impacts of a disaster, and the benefits of mitigation activities.

Additional Considerations

Conducting an economic analysis for potential mitigation activities can assist decision-makers in choosing the most appropriate strategy for their community to reduce risk and prevent loss from natural hazards. Economic analysis can also save time and resources from being spent on inappropriate or unfeasible projects. Several resources and models are listed on the following page that can assist in conducting an economic analysis for natural hazard mitigation activities.

Benefit/cost analysis is complicated, and the numbers may divert attention from other important issues. It is important to consider the qualitative factors of a project associated with mitigation that cannot be evaluated economically. There are alternative approaches to implementing mitigation projects. With this in mind, opportunity rises to develop strategies that integrate natural hazard mitigation with projects related to watersheds, environmental planning, community economic development, and small business development, among others. Incorporating natural hazard mitigation with other community projects can increase the viability of project implementation.

Resources

CUREe Kajima Project, *Methodologies for Evaluating the Socio-Economic Consequences of Large Earthquakes*, Task 7.2 Economic Impact Analysis, Prepared by University of California, Berkeley Team, Robert A. Olson, VSP Associates, Team Leader; John M. Eidinger, G&E Engineering Systems; Kenneth A. Goettel, Goettel and Associates, Inc.; and Gerald L. Horner, Hazard Mitigation Economics Inc., 1997

Federal Emergency Management Agency, *Benefit/Cost Analysis of Hazard Mitigation* Projects, Riverine Flood, Version 1.05, Hazard Mitigation Economics, Inc., 1996

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Goettel & Horner Inc., *Earthquake Risk Analysis Volume III: The Economic Feasibility of Seismic Rehabilitation of Buildings in the City of Portland*, Submitted to the Bureau of Buildings, City of Portland, August 30, 1995.

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Interagency Hazards Mitigation Team, *State Hazard Mitigation Plan*, (Oregon State Police – Office of Emergency Management, 2000.)

Risk Management Solutions, Inc., *Development of a Standardized Earthquake Loss Estimation Methodology*, National Institute of Building Sciences, Volume I and II, 1994.

VSP Associates, Inc., *A Benefit/Cost Model for the Seismic Rehabilitation of Buildings*, Volumes 1 & 2, Federal Emergency management Agency, FEMA Publication Numbers 227 and 228, 1991.

VSP Associates, Inc., *Benefit/Cost Analysis of Hazard Mitigation Projects: Section 404 Hazard Mitigation Program and Section 406 Public Assistance Program, Volume 3: Seismic Hazard Mitigation Projects*, 1993.

VSP Associates, Inc., *Seismic Rehabilitation of Federal Buildings: A Benefit/Cost Model*, Volume 1, Federal Emergency Management Agency, FEMA Publication Number 255, 1994.

Appendix F:
Grant Programs and Resources

Post-Disaster Federal Programs

Hazard Mitigation Grant Program

- The Hazard Mitigation Grant Program (HMGP) provides grants to States and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. The HMGP is authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act.
  http://www.fema.gov/hazard-mitigation-grant-program

Physical Disaster Loan Program

- When physical disaster loans are made to homeowners and businesses following disaster declarations by the U.S. Small Business Administration (SBA), up to 20% of the loan amount can go towards specific measures taken to protect against recurring damage in similar future disasters.
  http://www.sba.gov/category/navigation-structure/loans-grants/small-business-loans/disaster-loans

Pre-Disaster Federal Programs

Pre-Disaster Mitigation Grant Program

- The Pre-Disaster Mitigation (PDM) program provides funds to states, territories, Indian tribal governments, communities, and universities for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event. Funding these plans and projects reduces overall risks to the population and structures, while also reducing reliance on funding from actual disaster declarations. PDM grants are to be awarded on a competitive basis and without reference to state allocations, quotas, or other formula-based allocation of funds.
  http://www.fema.gov/pre-disaster-mitigation-grant-program

Flood Mitigation Assistance Program

- The overall goal of the Flood Mitigation Assistance (FMA) Program is to fund cost-effective measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other National Flood Insurance Program (NFIP) insurable structures. This specifically includes:
  - Reducing the number of repetitively or substantially damaged structures and the associated flood insurance claims;
  - Encouraging long-term, comprehensive hazard mitigation planning;

- Responding to the needs of communities participating in the NFIP to expand their mitigation activities beyond floodplain development activities; and
- Complementing other federal and state mitigation programs with similar, long-term mitigation goals.
  http://www.fema.gov/flood-mitigation-assistance-program

Detailed program and application information for federal post-disaster and pre-disaster programs can be found in the f, available at :
https://www.fema.gov/library/viewRecord.do?id=4225

For Oregon Military Department – Office of Emergency Management grant guidance on Federal Hazard Mitigation Assistance, visit:
http://www.oregon.gov/OMD/OEM/pages/all_grants.aspx - Hazard_Mitigation_Grants

OEM contact: Dennis Sigrist, dsigrist@oem.state.or.us

State Programs

Community Development Block Grant Program

- Promotes viable communities by providing: 1) decent housing; 2) quality living environments; and 3) economic opportunities, especially for low and moderate income persons. Eligible Activities Most Relevant to Hazard Mitigation include: acquisition of property for public purposes; construction/reconstruction of public infrastructure; community planning activities. Under special circumstances, CDBG funds also can be used to meet urgent community development needs arising in the last 18 months which pose immediate threats to health and welfare.
  http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs

Oregon Watershed Enhancement Board

- While OWEB's primary responsibilities are implementing projects addressing coastal salmon restoration and improving water quality statewide, these projects can sometimes also benefit efforts to reduce flood and landslide hazards. In addition, OWEB conducts watershed workshops for landowners, watershed councils, educators, and others, and conducts a biennial conference highlighting watershed efforts statewide. Funding for OWEB programs comes from the general fund, state lottery, timber tax revenues, license plate revenues, angling license fees, and other sources. OWEB awards approximately $20 million in funding annually.
  http://www.oregon.gov/OWEB/Pages/index.aspx

Federal Mitigation Programs, Activities & Initiatives

Basic & Applied Research/Development

- National Earthquake Hazard Reduction Program (NEHRP), National Science Foundation. Through broad based participation, the NEHRP attempts to mitigate the effects of earthquakes. Member agencies in NEHRP are the US Geological Survey (USGS), the National Science Foundation (NSF), the Federal Emergency Management Agency (FEMA), and the National Institute for Standards and Technology (NIST). The agencies focus on research and

development in areas such as the science of earthquakes, earthquake performance of buildings and other structures, societal impacts, and emergency response and recovery. http://www.nehrp.gov/

- Decision, Risk, and Management Science Program, National Science Foundation. Supports scientific research directed at increasing the understanding and effectiveness of decision making by individuals, groups, organizations, and society. Disciplinary and interdisciplinary research, doctoral dissertation research, and workshops are funded in the areas of judgment and decision making; decision analysis and decision aids; risk analysis, perception, and communication; societal and public policy decision making; management science and organizational design. The program also supports small grants for exploratory research of a time-critical or high-risk, potentially transformative nature. http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5423

Hazard ID and Mapping

- National Flood Insurance Program: Flood Mapping; FEMA. Flood insurance rate maps and flood plain management maps for all NFIP communities. http://www.fema.gov/national-flood-insurance-program-flood-hazard-mapping
- National Digital Orthophoto Program, DOI – USGS. Develops topographic quadrangles for use in mapping of flood and other hazards. http://www.ndop.gov/
- Mapping Standards Support, DOI-USGS. Expertise in mapping and digital data standards to support the National Flood Insurance Program. http://ncgmp.usgs.gov/standards.html
- Soil Survey, USDA-NRCS. Maintains soil surveys of counties or other areas to assist with farming, conservation, mitigation or related purposes. http://soils.usda.gov/survey/printed_surveys/

Project Support

- Coastal Zone Management Program, NOAA. Provides grants for planning and implementation of non-structural coastal flood and hurricane hazard mitigation projects and coastal wetlands restoration. http://coastalmanagement.noaa.gov/
- Community Development Block Grant Entitlement Communities Program, HUD. Provides grants to entitled cities and urban counties to develop viable communities (e.g., decent housing, a suitable living environment, expanded economic opportunities), principally for low- and moderate- in come persons. http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs/entitlement
- National Fire Plan (DOI – USDA) Provides technical, financial, and resource guidance and support for wildland fire management across the United States. Addresses five key points: firefighting, rehabilitation, hazardous fuels reduction, community assistance, and accountability. http://www.forestsandrangelands.gov/
- Assistance to Firefighters Grant Program, FEMA. Grants are awarded to fire departments to enhance their ability to protect the public and fire service personnel from fire and related hazards. Three types of grants are available: Assistance to Firefighters Grant (AFG), Fire Prevention and Safety (FP&S), and Staffing for Adequate Fire and Emergency Response (SAFER). http://www.fema.gov/welcome-assistance-firefighters-grant-program

- Emergency Watershed Protection Program, USDA-NRCS. Provides technical and financial assistance for relief from imminent hazards in small watersheds, and to reduce vulnerability of life and property in small watershed areas damaged by severe natural hazard events. http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/ewpp

- Rural Development Assistance – Utilities, USDA. Direct and guaranteed rural economic loans and business enterprise grants to address utility issues and development needs. http://www.rurdev.usda.gov/Utilities_Programs_Grants.html

- Rural Development Assistance – Housing, USDA. Grants, loans, and technical assistance in addressing rehabilitation, health and safety needs in primarily low-income rural areas. Declaration of major disaster necessary.

  http://www.rurdev.usda.gov/HAD-HCFPGrants.html

- Public Assistance Grant Program, FEMA. The objective of the Federal Emergency Management Agency's (FEMA) Public Assistance (PA) Grant Program is to provide assistance to State, Tribal and local governments, and certain types of Private Nonprofit organizations so that communities can quickly respond to and recover from major disasters or emergencies declared by the President. http://www.fema.gov/public-assistance-local-state-tribal-and-non-profit

- National Flood Insurance Program, FEMA. Makes available flood insurance to residents of communities that adopt and enforce minimum floodplain management requirements. http://www.fema.gov/national-flood-insurance-program

- HOME Investments Partnerships Program, HUD. Grants to states, local government and consortia for permanent and transitional housing (including support for property acquisition and rehabilitation) for low-income persons. http://www.hud.gov/offices/cpd/affordablehousing/programs/home/

- Disaster Recovery Initiative, HUD. Grants to fund gaps in available recovery assistance after disasters (including mitigation). http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs/dri

- Emergency Management Performance Grants, FEMA. Helps state and local governments to sustain and enhance their all-hazards emergency management programs and to fund some hazard mitigation work. http://www.fema.gov/fy-2012-emergency-management-performance-grants-program

- Partners for Fish and Wildlife, DOI – FWS. Financial and technical assistance to private landowners interested in pursuing restoration projects affecting wetlands and riparian habitats. http://www.fws.gov/partners/

- North American Wetland Conservation Fund, DOI-FWS. Cost-share grants to stimulate public/private partnerships for the protection, restoration, and management of wetland habitats. http://www.fws.gov/birdhabitat/Grants/index.shtm

- Federal Land Transfer / Federal Land to Parks Program, DOI-NPS. Identifies, assesses, and transfers available Federal real property for acquisition for State and local parks and recreation, such as open space. http://www.nps.gov/ncrc/programs/flp/index.htm

- Wetlands Reserve program, USDA-NCRS. Financial and technical assistance to protect and restore wetlands through easements and restoration agreements. http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/wetlands
- Secure Rural Schools and Community Self-Determination Act of 2000, US Forest Service. Reauthorized for FY2012, it was originally enacted in 2000 to provide five years of transitional assistance to rural counties affected by the decline in revenue from timber harvests on federal lands. Funds have been used for improvements to public schools, roads, and stewardship projects. Money is also available for maintaining infrastructure, improving the health of watersheds and ecosystems, protecting communities, and strengthening local economies. http://www.fs.usda.gov/pts/

Appendix G:
Natural Hazard Risk Report
For Grant County, Oregon

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