Benton County

MULTI-JURISDICTIONAL NATURAL HAZARDS MITIGATION PLAN

VOLUME III: APPENDICES

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APPENDIX A:
MITIGATION STRATEGY ACTIONS FOR ALL JURISDICTIONS

Table 1. Completed Actions Sorted by Action ID and then by Jurisdiction.

Completed Actions 2016-2023 (All Plan Holders)									
Jurisdiction	**2023 Action ID**	**2023 Action Item**	**2023 Status**	**2023 Coordinating Organization or Individual**	**2023 Partner Organizations**	**2023 Timeline**	**2023 Potential Funding Sources**	**2023 Priority**	**2022-23 Update Notes**
Monroe	DR #1	Develop a drought impact assessment for Benton County.	Complete						A drought impact assessment for the City of Monroe was completed by the ACOE and climate impacts were included in this.
Adair Village	DR #2	Identify and develop a larger/alternative water supply.	Complete						Water storage capacity was increased by 2 million gallons using a Business Oregon loan.
Benton County	EQ #3	The county is building a new Courthouse that will be constructed with modern seismic codes. The historic Benton County Courthouse will remain in place but will not function as a vital public building.	Complete						The 2016 action was accomplished by another means. Seismic retrofitting is no longer required with a new building for the Benton County Courthouse.

		Completed Actions 2016-2023 (All Plan Holders)							
Jurisdiction	**2023 Action ID**	**2023 Action Item**	**2023 Status**	**2023 Coordinating Organization or Individual**	**2023 Partner Organizations**	**2023 Timeline**	**2023 Potential Funding Sources**	**2023 Priority**	**2022-23 Update Notes**
Corvallis	LS #3	Complete a detailed inventory of locations where critical facilities and infrastructure are subject to landslides.	Complete						This action was accomplished as part of the NHMP update through the DOGAMI multi-hazard risk assessment. Removed as it is part of the mitigation strategy.
Corvallis	MH #1		Complete						New development requires that utilities be installed underground. CPI is making an effort to put power lines underground, but the city doesn't have the authority to obligate old lines to be undergrounded. The city appreciates that the utility is taking that initiative.
Monroe	MH #3	Integrate the Mitigation Plan findings into planning and regulatory documents and programs including Comprehensive Plans.	Complete						The City of Monroe Comprehensive Plan was updated in its entirety in 2020. It took into account the prior Natural Hazard Mitigation Plan Addendum for the City of Monroe. The City Council and the City Administrator have set an expectation to update regulatory documents and conduct on-going review internalized within Monroe's regulatory documents.

		Completed Actions 2016-2023 (All Plan Holders)							
Jurisdiction	**2023 Action ID**	**2023 Action Item**	**2023 Status**	**2023 Coordinating Organization or Individual**	**2023 Partner Organizations**	**2023 Timeline**	**2023 Potential Funding Sources**	**2023 Priority**	**2022-23 Update Notes**
Benton County	WF #10	Obtain funding for a Type 6 Wildland Fire Engine for the Alsea Rural Fire District so that they can provide cross-jurisdiction help during wildfires.	Complete	Alsea Rural Fire Protection District	Alsea Community Effort (ACE)	Complete	Assistance to Firefighters (AFG)		The Alsea RFPD both identified and secured the funds to purchase this vehicle during the 2023 NHMP update process.

Table 2. All Mitigation Actions Sorted by Action ID and then by Jurisdiction. The purpose of this table is to track how mitigation actions with the same ID were revised by each jurisdiction during the 2022-23 update process.

Jurisdiction	2023 Action ID	2023 Action Item	2023 Status	2023 Coordinating Organization or Individual	2023 Partner Organizations	2023 Timeline	2023 Potential Funding Sources	2023 Priority	2022-23 Update Notes
Benton County	DR #1	Develop a drought impact assessment for Benton County	Retained	Benton County Community Development	Internal: Benton County Public Works, Emergency Management, and Health departments External: OSU Extension, Benton County Soil and Water Conservation District, Marys River Watershed Council, Oregon Climate Change Research Institute, Oregon Water Resource Dept., Silver Jackets, OHA	Medium term, 3-5 years	Climate Adaptation Grants potentially through Oregon Health Authority (OHA)	High	
Monroe	DR #2	Complete mitigation strategies identified in the drought impact analysis performed by the US Army Corps of Engineers (ACOE). the infiltration intake will be extended to the center of the river to mitigate low water conditions and the. ACOE will release more water from the Fern Ridge Reservoir (from 35 cfs to 50 cfs) These actions will be coordinated with the removal of the drop structure.	New Action	City Administrator	ACOE, Long Tom Watershed Council	Short-Term (1-2 years)	Long Tom Watershed Council	High	This new action follows from the completed drought impact analysis.

Jurisdiction	2023 Action ID	2023 Action Item	2023 Status	2023 Coordinating Organization or Individual	2023 Partner Organizations	2023 Timeline	2023 Potential Funding Sources	2023 Priority	2022-23 Update Notes
Adair Village	EQ #1	Expand and complete seismic vulnerability analysis of critical public facilities with significant seismic vulnerabilities, lifeline utility (water and wastewater) and transportation systems, including fire, police, medical and other emergency communication/response facilities.	Retained	City Engineer	Internal: Benton County GIS, Community Development External: Special districts in Benton County	Mid-Term (3-5 years)	Adair Village general funds Business Oregon grant funds	High	
Benton County	EQ #1	Use DOGAMI MHRA to analyze significant all-hazard vulnerabilities in critical public facilities. Develop an analysis of all-hazard resilience of infrastructure/lifeline systems (e.g. utilities and transportation systems, and emergency services and communication/ response facilities) as master planning for these systems takes place. Incorporate the analysis into master planning documents as they are updated.	Retained, revised	Benton County Public Works	Internal: Community Development External: Community Partners, ODOT, Private Utilities	Ongoing	County general funds, within existing capacity	Medium to High, as determined by the Board of County Commissioners	

Jurisdiction	2023 Action ID	2023 Action Item	2023 Status	2023 Coordinating Organization or Individual	2023 Partner Organizations	2023 Timeline	2023 Potential Funding Sources	2023 Priority	2022-23 Update Notes
Corvallis	EQ #1	Use DOGAMI MHRA to analyze significant seismic vulnerabilities in critical public facilities. Focus on analysis of seismic resilience of lifelines: utilities (water and wastewater) and transportation systems, and emergency services (fire, police, medical, emergency communication and response facilities).	Retained and updated	Corvallis Public Works	Internal: Community Development External: Community Partners (CPI, NWN), ODOT, Private Utilities	Mid-Term (3-5 years)	FEMA Flood Mitigation and/or BRIC grants	Medium	
Monroe	EQ #1	Determined that this action is no longer relevant because the vulnerability of some key city facilities is obvious due to their age and construction type.	Remove						Determined that this action is no longer relevant because the vulnerability of some key city facilities is obvious due to their age and construction type. New Action identified from this note - The prime need here is to identify an alternative set of systems to coninue operations following a hazard event.

Jurisdiction	2023 Action ID	2023 Action Item	2023 Status	2023 Coordinating Organization or Individual	2023 Partner Organizations	2023 Timeline	2023 Potential Funding Sources	2023 Priority	2022-23 Update Notes
Philomath	EQ #1	Expand seismic vulnerability analysis provided by DOGAMI Multi-hazard Risk Assessment to evaluate critical public infrastructure. Identify and prioritize mitigation of water, transportation and wastewater infrastructure components with significant seismic vulnerabilities.	Progressing	Philomath Public Works	Internal: Philomath Planning Official External: Benton County Planning and GIS	Ongoing			Revised to focus on public infrastructure. The water system is the highest priority system for which the 2018 Water Master Plan provides detailed analysis. Within the water system the city is most concerned with the intakes, pumps, pump stations and pressurized lines. Second priority system is the transportation system followed by the wastewater system. This work is done as as infrastructure plans are implemented.
Adair Village	EQ #2	Explore the possibility of developing a home seismic upgrade/retrofit (structural and non-structural) program. Consider an education/marketing program.	Retained	Adair Village Planning and City Administrator	Internal: Benton County Community Development External: Benton County	Mid-Term (3-5 years)	Adair Village general funds	Priority Low	

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Benton County	EQ #2	Explore the possibility of developing a home seismic upgrade/retrofit (structural and non-structural) program. Consider an education/marketing program.	Remove			Removed			This action was determined not be be within the capacity of the county. Oregon Department of Emergency Management may have access to more expertise and resources for such a program.
Corvallis	EQ #2	Conduct earthquake awareness training. Add seismic foundation upgrade information to City's Emergency Management web page.	Retained and Updated	Corvallis Emergency Planning Manager	Internal: Community Development, PIO External: Benton County	Short-Term (1-2 years)	OEM technical assistance, FEMA CTP grant	High	
Monroe	EQ #2	Explore the possiblity of developing a home seismic upgrade/retrofit (structural and non-structural) program. Consider an education/marketing program.	Retain; no change	City Administrator	OEM, Benton County Emergency Management	Medium Term (3-5 years)	Pacific Power Resilience grant fund, OEM technical assistance		This follows on from Action Item EQ #1 which was removed from this 2023 update.
Corvallis	EQ #4	Abandon water transmission lines on Marys River Bridge and bore new water transmission lines under Marys River.	Progressing	Corvallis Public Works	Internal: Community Development External:	Short-Term (1-2 years)	FEMA Flood Mitigation and/or BRIC grants	Low	Corvallis Public Works has removed the water line from the 15th Street Bridge and placed it underground. A water main remains on the 4th Street Bridge that will be relocated in

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									the next couple of years.
Philomath	EQ #5	Complete Neabeak Hill Reservoir seismic retrofit project.	New Action	Philomath Public Works	Internal: Finance, Administration External: Benton County and State of Oregon for funding options	Short term (1-2 yrs)	City water funds, Business Oregon grants funds, and FEMA BRIC	High	The Water Master Plan (WMP) completed in 2018 identifies three Priority 1A projects. These include Water Treatment Plan Improvements, 1.5 MG Ground Storage Reservoir and Redevelop 9th Street Well. These projects are all in the design phase or are underway. The WMP also identifies nine Priority 1 projects including the seismic retrofit of the Neabeack Hill Reservoir, 1952 and 1964 Faxon Water Rights Work, Old Water Treatment Pant Decommissioning, North 16th Street Waterline, 17th Street Water Line, North 19th Street Water Line

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									Segment A, South 19th Street Water Line, School Water System Improvements, and Neabeack Hill Domestic Pump Station Generator. Completing prioritization identified in EQ #1 will support future mitigation action identification from among these.
Benton County	EQ #6	Seismically retrofit the Alsea Rural Fire Protection District fire station.	New Action	Alsea Rural Fire Protection District	Alsea Community Effort (ACE), Emergency Management	Long term (>5 years)	Business Oregon's Seismic Rehabilitiation Grant Program, BRIC Grant		Note: The DOGAMI report does not identify the Alsea RFPD station as being vulnerable to an earthquake.
Benton County	FL #1	Coordinate with FEMA and state agencies to maintain and update Benton County Flood Insurance Rate Maps as necessary. Prioritize the determination of Base Flood Elevations (BFE) for all approximate Zone A areas.	Progressing	Benton County Floodplain Manager	Internal: Benton County Community Development Department; Public Works Department; Public Information Officer; Emergency Services Division; Natural Areas, Parks & Events Department External: FEMA Risk MAP program, USACE, DOGAMI, DLCD, OEM, incorporated	Short to Long-term depending on project, see notes	FEMA Risk MAP, USACE funding	High	Luckiamute watershed flood map revisions are underway and expected to be finalized by the end of 2024. Lead agency: USACE Upper Willamette watershed flood map revisions are underway and expected to be

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					cities within Benton County, adjacent counties				completed by 2028-2030. Lead agency: FEMA RiskMAP team Additional coordination with USACE, DOGAMI, DLCD, OEM, adjacent counties, and Cities of Adair Village, Albany, Corvallis, Philomath, & Monroe. Additional coordination with USACE, DOGAMI, DLCD, OEM, and Cities of Adair Village, Albany, Corvallis, Philomath, & Monroe. Alsea watershed flood map revisions are included in the Upper Willamette watershed flood map revisions. Lead agency: FEMA RiskMAP Additional coordination with USACE

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Corvallis	FL #1	Support county coordination with FEMA and state agencies to maintain and update Benton County Flood Insurance Rate Maps. Prioritize the determination of Base Flood Elevations (BFE) for all approximate Zone A areas.	Progressing	Corvallis Public Works	Internal: City of Corvallis; County GIS, and Assessment Offices External: DLCD, DOGAMI, FEMA	Short-Term (1-2 years)	FEMA Flood Mitigation and/or BRIC grants	High	County action that is underway; city is a partner and county is the coordinator
Monroe	FL #1	Coordinate with FEMA and state agencies to maintain and update Benton County Flood Insurance Rate maps as necessary. Prioritize the determination of Base Flood Elevations (BFE) for all approximate Zone A areas.	In Progress; no change	Monroe floodplain administrator	Benton County Floodplain Adminstrator	Short-Term (1-2 years)	FEMA RiskMAP		FEMA Risk Map project underway to produce detailed 1D study of the Long Tom in the vicinty of the City of Monroe.
Benton County	FL #2	Actively participate in the National Insurance Program's Community Rating System and maintain at least a Class 7 rating.	Retained, revised	Benton County Floodplain Manager	Internal: Benton County Community Development Department External: Oregon NFIP Coordinator, FEMA, Vrisk - Insurance Services Office	Ongoing	County general fund, part of staff current capacity	High	• Maintain existing level of flood hazard communication and risk reduction activities through continued implementation of Benton County's floodplain program; • Identify opportunities to improve communication of flood risk to property owners and residents; • Identify opportunities

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									to improve topic-specific flood risk communication to targeted audiences; and • Encourage community awareness of preparation for flood events, how to stay safe during a flood event, and what to do after a flood event.
Corvallis	FL #2	Take steps to maintain Community Rating System (CRS) rating.	Retained and Updated	Corvallis Community Development	Internal: Emergency Planning Manager, Public Works External: DLCD, OEM, FEMA	Ongoing	OEM Mitigation and/or FEMA BRIC and other grants		Edited to reflect the fact that Corvallis already participates, but does not intend to go for a better rating at this time. Using only the word "maintain"
Monroe	FL #2	Take steps to participate, maintain, or improve Community Rating System (CRS) rating, as applicable.	Deferred; no change to action item statement			Deferred			The Special Flood Hazard Area in Monroe are unnumbered A zones. Developable land is mostly not in the floodplain. Most floodplain is already in dedicated open space. There are only two flood insurance policies in the City of Monroe. This action may not be

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									within the city's priorities.
Philomath	FL #2	Investigate value of participation in the CRS	Retain; revised wording	Philomath Planning Official	DLCD, FEMA	Ongoing		Low	
Benton County	FL #3	Improve county-maintained road network to provide continuous access during flood events where feasible.	Retained, revised	Benton County Public Works - Road Maintenance Division	Internal: Benton County GIS External: Marys River Watershed, DLCD, FEMA	Ongoing to Long-term as funds allow	Existing resources to analyze and FEMA BRIC grant for projects	Medium	• Identify locations that experience regular flooding, significant damage due to flooding, and frequent road closures during flood events. • Identify mitigation projects – such as upsizing culverts or storm drainage ditches – appropriate for each location. • Use the expected number of properties and structures that would be served by the identified mitigation projects to develop a prioritized list of projects to pursue.

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Corvallis	FL #3	Identify locations that experience regular flooding and significant damages or road closures, determine and implement mitigation measures.	Retained and Updated	Corvallis Public Works	Internal: Community Development External: DLCD, Benton County	Short-Term (1-2 years)	FEMA Flood Mitigation grant	High	
Monroe	FL #3	Monitor locations that experience regular flooding and significant damages or road closures. Maintain materials such as sand bags in place for use in the case of flooding.	Retain; revised			Ongoing			Revised to make this action more achievable. There is more interested in monitoring locations that experience flooding. The food pantry is in an area that the city would want to monitor. City representatives determined that developing water retention may be more useful than upsizing culverts; short term rapid water flows are the cause of flooding. It may be better to retain and slow water so that the existing drainage system can handle the flow. It may be useful to take a more wholistic look at the drainage

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									patterns in the city to address flooding problems.
Philomath	FL #3	City to continue determining locations of regular flooding.	Retain	Philomath Public Works	DLCD State NFIP Coordinator, Benton County	Medium term (3-5 years)	Low	City staff time, general funds	Benton County has been addressing this on some local County roads.
Benton County	FL #4	~~Ensure the locations of Repetitive Loss Properties have been accurately registered with FEMA and work with affected RL and other flood prone property owners to remove, relocate, or elevate non-conforming, pre-FIRM structures in flood hazard areas.~~	Remove			Remove			Remediation of Repetitive Loss properties will be addressed through other mitigation strategies in this plan.
Corvallis	FL #4	Ensure the locations of Repetitive Loss Properties have been accurately registered with FEMA and work with affected RL, and other flood prone, property owners to remove, relocate,	Retain	Corvallis Community Development	Internal: Public Works, Emergency Management External: DLCD, FEMA	Short-Term (1-2 years)	FEMA Flood Mitigation grant	Low	The conversation on RL properties did not indicate they were significant enough for any additional actions.

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		or elevate non-conforming, pre-FIRM structures in flood hazard areas.							
Monroe	FL #4	Ensure the locations of Repetitive Loss Properties have been accurately registered with FEMA and work with affected RL and other flood prone property owners to remove, relocate, or elevate non-conforming, pre-FIRM structures in flood hazard areas.	Remove						This Action Item is not relevant to the City of Monroe because there are no RL properties in the city.
Philomath	FL #4	Ensure the locations of Repetitive Loss Properties have been accurately registered with FEMA and work with affeted RL, and other flood prone, property owners to remove, relocate, or elevate non-conforming, pre-FIRM structures in flood hazard areas.	Remove			Remove			No RL properties in Philomath.
Benton County	FL #5	Support the City of Philomath in mitigating the flooding of South 13th Street area as	Retain, revised	Benton County Public Works - Road	External: City of Philomath	Medium to Long term, 3-5 years or more	County Road Fund, potential CAMPO funding	Medium	

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		infrastructure improvements are made		Maintenance Division					
Philomath	FL #5	Support the county in mitigating flooding of South 13th Street area.	Retain; revised	Benton County		Defer until county takes action			Area identified is not in city limits or UGB North side of Chapel in UGB; south side is in county; the road is county jurisdiction; support the county as most of the area is in the county; need to raise the elevation of the road; County has taken no action yet.

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Benton County	FL #7	Develop targeted flood risk mitigation projects for structures at risk of flooding in Benton County.	Retained, revised	Benton County Floodplain Manager	Internal: Benton County Community Development Department, Public Information Officer, Public Works Department, Emergency Services Division External: DLCD, DOGAMI, FEMA, USACE	Mid- to Long-term (3-5 years) or more	FEMA Flood Mitigation Assistance grant, DLCD Technical Assistance, USACE, OEM, local capital improvements project funding	High	This bulleted list below provides a set of discrete projects that could be funded a bit at a time if there are smaller chunks of funding and also provides a total picture in case a large amount of funding can be secured. • Identify all structures (by type) with floor elevations below the Base Flood Elevation. • Evaluate identified structure locations to determine if there are distinct clusters of structures or if they are spread out. • Evaluate identified structure types to determine how many are dwellings, commercial structures, schools, centers for community gathering, government buildings, accessory structures, etc.

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									• Develop a prioritized list of scalable mitigation projects based on location, structure types, and type of mitigation needed. • Provide outreach to owners of identified structures informing them of expected flood risks and potential mitigation methods. • Identify and pursue funding opportunities to implement identified mitigation projects.
Adair Village	LS #1	Utilize the updated regional landslide risk maps (DOGAMI O-16-02) to identify hazard areas and collaborate with the Oregon Department of Geology and Mineral Industries to work on landslide risk reduction efforts; determine areas and buildings at risk to landslides and propose Comprehenisive Plan and land use policies accordingly.	Removed, no landslide risk						

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Benton County	LS #1	Utilize the updated regional landslide risk maps (DOGAMI O-16-02 and O-21-14) to identify hazard areas and collaborate with the Oregon Department of Geology and Mineral Industries to work on landslide risk reduction efforts; determine areas and buildings at risk to landslides and propose Comprehensive Plan and land use policies accordingly.	Retain	Benton County Community Development	External: DOGAMI, DLCD	Medium term, 3-5 years	Hazard Mitigation Grant	Medium to High, as determined by the Board of County Commissioners	This action should be incorporated into a voluntary periodic review depending on the issues the Board of County Commissioners determine should be incorporated in such a work program.
Corvallis	LS #1	Utilize the updated regional landslide risk maps (DOGAMI O-16-02 and O-21-14) to update the Comprehenisive Plan and the Developent Code.	Retain	Corvallis Community Development	Internal: GIS Department, Emergency Planning Manager External: DOGAMI, DLCD	Short-Term (1-2 years)	OEM Mitigation and/or FEMA BRIC and other grants	High	Parts of the 2016 action have been completed. The city has received updated landslide inventory maps and now intends to use them to updated the Comprehensive Plan and the Development Code. Changes include requirement for geotechnical reports and development prohibitions in some areas; some development requires mitigation.

Jurisdiction	2023 Action ID	2023 Action Item	2023 Status	2023 Coordinating Organization or Individual	2023 Partner Organizations	2023 Timeline	2023 Potential Funding Sources	2023 Priority	2022-23 Update Notes
Monroe	LS #1	Utilize the updated regional landslide risk maps (DOGAMI O-16-02 and O-21-14) to identify hazard areas and collaborate with DOGAMI to work on landslide risk reduction efforts; determine areas and buildings at risk to landslides and propose Comprehensive Plan and land use policies accordingly.	Remove, incorporated into MH #3c						The Multi-Hazard Risk Analysis developed by DOGAMI and published as O-23-06 identifies landslide hazard areas and determines areas and buildings at risk from landslide. This City of Monroe can incorporate this data into land use planning policies as a part of MH #3.
Philomath	LS #1	Connect with Oregon Department of Geology and Minerals, Benton County GIS and Planning staff, and determine which structures are at risk buildings in Philomath.	Retain	Philomath Planning Official	Benton County GIS Department, Benton County Emergency Management External: DOGAMI, DLCD	Short-Term (1-2 years)		City staff time - City Manager (Planning Official), Associate Planner, and GIS staff.	
Corvallis	LS #2	Complete geotechnical analysis of the slope on NW Witham Hill Drive from NW Canary Drive to NW Walnut Boulevard and implement rehabilitation strategies to stablize the slope.	Retain	Corvallis Public Works	Internal: Community Development External: DOGAMI, DLCD	Short-Term (1-2 years)	OEM Mitigation and/or FEMA BRIC and other grants	High	The geotechnical analysis was completed. It may be 5 or so years away from implementing this action. The problem is a result of the way the roadway was

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									constructed. This could be a project to fund in the short-term future.
Benton County	LS #4	Obtain a geotechnical assessment for the hillside north of the Alsea Clinic to determine the vulnerability of the clinic to landslides, and if necessary, what actions to be taken to safegaurd the clinic.	New Action	Benton County Community Development	External: Alsea Community Effort (ACE), DOGAMI	Medium term, 3-5 years			
Adair Village	MH #1	Enhance hazard resistant contruction methods (Earthquake, wind, winter storm, landslide, etc.) where possible to reduce damage to utilities and critical facilities.	Retained as is	Engineer/Public Works, City Admin	Internal: Benton County Community Development, Emergency Management, GIS, Civil West External: State Building Codes Public Utility Commission, Consumer Power, Inc., Pacific Power	Ongoing		Low	
Benton County	MH #1	Determine whether Benton County can develop franchise utility agreements with the "dry utilities". If that is possible, then code changes to require undergrounding utilities could be pursued.	Retained and revised	Benton County Public Works	Internal: Benton County Community Development, GIS External: Public Utility Commission, Consumers Power, Inc., Pacific Power	Long term (>5 years)	FEMA BRIC Grant or other Hazard Mitigation Grant, Fire Mitigation Grant	High	There are no regulations requiring undergrounding utilities at the county level; City agreements are franchised and the city can then regulate the placement of those dry lines. If Benton County can

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									develop franchise utility agreements with the "dry utilities", then code changes to require undergrounding utilities could be pursued.
Monroe	MH #1	Develop standards for new construction and utility installations that address the shrink/swell nature of some soils and the high water table in some areas of Monroe. This consideration is particularly important when installing utilities underground. Requirements for soil testing are being developed through Monroe Land Use Code.	Retain; revised	City Administrator	Benton County Community Development Dept., especially GIS staff	Medium Term (3-5 years)	City general fund,	Medium	Action as worded in 2016 was determined to be outside the ability of the city to affectuate it. City will work to codify standards that address the soil conditions in the city which include expansive soils that buckle when the water table drops; drought conditions exacerbates this soil condition. Evidence of this problem is telephone poles tilting when the soil is dry; sections of foundations fill with water in the wet season, and move the foundations in the dry season.

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Philomath	MH #1	Look at current codes and polices and access how to encorporate changes.	Retain	Philomath Planning & Public Works	Benton County Planning & Building	Long term (>5 yrs)	Low	Possible DLCD offers a Technical Assistance grant on a biannually basis.	
Adair Village	MH #2	Deliver educational information aimed at mitigaing the risk posed by natural hazards through newsletters and website.	Retained and revised			Ongoing			
Benton County	MH #2	Continue to deliver education programs aimed at mitigating the risks posed by hazards.	Retained and revised	Benton County Emergency Management	Internal: Benton County Community Development, Public Works External: Community organizations; cities and special districts; established community preparedness groups	Ongoing	Hazard Specific Grants that allow publication design and printing, potentially FEMA CTP grant	Medium	

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Corvallis	MH #2	Deliver education programs aimed at mitigating the risk posed by hazards through workshops, on-line presentations, and media campaigns.	Retained and Updated	Corvallis Emergency Planning Manager	Internal: All City Departments, Benton County Emergency Management External: Community Neighborhood Districts and/or organizations; special districts; established community preparedness groups	Ongoing	OEM, OSFM, or NFPA grants to support current staff capacity		
Philomath	MH #2	Deliver education programs aimed at mitigating the risk posed by hazards. (No change to wording)	Retain	Philomath Fire & Rescue	Internal: Philomath Public Works, Philomath City Council members, Benton County Community Development, Benton County Emergency Management External: Oregon State University Extension; Oregon Department of Forestry, Community organizations, FEMA, OSFM	Ongoing			The city is using Town Hall meetings to implement the Philomath City Council's interest in promoting earthquake awareness
Adair Village	MH #3	Provide back up Power to Water Plant, lift Stations, City Hall and any other identified critical facitlities for all possible emergecny events. Power outages happen due to wind, earth quakes, winter storms, casuing power	refer to WT #1	Public Works Dept. and City Administrator	Internal: Civil West (consulting engineer) External: Consumer Power, Benton County	Short Term (1-2 years)	Adair Village is currently working on a FEMA grant application with OEM staff.	High	

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		outages due to inclement weather.							
Benton County	MH #3	Integrate the Mitigation Plan findings into planning and regulatory documents and programs including Comprehensive Plans.	Retained and progressing	Benton County Community Development	Various depending on the issues, scope and scale addressed during Comprehensive Plan review	Medium term, 3-5 years	County general fund, within existing capacity	Medium to High, as determined by the Board of County Commissioners	Benton County Planning Commission and Board of Commissioners have identified several long range planning needs, including the need to plan for wildfire and water resilience. Any County efforts to address natural and other hazards in the comprehensive plan should consider the NHMP and should specifically incorporate portions of the NHMP as appropriate into the comprehensive plan, development code and other relevant County policies.

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Corvallis	MH #3	Ensure these Mitigation Plan findings are incorporated into planning and regulatory documents and programs including Comprehensive Plans during Corvallis NHMP Committee review meetings.	Retained and Updated	Corvallis NHMP Steering Committee	Internal: Community Development, Public Works, Parks and Recreation External: FEMA, APA, DLCD, OEM	Ongoing during semi-annual reviews			There was interest expressed in the process of incorporating the NHMP findings into Corvallis's Comprehensive Plan. That work is not an ongoing action. The action was revised to make this a topic for biannual reviews.
Philomath	MH #3	Integrate the Mitigation Plan findings into the Comprehensive Plan.	Retain, revised to focus action	City Manager and Philomath Planning Commission	Internal: Public Works External: Benton County Planning, FEMA, DLCD	Medium term (3-5 years)	City general funds, DLCD Technical Assistance Grant		The City has recently updated the Housing and Economic sections of the Comprehensive Plan. Because the city is still working to incorporate recent Comp Plan changes into code, capacity for further updates, in particular to Natural Hazards section, is several years away. Chris, Pat, Planning Commission, not Finance
Monroe	MH #3B	Develop proposals for code updates to put	New Action	Planning Commission		Medium Term (3-5 years)	City general fund, TGM grants, DLCD Technical Assistance	High	Completed Action MH#3 gives rise to this new action.

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		Comprehensive Plan policies into Land Use Code.							
Monroe	MH #3C	Develop a new permitting system that reflects changes in the Comp Plan update and Monroe Land Use Code; this new system will identify the natural hazard mitigation efforts needed to reduce risk to Monroe residents. This will be an all encompassing approach to address how proposed land use activities can be carried out in a way that minimizes or reduces risk from the range of hazards faced by the city's residents.	New Action	City Administrator	Planning Commission	Medium Term (3-5 years)	City general fund	High	MH#3 also gives rise to this new action. The city will utilize the detailed landslide data contained in DOGAMI O-16-02 and O-21-14 to revise Monroe Article 8, Construction Standards. This portion of the code could be better delineated. Consider revising it to include detail about risks that stem from earth moving, erosion, water movement on the land surface.
Adair Village	MH #4	Replace outdated Wastewater facility to be upgraded for any natural hazard. This will provide citizens with adequate wastewater treatment during an earthquake, heavy rainfall, winter storms, and fire events. The City has already completed phase one of the	New Action	Public Works Dept and City Administrator	Internal: City Staff, Civil West (consutlting engineer) External: DEQ, Benton County	Short Term Phase 1 complete Phase 2 (1-2 yrs) Phase 3 (2 -3 yrs)	Adair Village wastewater rate increases Infrastructure Funding Authority grant	High	

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		project. City paid $2.7million through Bus OR loan							
Benton County	MH #4	Develop detailed inventories of at-risk public buildings and infrastructure and prioritize mitigation actions, especially for critical facilities.	Progressing	Benton County Community Development	Internal: Benton County Public Works, Benton County Sheriff's Office/Emergency Management, Benton County Health/Environmental Health, Natural Areas Parks & Events External: Regional Fire Districts, Benton County cities, DOGAMI, FEMA	Short to Medium term, 2-5 years	Hazard Mitigation Grant Homeland Security Grant	Medium	This action is partially completed because the DOGAMI database that accompanies the Multi-hazard Risk Report prepared for this NHMP update. It identifies at risk public buildings, but infrastructure was not part of that assessment. Further inventory, risk assessment and prioritization may be work that the NHMP Steering Committee can do during Plan Maintenance meetings during the life of the plan pending participation by the relevant partners. Potentially a RARE student or an intern

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									could make this work more efficient.
Corvallis	MH #4	Develop detailed inventories of at-risk public buildings and infrastructure and prioritize mitigation actions, especially for critical facilities.	Retained	Corvallis Public Works	Internal: Community Development, Emergency Management External: FEMA, APA, DLCD, OEM	Short-Term (1-2 years)	OEM Mitigation and/or FEMA BRIC and other grants	High	A city planning process is going on now to evaluate provision of enhanced services for public buildings and infrastructure.
Monroe	MH #4	Use FEMA Continuity of Operations plan steps to equip the key facilities (library and FD) with communications equipment and emergency supplies.	In progress; revised	City Administrator	Monroe Rural Fire Protection District	Short-Term (1-2 years)	Fire District, DHS/FEMA EMPG grants	Highest	The Library and the Fire Department building have been identified as the key Critical Facilities. This mitigation action has been revised to focus on identifying which buildings should be supplied and with what equipment and materials. The equipment and materials will support

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									the function identified for those facilities. The City Administrator identifies the need to install critical communications equipment in other key facilities (e.g. Fire Department) due to the possibility that the city could be cut off from neighboring communities following an earthquake or flood.
Philomath	MH #4	Develop detailed inventory of at-risk critical facilities; NHMP list of critical and important facilities is the basis for this inventory and the analysis prepared by DOGAMI will inform prioritization of these facilities.	Progressing; partially completed during this update	Philomath Public Works; Philomath NHMP Management committee	Internal: City Manager, Finance External: School District, Local Churches, Philomath Fire and Rescue District, Philomath Community Services	Short term (1-2 yrs)	City staff time, general funds		Revised to focus on facilities. The inventory is being developed during plan update and is in part based on DOGAMI's analysis.
Philomath	MH #4B	Use the inventory of at-risk critical facilities to prioritize mitigation actions and identify funding streams to support mitigation of those facilities at the highest risk.	New Action	Philomath Public Works; Philomath NHMP Management committee		Long term (>5 yrs)	City staff time, general funds		MH #4 supports this new action

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Adair Village	MH #5	Integrate the Mitigation Plan findings into planning and regulatory documents and programs including Comprehensive Plan and Development Code.	Retained, revised	Adair Village Planner, Engineers, City Administrator	Internal: Benton County Emergency Management, Public Works, County Commissioners, Civil West External: FEMA, APA, DLCD, OEM	Ongoing		Medium	
Benton County	MH #5	Develop appropriate and necessary community recovery plans starting with the highest priority hazards. Continue to integrate hazard, vulnerability and risk mitigation plan findings into enhanced emergency operations planning.	Retained and revised	Benton County Emergency Management	Internal: Benton County Community Development, Health Department, Public Works External: NAPE, Utilities, other partners as necessary	Medium term, 3-5 years	Hazard Mitigation Grant Homeland Security Grant Fire Mitigation Grant	Medium	Potentially a RARE student or an intern could make this work more efficient.
Philomath	MH #5	Connect with partner organizations to determine priorities for recovery plan development.	Retain	Philomath Planning & Public Works	Benton County Emergency Management	Ongoing	Low	Benton County Emergency Management staff; City staff time (City Manager, Public Works Director, Associate Planner).	

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Corvallis	MH #5A	List and prioritize the hazards likely to warrant recovery plans of hazards that impact primarily the City of Corvallis. This could be the loss of key infrastructure owned by the City or key partner agency loss (e.g. Corvallis School District). Develop prioritized strategies based on the anticipated impact to the community. Continue to integrate hazard, vulnerability, and risk mitigation plan findings into enhanced emergency planning.	Retained and revised into two actions	Corvallis Emergency Planning Manager	Internal: Community Development, Public Works, Parks and Recreation. External: Benton County Emergency Management, FEMA, OEM, DLCD	Short term (1-2 years)	OEM, OSFM, NFPA Grants	High	Revised into two actions; one to prioritize hazards likely to warrant city recovery plans and secondly, coordinate with Benton County to develop appropriate and necessary community recovery plans starting with the highest priority hazards.
Corvallis	MH #5B	Coordinate with Benton County to develop appropriate and necessary community recovery plans for those incidents that are anticipated to impact both the City of Corvallis and Benton County. Prioritize the hazards as outlined within this plan.	Retained and revised into two actions	Corvallis Emergency Planning Manager	Internal: Community Development, Public Works, Parks and Recreation. External: Benton County Emergency Management, Public Works, and N.A.P.E. FEMA, OEM, DLCD	Short-Term (1-2 years)	OEM, OSFM, NFPA Grants	High	Revised into two actions; one to prioritize hazards likely to warrant city recovery plans and secondly, coordinate with Benton County to develop appropriate and necessary community recovery plans starting with the highest priority hazards.

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Adair Village	MH #6	Develop detailed inventories of at-risk public buildings and infrastructure and prioritize mitigation actions, especially for critical facilities.	Retained as is	Engineer/Public Works	Internal: Community Development External:	Ongoing		Medium	
Benton County	MH #6	Continue to incorporate the identified impacts of climate change on the natural hazards in Benton County in the Comprehensive Plan.	Retained and revised	Benton County Community Development	Internal: Benton County Sustainability Coordinator, Health Department, Corvallis Community Development and Public Works External: State Interagency Hazard Mitigation Team, DLCD, OSU, OCCRI	Ongoing	County general fund, within existing capacity	Medium	
Corvallis	MH #6	Continue to incorporate the anticipated impacts of climate change into master plans in the City of Corvallis. The city Water Master Plan and the Emergency Operations Plan emphasize how climate change impacts these plans.	Retained and Updated	Corvallis NHMP Steering Committee	Internal: Corvallis Community Development, Public Works, and Fire Emergency Planning Manager External: State Interagency Hazard Mitigation Team, DLCD, OSU OCCRI	Ongoing during semi-annual reviews			The action was revised to recognize that incorporation of the impacts of climate change is more important than for the city to continue to evaluating those impacts.
Corvallis	MH #7	Continue to identify and remove high risk trees that will impact rights of way or create repetitive tree fall problems.	Retained and Updated	Corvallis Public Works	Internal: Parks and Recreation External: None	Ongoing			Continue to support Public Works inventory of street trees and trees along trails during normal operations; continue to perform annual and post-storm inspection and

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									maintenance of trees of particular interest and areas subject to repetitive tree fall problems.
Philomath	MH #7	Begin inventory of trees in parks/public ROW	Retain	Philomath Public Works	None	Ongoing, visit annually	Low	City staff time, general funds; could use technical grant for assistance if available	This effort is ongoing throught the year
Corvallis	MH #8	Perioidically update the inventory of locations in Corvallis subject to repetitive tree fall problems.	Incorporated into MH #7	Corvallis Public Works	Internal: Parks and Recreation External: None	Removed			Incorporated into MH #7
Corvallis	MH #9	Communicate via social media and city website about mitigation activities, opportunities, and success stories.	Revised and Updated	Corvallis Public Information Officer	Internal: Public Works, Community Development, Emergency Management External: Benton County PIO	Ongoing			
Corvallis	MH #10	Develop invasive pest action plan for Emerald Ash Borer (and others impacting municipal trees).	Retained and Updated	Corvallis Parks and Recreation	Internal: Public Works, Community Development External: OSU Extension, OSU Forestry	Short Term (1-2 years)		High	This is now a high priority, short-term action because the city could loose 90% of ash trees in a short time frame. The city has already removed Ash

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									from the acceptable planting list. The city may want to remove declining trees proactively. Pesticides can be used, but it is expensive and required annually. Jude will engage the Urban forestry team to discuss as well as some PW folks.
Benton County	MH #11	Assess vulnerability of routes feeding into South Fork Rd to improve evacuation capacity on that road.	Retained and revised	Benton County Public Works	Internal: Benton County Emergency Management, Benton County Community Development, Alsea Emergency Preparedness Council, Alsea School District, Alsea Rural Clinic, Alsea Library, Alsea Rural Fire Protection District External: ODOT, OEM	Medium to Long term (>3 years)	ODOT Annual Grant Program Hazard Mitigation Grant Fire Mitigation Grant		
Benton County	MH #12	Rebuild the railroad crossing on SW 53rd Street south of SW Reservoir Avenue.	Retained	Benton County Public Works	Internal: Community Development External: Willamette & Pacific Railroad, Union Pacific Railroad	Long term, >5 years	The county has applied for federal funding for final design and construction, but has not yet been successful in securing funding for this project.	Low	

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Corvallis	MH #13	Construct a raw water intake system to reduce risk and improve reliability in the case of a natural disaster.	Retained	Corvallis Public Works	Internal: External: Corps of Engineers, Fish and Wildlife, DEQ	Mid-term (3-5 years)	FEMA BRIC and other grants	Medium	Current raw water intake is potentially limited during low flow periods.
Corvallis	MH #14	Complete water transmission main from Rock Creek Water Treatment Plant to the Baldy Reservoir.	Retained and Updated	Corvallis Public Works	Internal: External: City of Philomath. OEM, FEMA	Medium term (3-5 years)	FEMA BRIC and other grants	High	Corvallis has received $10 million from American Rescue Plan Act (ARPA) funds to start Phase I. This work is budgeted for in the Captial Imrovement Plan, but the city also intends to supplement with grant funding.
Monroe	MH #15	Set up redundancies in city systems to allow continuity of government following a natural hazard event.	New Action	City Administrator		Short-term (1-2 yrs	City general funds	High	City Council has identied this as a goal for the 2023-24 fiscal year.
Adair Village	MH #16	Replace existing Water infrastructure to meet earthquake standards, provide fire suppression support during an event and to ensure delivery of fresh water during drought situations.	New Action	Public Works Dept. and City Administrator	Internal: Benton County Community Development, Emergency Management, Civil West (consulting engineer) External: Community organizations; cities and special districts; established community preparedness groups	Short Term (1-2 years)	Adair Village is working on FEMA BRIC Grant now	Highest	

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Adair Village	MH #17	Identify partners and back up connections for support during an event.	New Action	Public Works Dept. and City Administrator	Internal: Civil West External: City of Albany City of Corvallis, OSU, Benton County, Adair Rural Fire and Rescue	Mid-Term (3-5 years)	Water funds in Adair Village, Albany and Corvallis	Medium	
Adair Village	MH #18	Develop a shelter with proper heating and coooling to provide refuge for residents. Currently working to identify a location where the city would make imporovements or develop building plans for extreme heat and extreme cold conditions.	New Action	City Administrator and Public Works Dept.	Internal: Civil West, Adair Living History External: Consumer Power	Short Term (1-3 Years)	Adair Village general funds, Adair Living History non-profit, Siletz Tribal foundation funds has already provided $10k	High	
Corvallis	MH #19	Develop alternative communications network that allows community resilience centers to coordinate information and needs. This network should be able to connect to the Benton-Corvallis Emergency Operations Center Incident Management Team.	New Action	Corvallis Emergency Planning Manager	Internal: Fire, Corvallis PIO External: Benton County Emergency Manager, OSFM, ODF, OSU Forestry, OSU Extension, OEM	Medium Term (3-5 years)	OEM technical assistance, FEMA BRIC grant	Medium	Evaluate and develop an alternative communications plans to build a communications network for the City of Corvallis that does not rely on internet or existing systems or utilities. This could be through amatuer radio networks, or systems like a "MESH Network", or some other option.

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Corvallis	MH #20	Ensure that all areas of Corvallis have caches of equipment, trained volunteers, and processes in place to respond to a major disaster. This will create community resilience centers that support short term recovery following a major incident as outlined in Corvallis's Neighborhood Resilience Plan.	New Action	Corvallis Emergency Planning Manager	Internal: Community Development, Parks and Recreation, Public Works External: OEM, ODHS, FEMA	Medium Term (3-5 years)	ODHS grants for resilience hubs, OEM technical assistance, FEMA BRIC grant	Medium	Develop community resilience centers that allow neighborhoods to organize, equip, train, and respond during an earthquake event.
Corvallis	MH #21	Ensure that all critical facilities in Corvallis have backup power and emergency operations plans to deal with power outages and Public Safety Power Shutoffs.	Retained and Updated	Corvallis Public Works	Internal: Emergency Planning Manager External: Benton County Emergency Management, Community Development, Private owners	Short Term (1-2 years)	OEM technical assistance, FEMA Advanced Assistance	High	The city can identify any gaps in older buildings. Newer ones have backup systems built in. This action item has been reclassified to a multi-hazard item due to the multiple reasons for back up power needs.
Corvallis	MH #22	Identify requirements, obtain and install generator backup system for both Taylor and Rock Creek Water Treatment plants. This will allow Corvallis to maintain the ability to produce potable water in any incident the disrupts the electrical supply.	New Action	Corvallis Public Works	Internal: Emergency Planning Manager External: City of Philomath. OEM, FEMA	Medium term (3-5 years)	FEMA BRIC and other grants	Highest	

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Corvallis	MH #23	Ensure that all community members understand the need, importance, and steps for evacuation for any incident in their area.	New Action	Corvallis Emergency Planning Manager	Internal: Fire, Corvallis PIO External: Benton County Emergency Manager, OSFM, ODF, OSU Forestry, OSU Extension, OEM	Ongoing	OEM technical assistance		Educate all community members on the process and levels of evacuation. Conduct Evacuation Workshops virtually or in-person to create understanding and allow for community feedback on processes. Conduct or support Neighborhood Evacuation Exercises to clarify processes and validate plans.
Benton County	MH #24	Seismically retrofit the Alsea School.	New Action	Alsea School District	Alsea Community Effort (ACE)	Long term (>5 years)	Business Oregon's Seismic Rehabilitiation Grant Program BRIC Grant		The school is likely to be the main community meeting place and shelter in an emergency event. **Potential funding source:** Business Oregon's Seismic Rehabilitiation Grant Program.
Benton County	MH #25	Provide facility upgrades to Alsea School, such as an industrial kitchen, so that the school may serve as a natural hazard shelter for the community.	New Action	Alsea School District	Alsea Community Effort (ACE)	Long term (>5 years)			The school is likely to be the main community meeting place and shelter in an emergency event

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Benton County	MH #26	Invest in the communications infrastructure that supports the Benton County first responders, road crews, etc. in accordance with the Radio Infrastructure Assessment and Improvement Plan. Align these projects with the Interoperable Communications Plan within the Region.	New Action	Benton County Sheriff's Office, Corvallis Regional Communication District	Benton County Fire Defense Board, Benton County Rural Fire Protection Districts	Long term, >5 years	Assistance to Firefighters (AFG) BRIC Grant	High	
Benton County	MH #27	Develop an All-Hazard Emergency Evacuation Route Priority Plan • Convene communities across Benton County to identify and prioritize Emergency Priority Route needs and gaps, • Incorporate community-identified needs and gaps into a comprehensive county-wide strategy that identifies priority evacuation routes, • Identify potential funding for priority routes, and • Adopt the Emergency Evacuation Route Priority Plan into the Benton County Comprehensive Plan and Development Code.	New Action	Benton County Community Development, Sheriff's Office Emergency Management and Public Works staff	Internal: External: Municipal governments, Community Hazard Stakeholders	Short term, 1-3 years	Purchase of software to map options possibly using ODOT Annual Grant Program, Hazard Mitigation Grant, or Fire Mitigation Grant	High	Benton County Planner recently recently did research for grants that would fund planning to support evacuation strategy. She identified a annual grant program within ODOT that would support planning for alterntive evacuation routes. The representative for the community of Wren has identified a concern about areas where residences have a single access way. Developing alternative evacuation routes would reduce

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									risks from wildfire for these people.
Benton County	MH #28	Construct a new bridge on Hayden Road.	New Action, progressing	Benton County Public Works		Short term, 1-3 years	State of Oregon's Local Agency Bridge Program grant	High	The load limit on Hayden Bridge resulted in the design of a new bridge adjacent to the historic covered bridge there. The design of the bridge is in process and construction funds have been identified. Construction is slated for 2025-26

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Benton County	MH #29 (Wildfire, Windstorm, Winter Storm, Volcanic Activity)	System hardening that is system-wide: -transitioning to metal & fiberglass power poles -add composite crossarms -transition to covered conductors -power system undergrounding -add protective fireproof wraps around wooden power poles	New Action	Consumer Power Inc.	Internal: Benton County Community Development, Benton County Emergency Management, Benton County Public Works External: Utility partners, Private land-owners	Ongoing as funds come available	CPI Operating budget Oregon Department of Energy Oregon Department of Emergency Management	Medium	System hardening consists of building new infrastructure and retrofitting legacy infrastructure with more resilient materials. These materials stand up to damage better than traditional wooden system components. System hardening components include metal & fiberglass power poles, composite crossarms, covered conductors, system undergrounding, and protective fireproof wraps around wooden poles.
Benton County	MH #30 (Wildfire, Windstorm, Winter Storm, Volcanic Activity)	Enhance power system intelligence capabilities by running fiberoptic communication cables to new system components so that CPI can communicate with them without a linemen in the field.	New Action	Consumer Power Inc.	Internal: Benton County Community Development, Benton County Emergency Management, Benton County Public Works External: Utility partners, Private land-owners	Ongoing as funds come available	CPI Operating budget Oregon Department of Energy Oregon Department of Emergency Management	Medium	System intelligence refers to efforts to enhance system control and automation through the CPI SCADA system. In the past, system components such as reclosers were exclusively manually operated by linemen in the field. CPI is investing in newer technologies that allow greater command and control of the system via our SCADA system. This means that

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									CPI dispatchers can change system settings very quickly in response to threats. Compared to older technologies the difference in control allows system changes to be made in minutes instead of hours or days. This effort involves running fiberoptic communication cables to new system components so that CPI can communicate with them.
Benton County	MH #31 (Wildfire, Windstorm, Winter Storm, Volcanic Activity)	Enhance knowledge of current weather conditions throughout CPI's Benton County regional system: -purchase Tempest Weatherflow systems -install Tempest Weatherflow systems	New Action	Consumer Power Inc.	Internal: Benton County Community Development, Benton County Emergency Management, Benton County Public Works External: Utility partners, Private land-owners	Ongoing as funds come available	CPI Operating budget Oregon Department of Energy Oregon Department of Emergency Management	Medium	Environmental Intelligence refers to CPI efforts to characterize the current state of the lower levels of the atmosphere and analyze the potential effects to CPI system operations. Knowledge of current weather conditions is a key part of CPI's wildfire mitigation plan. Current weather conditions play a significant part in decisions about protective measures that CPI takes to prevent our system from starting fires. The rural nature of CPI's system

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									means that existing publicly owned weather stations are often far from critical system components. The weather stations that do exist in CPI areas are often installed at an altitude that makes them unrepresentative of the conditions at the altitude of CPI's electrical system components. To remedy this CPI is going to buy and install Tempest Weatherflow systems over the next couple of years. CPI will purchase and deploy roughly 20-40 Weatherflow sensors throughout our service territory to provide environmental intelligence. The pictures below depict a Weatherflow sensor and its information output.
Adair Village	WF #1	Implement actions identified in the Community Wildfire Protection Plan.	Retained as is	Adair Village Rural Fire		Ongoing			

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Benton County	WF #1	Implement actions identified in the Community Wildfire Protection Plan.	Retain	Benton County Community Development	Internal: Emergency Management staff External: Oregon Department of Forestry	Short to Long-term depending on the action	OSFM, FEMA BRIC grant		The actions referred to are detailed in the Community Wildfire Protection Plan
Corvallis	WF #1	Implement actions identified in the Community Wildfire Protection Plan.	Retained and Updated	Corvallis Fire, Corvallis Rural Fire Protection District, Corvallis Public Information Officer	External: Benton County Community Development, Emergency Manager , ODF, OSFM, OSU Extension, NFPA	Ongoing	OEM, OSFM, NFPA grants to supplement existing staff capacity		Actions include the following: 1. Continue to educate the community on the dangers of wildfire in both urban and rural settings through community outreach. 2. Conduct workshops on the benefits of creating fire resilient home spaces, reducing fuels around your home, and organizing your neighborhood (Associations or Firewise). 3. Conduct fuels reduction events in key neighborhoods for both vegetation and hazard reduction (dumpster days). 4. Develop Community Grants Review Committee to provide

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									grant funding for fuels reduction to low and moderate income community members.
HKV RFPD	WF #1	Implement actions identified in the Community Wildfire Protection Plan.	New Action	HVK RFPD	Benton County	Ongoing			
Monroe	WF #1	Implement actions identified in the Community Wildfire Protection Plan.	Retain; no change	City Administrator	Monroe Rural Fire Protection District, Benton County Community Development and Emergency Management	Short-term (1-2 yrs)	OSFM, FEMA EMPG funding	High	Evacuation routes are of concern to the city and nearby residents because in the unincorporated county near the City of Monroe there are several thousand residents; Monroe itself has a population of 723. The other primary area of concern is reducing the volume of 1000 hour fuels.

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Philomath	WF #1	Implement actions identified in the Community Wildfire Protection Plan.	Retain	Philomath Fire & Rescue	Internal: City of Philomath Administration External: Benton County Sheriff's Office	Ongoing			no change; due to the status of the CWPP no additional detail or identification of specific actions for Philomath can be identified at this time.
Adair Village	WF #2	Develop a community Wildfire Plan	New Action	City Administrator	Adair Rural Fire Department, Benton County, Adair Village Cert Team, City of Corvallis, City of Albany	Short Term (1-3 Years)	Adair Village General Fund Adair Rural Fire Department General Fund	Medium	
HKV RFPD	WF #2	Conduct analysis of the water supply resources based on the NFPA standards and id areas with lack of supply	New Action	HKV RFPD	Benton County Planning and Emergency Management, Benton County SWCD, Greenbelt Land Trust, OSU, Special Districts Association; OSFM; consultant; OEM/FEMA	Short term; 1-3 years	OSFM, FEMA EMPG funding	High	The work could be conducted by a consultant. The district would like to use a GIS database for the analysis potentially a network analysis to identify supplysheds and where there are deficiencies in water supply.
HKV RFPD	WF #3	Identify locations where district could site new water supplies (tanks are preferred, estimate that 3 30-gallon tanks placed strategically, ponds - issues with evaporation)	New Action	HKV RFPD	Local property owners, legal advice may be needed, OEM/FEMA	Short term; 1-3 years	OSFM, FEMA EMPG funding	High	Ownership may be a concern for siting. Consider purchase, lease, or easement to surmount this barrier

Jurisdiction	2023 Action ID	2023 Action Item	2023 Status	2023 Coordinating Organization or Individual	2023 Partner Organizations	2023 Timeline	2023 Potential Funding Sources	2023 Priority	2022-23 Update Notes
Benton County	WF #4	Conduct oureach effort to inform the public and other property owners such as timber companies about ways to reduce hazard risks to electricity or other utility infrastructure during the completion of routine projects.	New Action	Benton County Community Development and Public Works Departments	Internal: Emergency Management External: Utility providers	Medium term, 3-5 years	County General Fund	Low	This would include information to timber companies that removing all the trees adjacent to power lines may limit risk to them from high winds or landslides. This would also include information to power companies about the Benton County PW practice of encouraging making temporary utility bypasses to become permanent during bridge and culvert replacements.
Benton County	WF #5	Improve remote draft site at Daisy Drive in Marys River Estates by replacing the fixed water pump from the late 1960's or early 1970's with two portable pumps that will provide more reliability and will be easier to maintain.	Progressing	Philomath Fire & Rescue Deputy Fire Chief	Internal: Benton County Planning, Public Works External: Marys River Estate residents	Short-term (1-2 yrs)	Philomath Fire and Rescue District funds	Low-Medium	Prior improvements to this draft site include better road surfaces and concrete flooring added to the pump housing. The portable pumps are being procured and are scheduled to be in service by March 2024. The Marys River Estates Road District and Property Owners

Jurisdiction	2023 Action ID	2023 Action Item	2023 Status	2023 Coordinating Organization or Individual	2023 Partner Organizations	2023 Timeline	2023 Potential Funding Sources	2023 Priority	2022-23 Update Notes
									Association will maintain access to the existing pump house.
Benton County	WF #6	Install a water storage tank in Alsea that supports the Alsea Rural Fire Protection District.	New Action	Benton County Public Works, Alsea Rural Fire Protection District					
Benton County	WF #7	Consider development of a plan to upgrade Alsea's water system. This involves identifying funding sources and detailing the needed upgrades.	New Action	Benton County Public Works	Internal: Benton County Community Development, Alsea Community Effort (ACE) External: OEM, OSFM	Long term, >10 years	Community Development Block Grant, USDA Rural Development Assistance - Utilities grant	Low	No assessment has been done to establish what upgrades might be needed, and if a cost/benefit analysis will support proposed upgrades. Examples of possible upgrades could include replacement of existing 3" pipes with 6" pipes, constructing additional water storage facilities, and installing additional fire hydrants to ensure adequate capacity for fire fighting within the community.

Jurisdiction	2023 Action ID	2023 Action Item	2023 Status	2023 Coordinating Organization or Individual	2023 Partner Organizations	2023 Timeline	2023 Potential Funding Sources	2023 Priority	2022-23 Update Notes
Benton County	WF #8	Install a fire radio station at the Alsea Rural Fire Protection District Fire Station to improve the communication system of the district.	New Action	Alsea Rural Fire Protection District	Benton County Fire Defense Board, Corvallis Regional Communication District	Medium term, 3-5 years			A Fire Radio Station can monitor frequencies from many agencies including ODF, Benton County, and more locally the Alsea Ham station.
Benton County	WF #9	Install a sprinkler system in the Alsea Fire Hall.	New Action	Alsea Rural Fire Protection District	Alsea Community Effort (ACE)	Long term, >5 years			
Adair Village	WS #1	Secure emergency supplies and critical equipment needed in extended winter conditions.		City Administrator and Public Works Dept.	Internal: Civil West External: Consumer Power	Ongoing		Priority Medium	
Adair Village	WT #1	Ensure that all critical facilities in Adair Village have backup power and emergency operations plans to deal with power outages.	Removed, action is covered in MH#3						

APPENDIX B: PLANNING AND PUBLIC PROCESS

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Project Background

Benton County, the incorporated cities and the Hoskins Kings Valley Rural Fire Protection District partnered with staff members of the Oregon Department of Land Conservation and Development to update the 2023 Benton County Multi-Jurisdictional Natural Hazards Mitigation Plans (MNHMP). The Disaster Mitigation Act of 2000 requires communities to update their mitigation plans every five years to remain eligible for Hazard Mitigation Grant funding including the Building Resilient Infrastructure and Communities (BRIC) grant program, formerly the Pre-Disaster Mitigation (PDM) program, Flood Mitigation Assistance (FMA) program funding, and Hazard Grant Mitigation Program (HMGP) funding. DLCD staff met with members of the Benton County Steering Committee to update portions of their NHMPs. The Steering Committee included representatives from the cities of Adair Village, Monroe, and Philomath, and Corvallis. The Hoskins Kings Valley Rural Fire Protection District opted to join the multi-jurisdictional plan for the first time during the 2022-2023 update process. The DLCD project manager drafted the plan and in conjunction with the representatives from the cities and the special district, the Steering Committee made several changes to the 2016 MNHMP as described below.

2023 Plan Update Changes

The sections below discuss only *major* changes made to the MNHMP during the 2022-2023 plan update process. Major changes include the replacement or deletion of large portions of text, changes to the plan's organization, new mitigation action items, and the addition of city addenda to the plan. If a section is not addressed in this appendix, then it can be assumed that only minor changes were made.

The 2023 Benton County Multi-Jurisdictional Natural Hazard Mitigation Plan retains the same format and organization as the 2016 NHMP prepared by the Oregon Partnership for Disaster Resilience.

Table B-1 Changes to Plan Organization

2016 Benton County Multi-Jurisdictional NHMP	2023 Benton County Multi-Jurisdictional NHMP
Front Page	Updated to include photos, the effective dates of the plan and a location map.
Acknowledgements	Updated with 2022-2023 participants
Table of Contents	
Approval Letters and Resolutions	Moved to Appendix dedicated to Approval letters, Review Tool and resolutions
FEMA Review Tool	Same as above
Volume I: Basic Plan	
Plan Summary	
Section 1: Introduction	
Section 2: Risk Assessment	• Incorporated multi-hazard risk report prepared by Department of Geology and Mineral Industries using HAZUS analysis and depth grids for flood exposure analysis. • Incorporated Future Climate Projection Report for Benton County prepared by Oregon Climate Change Research Institute to address impacts to hazard frequency and characteristics from warming temperatures. • Added consideration of Extreme Temperatures, Dam Failure and Poor Air Quality as a related effect of Wildfires to the characterization of the hazards faced in Benton County.
Section 3: Mitigation Strategy	Updated mitigation strategy actions and added new.
Section 4: Plan Implementation and Maintenance	Provided links to county plan documents and updated plan maintenance schedule.
Volume II: City Addenda	
Adair Village	Updated recent hazard events and mitigation strategies
Corvallis	Updated recent hazard events and mitigation strategies
Monroe	Updated recent hazard events and mitigation strategies
Philomath	Updated recent hazard events and mitigation strategies
	Added Addendum for Hoskins Kings Valley Rural Fire Protection District
Volume IV: Appendices	
Appendix A: Action Items	Action Item worksheets were restricted to those actions identified as High Priority for the participating plan holders.
Appendix B: Planning and Public Process	Provided updated documentation of the planning and public process for 2022-2023
Appendix C: Community Profile	Updated demographic information and other details about the county.
Appendix D: Economic Analysis of Natural Hazard Mitigation Projects	No change
Appendix E: Grant Programs	Updated grant program list and links
Appendix F: Community Survey	Provided results of 2023 survey
	NEW Appendix G: DOGAMI Multi-hazard Risk Report for Benton County
	NEW Appendix H: OCCRI Future Climate Projections report
	NEW Appendix I: Approval letters, Review Tool, and Resolutions

2023 NHMP Update Public Involvement

Benton County is dedicated to directly involving the public in the review and update of the Multi-Jurisdictional Natural Hazard Mitigation Plan. The 2023 NHMP Steering Committee was comprised of representatives of the plan holding jurisdictions. This group mounted a public information campaign that took place in public city council meetings, through the use of the city's websites and through a widely distributed public survey. These are the ways that the residents of Benton County, Adair Village, Corvallis, Monroe, Philomath, and those served by the Hoskins Kings Valley RFPD.

Benton County made the final draft Benton County Multi-Jurisdictional NHMP available via the county's website for public comment from DATE through the FEMA review period. Comments received during that period and the responses to them are provided in a table in this section.

Public Involvement Summary

Members of the MNHMP Steering Committee took action in their own localized areas such as Alsea, Wren and the smaller cities to invite participation by the public in the update to the MNHMP. The county and the City of Corvallis took action geared toward informing as many community members as possible about the update that was underway.

Benton County posted information on its website running from May 23, 2023 to inform the public that an update to the NHMP was occurring and to provide an opportunity for the public to provide input through an online survey. The survey was provided in Spanish and English and distributed by the Benton County Department of Health staff to vulnerable and underserved people. The survey ran for several months to allow residents to provide input on the hazards that they have experienced, the hazards to which respondents felt most vulnerable and ways in which they have prepared to be resilient as well as ways they would like the county to further reduce risk from natural hazard events.

Localized actions taken to solicit participation from the public include the following. The Steering Committee representative from the unincorporated community of Alsea wrote newsletter articles for the Alsea Valley Voice and conducted an informal survey of residents in that community early in the process. The representative from the City of Adair Village and Monroe worked to provide updates on the process during public city council meetings during the plan update process. Notification about the process was also provided in the Adair Village News. The RARE program volunteer connected the Spanish-speaking population in Monroe to participate in the planning process. The representatives of the City of Philomath set up a table at the Farmer's Markets to invite participation from public. Potentially more vulnerable members of the community were reached with the mailed Alsea newsletter and the online Adair Village newsletter, the direct contact with Spanish speakers in Monroe and the in person markets in Philomath. The feedback received was incorporated into both the Risk Assessment and the Mitigation Strategy.

Members of the steering committee provided edits and updates to the NHMP during the drafting process. Those comments and corrections are reflected in the final document.

The County posted the Draft 2023 Benton County Multi-Jurisdictional Natural Hazard

Mitigation Plan update to allow the public to view and comment on the final draft updated plan as it was undergoing review by the Oregon Department of Emergency Management. There were X comments received during the public review period. (if any received, provide response matrix)

Public Outreach

After the Steering Committee had reconsidered the hazard scores that the OEM Methodology yielded by using a ranking methodology, the Steering Committee members were particularly interested in learning the perception of the public. Representatives of both the Cities of Monroe and of Adair Village noted that they regularly updated their city councils as a standing agenda item. An example of the Adair Village City Council agenda is provided below. In May 2023 the Steering Committee members launched informational postings on their websites. After the Benton County staff completed the development of the survey in consultation with other county staff, the Community Development Department, in particular, the survey was launched in May and remained open for several months in order to allow jurisdictions that had not yet participated in public engagement activities had ample opportunity to do so.

The survey was one way that the Steering Committee solicited feedback from more vulnerable people and those who may be underserved. In order to expand the reach of the survey, the Benton County Public Information Officer had the survey translated into Spanish. After the initial results did not contain any responses to the Spanish language version , a renewed effort to distribute the survey to Spanish speakers took place in August. The survey questions and the results along with the extensive open comments are available as Appendix F to this plan.

Figure B-1. Benton County webpage May 2023.

Figure B-2. Alsea Voice article Jan-Feb 2023

January - February 2023

Alsea Valley Voice

Survey Results for Benton County Natural Hazards

By Phil Plaza

The results are in from Alsea/Lobster Valley. The surveys prioritizing the Natural Hazards in the Alsea/Lobster Valley area have been tabulated and will soon be presented to the Benton County Steering Committee. Generally speaking the results are somewhat in alignment with the other Benton County areas. The prioritizing is not yet completed for all of Benton County. As you can imagine there are some slight differences from our area.

The final results are as follows: The number 1 most concerning hazard out here was wildfire. Far and away this was ranked number one. This was followed in order by landslides, flooding, and the Cascadian Subduction Zone Earthquake. Coming next, were winter storms, followed by drought, a Crustal Earth Quake, then extreme heat, a pandemic, dam failure and finally a volcanic event was ranked last at number 11.

Given the local environment and the proximity of our location to the ocean, a major event such as the Subduction Zone Earthquake would play a significant factor in our community's ability to be resilient, both as a route of exit for the residents from Waldport as well as the many landslides along Highway 34. We will be impacted one way or another.

There is more work to be done, however all the results will offer the County a roadmap in order to acquire funding to help mitigate the effects of any future events. This is the Mitigation Plan's purpose. The Alsea Emergency Preparedness Plan is slightly different in that it gives us a roadmap of what to do once the event has occurred. For example what can landowners do to mitigate the effects of a potential wildfire? They can start by clearing vegetation away from their homes, clear out the hazardous material that accumulates in the understory and importantly plan ahead. The Alsea Emergency Preparedness Plan is what happens while we have a disaster. Gathering points for personal safety, for needed medical care, supplies and other help are identified and ready to be of assistance.

There will be federal grants offered to Benton County very soon. Several projects have already been identified for mitigation purposes. If you as a concerned citizen have some ideas or suggestions with respect to mitigation measures, please speak up soon. You can e-mail me at philplaza@hotmail.com with your suggestions. And thanks to all who filled out the survey. Your concerns will be heard.

Figure B-3. Adair Village City Council agenda

ADAIR VILLAGE CITY COUNCIL-Final
City Hall - 6030 Wm. R Carr Av.
****Tuesday, May 2, 2023 - 6:00pm****

1. ROLL CALL – Flag Salute

2. CONSENT CALENDAR: - *The following items are considered to be routine and will be enacted by one motion. There will be no separate discussion of these items unless a Council member so requests, in which case the item will be discussed before the Consent Calendar is considered. If any item involves a potential conflict of interest, Council members should so note before adoption of the Consent Calendar.*

a. Minutes – City Council Meeting – April 4, 2023 (Attachment A)
b. Bills List through – April 30, 2023 (Attachment B) – $133,757.94

3. PUBLIC COMMENT (Please limit comments to 3 minutes)

4. STAFF REPORTS:

a) Sheriff's Report (Attachment C)	Pat Hare
b) Public Works (Attachment D)	Pat Hare
c) City Administrator (Attachment E)	Pat Hare
d) CSO Report (Attachment F)	Pat Hare
e) Financial Report (Attachment G)	Pat Hare

5. OLD BUSINESS:

a) Natural Hazard Mitigation Plan Update (Attachment H) — Pat Hare
Action: Discussion

6. NEW BUSINESS:

a) Annexation and Zoning of properties brought into the UGB (Attachment I, I1, I2, I3, I4) — Pat Hare
Action: Public Hearing/Decision

7. ORDINANCES, RESOLUTIONS, AND PROCLAMATIONS:

a) Ordinance No. 2023-03 Annexation of 55 Acres (Attachment J) — Pat Hare
Action: Decision

b) Ordinance No. 2023-04 Amending Comprehensive Plan Map (Attachment K) — Pat Hare
Action: Decision

8. EXECUTIVE SESSION:

a) N/A
Action: n/a

9. COUNCIL and MAYOR COMMENTS:

10. ADJOURNMENT:

Next meetings - City Council –Tuesday, June 6, 2023, 6:00 PM
Planning Commission – May 16, 2023, 6:00pm

The Community Center is accessible to person with disabilities. A request for an interpreter for the hearing impaired or for other accommodations for persons with disabilities should be made at least 48 hours before the meeting by calling City Offices at 541-745-5507 or e-mail "karla.mcgrath@adairvillage.org", or Oregon Relay Services by dialing 7-1-1. The City of Adair Village is an Equal Opportunity Employer.
The order in which items on the Agenda are addressed by the City Council may vary from the order shown on the Agenda.
S:\Admin\City Council\Meetings\2023 Meetings\230502 CC Mtg\Agenda 230502.docx

Figure B-4. Adair Village News, July 2023

City of Adair Village
Grounded in history, growing for the future.

ADAIR VILLAGE NEWS

July 2023

UPCOMING EVENTS

City Council Meeting
Tuesday, July 11th at 6:00 p.m., City Hall

Planning Commission
Tuesday, July 18th at 6:00 p.m., City Hall

Adair Living History
Call (541) 231-7838 for meeting information and/or volunteer opportunities

Inside this Issue:

- **Founders Day**
- **Natural Hazard Mitigation Plan**
- **Build a "Go" Bag**
- **Help Paying Your Utility Bill**

Adair Village Mission Statement
To build a safe, attractive, vibrant environment with a welcoming sense of community.

ADAIR VILLAGE'S ANNUAL FOUNDERS DAY EVENT

Saturday, August 12, 2022; 10 AM to 3 PM

We are excited about this year's annual community event! We hope that everyone will join us for food and fun and get to know their neighbors a little better. We have lots of great activities planned, including:

- A free BBQ lunch (from 11 AM - 2 PM)
- Face painting
- Two balloon sculptors
- Extra-large obstacle course bouncy house
- The Sheriff's Department
- The Fire Department
- Live music with the Albany Swing Band
- Adair's Community Emergency Response Team (featuring a free MRE with completion of an educational task)
- Adair Living History events
- Venders' booths

If you are interested in becoming a vendor at this event, please call 541-745-5507 or email karla.mcgrath@adairvillage.org. Vendor spaces are free, but we need you to register.

NATURAL HAZARD MITIGATION PLAN

The City is involved in updating its Natural Hazard Mitigation Plan. For more information visit our website at adairvillage.org.

Advertisements below do not represent City sanctioned events or information.

GOOD GROUNDS · COFFEE SHOP ·

Our summer hours are Monday through Friday 6:30 a.m. - 2:00 p.m. Saturday 7:30 a.m. - 12:00 p.m. and closed on Sundays.

Come by for a refreshing iced latte, lemonade, smoothie, or a milkshake! Follow us on Facebook or Instagram for the latest news at the shop.

City of Adair Village 6030 NE William R Carr Ave., Adair Village, OR 97330 541.745.5507

Figure B-5. Adair Village webpage

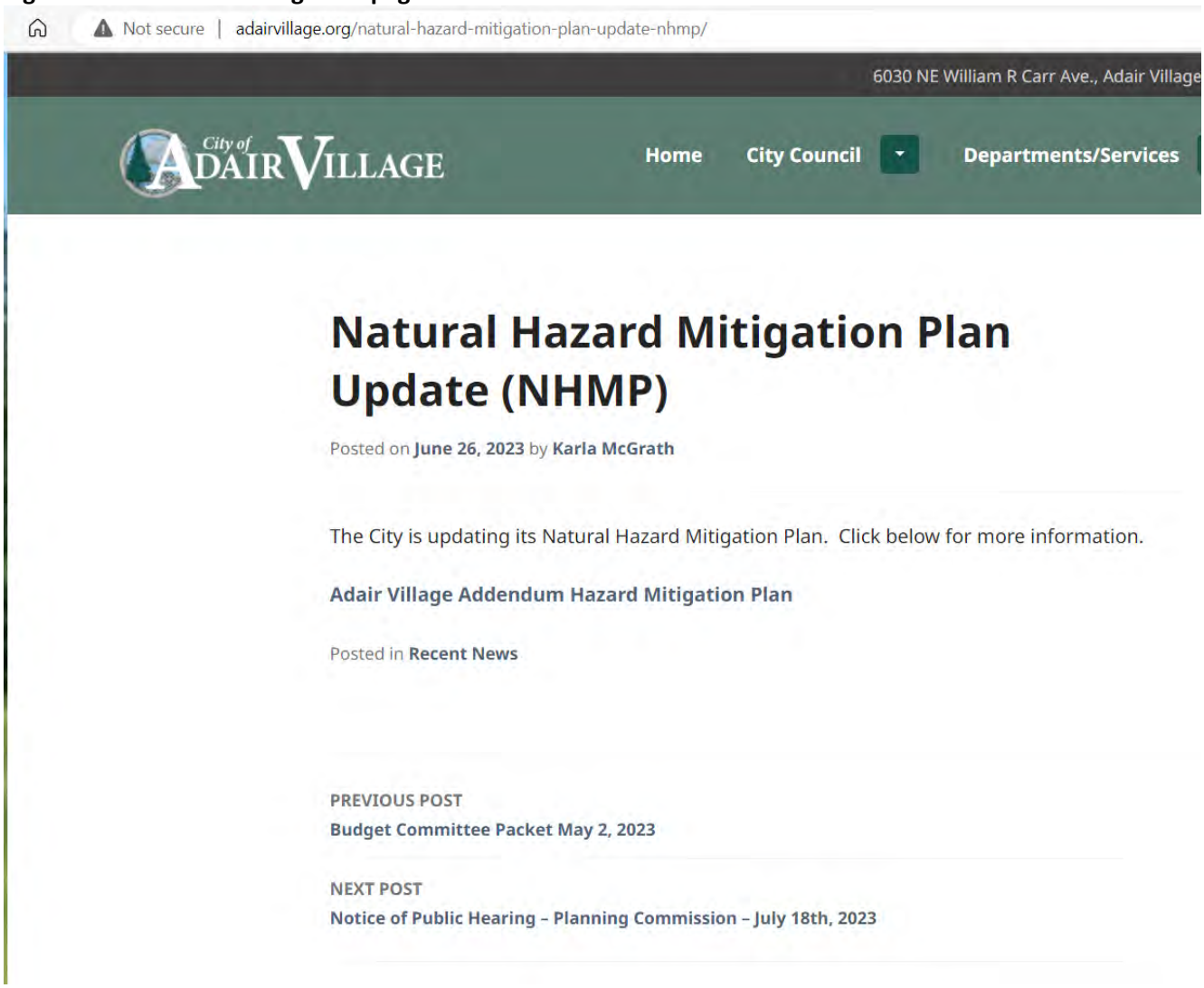


Figure B-6. Philomath Facebook Post

Figure B-7. Philomath Police Department repost

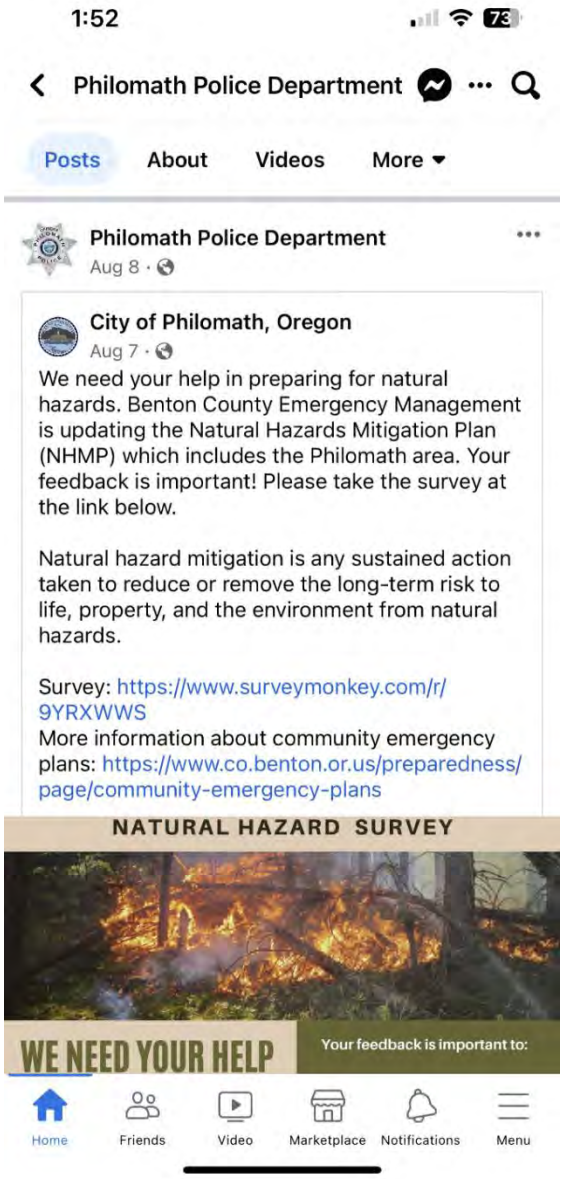
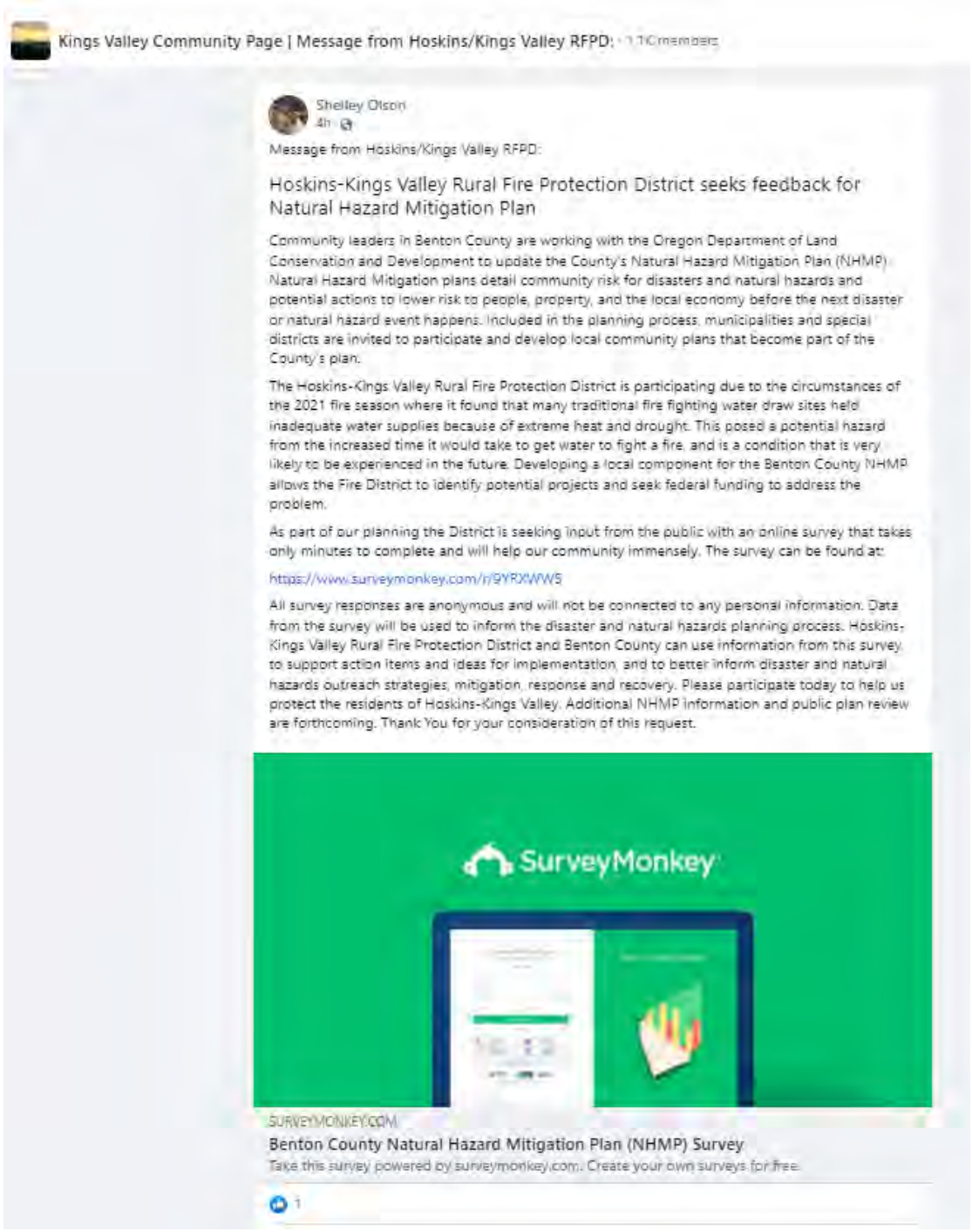


Figure B-8. Hoskins Kings Valley RFPD post on Kings Valley Community Page



Benton County Steering Committee

Steering committee members were familiar with the Benton County community and how the people and assets may be affected by natural hazard events. The Steering Committee was comprised of members and interested parties. The members represented governments and districts that are plan holders. The Interested Parties represented neighboring communities, local fire districts, and two academic institutions with facilities in Benton County. The project manager guided the Steering Committee through the update process. The planning process steps including hazard identification and risk assessment, confirmation of mitigation goals and objectives, review of action items and development of methods for information sharing to engage public participation. The Steering Committee members provided data and documents to make the plan as comprehensive as possible. The steering committee met on the following dates:

- **Meeting #1:** Understanding the Process and Forming the Steering Committee**,** June 23, 2022
- **Meeting #2:** Hazard History and Vulnerability Assessment, July 21, 2022
- **Meeting #3:** Vulnerability Assessment – Part 2, September 15, 2022
- **Meeting #4:** Risk Assessment, October 20, 2022
- **Meeting #5:** Complete Risk Assessment, November 17, 2022
- **Meeting #6:** Multi-hazard Risk Report presentation, March 2 2023
- **Meeting #7:** Future Climate Projections report, April 11, 2023
- **Meeting #8:** Public Outreach and Mitigation Strategies, August 2, 2023
- **Meeting #9:** Finalizing the Draft, September 6, 2023

The following pages provide copies of meeting agendas and adopted meeting notes from each of the meetings listed above.

In addition to the meetings listed above the project manager held one to two meetings with each jurisdiction to review and revise the mitigation strategy actions for each prospective plan holding jurisdiction. All meetings were held through an online meeting platform.

The plan was submitted to the Oregon Department of Environmental Management on DATE. At this point Benton County posted the final version that had been submitted for OEM review. A final meeting of the Steering Committee was held in person on DATE following the receipt of the Oregon Department of Environmental Management's review of the document in order to address any comments made by OEM or the public .

Figure B-9. June 23, 2022 Steering Committee (SC) meeting agenda

Benton County Natural Hazard Mitigation Plan Update
Steering Committee Meeting

Understanding the process
and forming the Steering Committee

June 23, 2022
12:00 – 2:00 pm
Virtual meeting: https://meet.goto.com/471696037
By phone: (312) 757-3121
Access Code: 471-696-037

AGENDA

Introduction and Meeting Objectives 12:00 -12:20

- Introductions
- Meeting Objectives
  - Discuss the purpose and process
  - Understand the roles of all participants
  - Discuss the schedule and expectations
  - Discuss public engagement strategy
  - Forming the Steering Committee and discuss IGA/Scope of Work

NHMP Purpose and Process/Role of DLCD and the County 12:20 – 12:40

- Purpose of NHMP updates
  (good planning, plan integration, access to FEMA funding)
- Role of DLCD and the County
  - Manage the process (agendas, minutes, follow-up actions, schedule)
  - Write the plan update
  - GIS mapping
  - Administration of grant funds

Roles of participants 12:40 – 1:00

- Role of prospective Plan Holders
  - Participate actively; keep track of time spent on this project
  - Help develop a public engagement strategy and participate in it
  - Communicate with constituents and community members who may not attend these meetings
  - Plan Holders will shepherd the NHMP update through the adoption process
- Draft Schedule
- Intergovernmental Agreements (IGA) and Scope of Work (SOW) for Plan Holders; identify dates to bring to decision makers

Figure B-10. June 23, 2022 SC meeting notes

Benton County Natural Hazard Mitigation Plan Update
Steering Committee Meeting

Understanding the process and forming the Steering Committee

June 23, 2022
12:00 – 2:00 pm
Virtual meeting: https://meet.goto.com/471696037
By phone: (312) 757-3121
Access Code: 471-696-037

Adopted Meeting Notes

Convener: Bryan Lee, Benton County Emergency Manager
Project Manager: Katherine Daniel, DLCD Natural Hazards Planner
Attendees:
Chad Marshall, Corvallis Public Works
Kim Webster, Wren Emergency Preparedness Council
John Moore, Corvallis Fleet Supervisor
Jay Tappen, Hoskins RFPD
Inga Williams, Benton County Senior Planner
Max Hildebrand, Corvallis Public Works Operations
Laurel Byer, Benton County Public Works, Engineering Manager
Aaron Manley, Corvallis Public Works, Development Review Supervisor
Toby Lewis, Benton County Associate Planner, CFM
Chad Gordon, Corvallis Public Works
Jason Yaich, Corvallis Community Development, Planning Manager
Rich Saalsaa, Philomath Fire and Rescue
Garry Black, Philomath Public Works Operations
Darren Nichols, Benton County Community Development Director
Pat Malone, Benton County Board of Commissioners, Vice Chair
Chris Brandon, Oregon State University Emergency Planner

Bryan opened the meeting at 12:05 and facilitated the introductions of attendees. Katherine reviewed the meeting objectives which included discussing the purpose and process of updating Benton County's Natural Hazard Mitigation Plan (NHMP), understand the roles of all participants, discussing the schedule and expectations for attendance, discussing the public engagement strategy for the project and discussing the formation of the steering committee and the IGA/Scope of Work.

Katherine described the purpose of updating the NHMP which includes gaining eligibility for FEMA Hazard Mitigation Assistance (HMA) grants for both pre-and post-disaster grant funding. The NHMP also forms the basis of cohesive planning to reduce risk from natural hazards through the participating jurisdictions' existing plans, policies and procedures. She described the roles of the prospective Plan Holders (participate actively; keep track of time spent on this project, help develop a public engagement

strategy and participate in it, communicate with constituents and community members who may not attend these meetings, shepherd the NHMP update through the adoption process) and those of DLCD and the County as the project leads. The DLCD project manager will manage the process and in collaboration with the Convener they will develop and disseminate agendas, meeting notes, follow-up actions, and the project schedule. The Project Manager will draft the plan update for steering committee review and administrate the grant funds. The Benton County and City of Corvallis Geographic Information Systems staff will prepare maps for the NHMP update.

The group discussed other groups and individuals who might want to or might benefit from participation in the steering committee. These included a representative from Alsea, the Public Information Officer for the City of Corvallis, a representative from the county Health Department. The Health Department has a well-developed public engagement function and could help ensure that vulnerable people are represented in the NHMP update process.

Katherine reviewed the contents of the Intergovernmental Agreements (IGA) and Scope of Work (SOW) for the participants. The group agreed that all a target for providing signed IGAs would be August 31. This would facilitate a clear understanding of the roles of participants in the steering committee, both prospective plan holders and interested parties to the process.

Katherine initiated a discussion about how to conduct the public engagement aspect of the NHMP update process. The group named some methods they could use including the networks of the Health Department, of OSU extension and the annual letter sent to property owners with property in the FEMA floodplain.

The group discussed whether to take public input during steering committee meetings and decided that short time slots at the beginning and at the end of meetings could be dedicated to time limited comments by members of the public that might attend steering committee meetings.

Katherine will send invitations to the participants for the file sharing application called Box. This will be the location for documents the group will access frequently or documents the group will be consulting or editing during the project. She will also use Doodle Poll to find a commonly available time for monthly meetings from June-November.

The participants were asked to review the IGA and Scope of Work in order to discuss the agreement with decision makers and to seek signatures on the IGA. The participants were also asked to consider these questions: *Since 2017 what natural hazards have impacted or cause damage to people or property in your jurisdiction? Do you have images of areas of natural hazard concern or damage from natural hazard events you can share?*

Next meeting will be set based on the Doodle Poll results.
Meeting adjourned at 2:00 pm

Figure B-11. July 21, 2022 SC meeting agenda

Benton County Natural Hazard Mitigation Plan Update
Steering Committee Meeting

Hazard History and Vulnerability Assessment

July 21, 2022
2:30 – 4:30 pm
Virtual meeting: https://meet.goto.com/471696037
By phone: (312) 757-3121
Access Code: 471-696-037

AGENDA

Introduction and Meeting Objectives 2:30-2:40

- Introductions
- Review and accept meeting notes from 6/23/22 meeting
- Meeting Objectives
  - Review process; discuss formation of Steering Committee meeting; IGA signature goal date
  - Review Benton County's recent history of natural hazard events
  - Introduce and begin the Hazard Vulnerability Assessment
  - Discuss Critical and Essential Facilities
  - Develop Public Engagement strategy for this project

NHMP Purpose and Process/Role of DLCD and the County 2:40-2:50

- Purpose of NHMP updates; roles of DLCD and prospective plan holders
- Steering Committee participants (prospective plan holders and interested parties)
- IGA signature goal date: August 31

Hazard Identification and Vulnerability Assessment 2:50 – 3:40

- Natural Hazard Identification
- Vulnerability Assessment (OEM Methodology factors include History, Probability, Vulnerability, and Maximum Threat)

Critical and Essential Facilities 3:40 – 4:00

Public Engagement Strategy 4:00 – 4:15

- When to engage the public and seek input on the plan?
- What ways will Plan Holders use to solicit public input and engagement?

Wrap up

Next meeting: August 19th 2:30-4:30 4:15 to end of meeting

Figure B-12. July 21, 2022 SC meeting notes

Benton County Natural Hazard Mitigation Plan Update
Steering Committee Meeting

Hazard History and Vulnerability Assessment

July 21, 2022
2:30 – 4:30 pm
Virtual meeting: https://meet.goto.com/471696037
By phone: (312) 757-3121
Access Code: 471-696-037

Adopted Meeting Notes

Convener: Bryan Lee, Benton County Emergency Manager
Project Manager: Katherine Daniel, DLCD Natural Hazards Planner
Attendees:
Kim Webster, Wren Emergency Preparedness Council
Jay Tappen, Hoskins RFPD
Inga Williams, Benton County Senior Planner
Laurel Byer, Benton County Public Works, Engineering Manager
Jason Yaich, Corvallis Community Development, Planning Manager
Rich Saalsaa, Philomath Fire and Rescue
Garry Black, Philomath Public Works Operations
Phill Plaza, Alsea Preparedness Council
Cory Grojan, Benton County Public Information Officer
Dave Busby, Corvallis Fire Planning and Administration Division Chief
Kevin Fear, Philomath Public Works Director
Jude Geist, Corvallis Parks, Parks Supervisor
Chelsea Starner, Philomath Assistant City Manager
Steven Martinenko, Monroe Chief Operating Officer

Introduction and Meeting Objectives

Bryan opened the meeting at 2:30 pm and Katherine called on participants to introduce themselves after providing a brief introduction herself. She reviewed the preferred procedure of formally reviewing and adopting the meeting notes from the previous meeting, but apologized for not having the 6/23/22 meeting notes prepared. Two sets of notes will be reviewed at the August meeting.

Katherine reviewed the objectives of the meeting today which included
- Review process; discuss formation of Steering Committee meeting; IGA signature goal date
- Review Benton County's recent history of natural hazard events
- Introduce and begin the Hazard Vulnerability Assessment

- Discuss Critical and Essential Facilities
- Develop Public Engagement strategy for this project

Katherine briefly reviewed the purpose and process of updating the NHMP including a review of the roles and expectations for prospective Plan Holders as well as interested parties. Jay Tappen identified the interest of the Hoskins Rural Fire Protection District in becoming a Plan Holder. Katherine will provide him with an IGA to bring to the district's board.

Katherine asked for confirmation that the group had identified August 31 as the target date for signed IGAs. This was confirmed and most jurisdictions are working toward meeting that goal.

Katherine initiated a discussion about the formation of the Steering Committee and spoke about the importance of including agencies or organizations that represent historically under represented groups. The Health Department could be a useful agency to include for this purpose and the Public Information Officer will check with the EDI committee for Benton County to identify other ways to reach agencies or organizations that represent the underserved populations of Benton County.

The group then began the Risk Assessment phase of the project by identifying natural hazard events that have occurred in the county since 2016 when the prior plan began its effective period. The 2019 floods, the 2021 ice storm and winter storm were identified. A landslide north of Corvallis on Vineyard Mountain cause several million dollars' worth of damage but occurred in 2012. No other major landslides were identified during the period since 2016 but an area on the Lincoln-Benton County line near Fish Hatchery Rd. was identified as having frequent rockfall incidents. A fire in 2021 near or in Alsea along Route 34 was identified as having brought awareness to issues concerning evacuation routes.

The group was asked to identify any other natural hazards that it would like to address in this NHMP update. Extreme Heat, Pandemic and Dam Failure were identified as new hazards to address. When considering whether the two types of earthquake should be combined for the purposes of this NHMP, there was concern about doing so due to the local vs. statewide differences in the impacts that could be experienced with a crustal earthquake vs. a Cascadia Subduction Zone (CSZ) earthquake that may cause evacuees from the coast to move into Benton County. This would not be the case for a crustal earthquake.

The group began to consider the four factors used in the OEM Hazard Vulnerability Assessment methodology (History, Probability, Vulnerability and Maximum Threat). Using this methodology, the group reviewed the rankings for CSZ Earthquake and Flood. They then applied that methodology to Extreme Heat and to Pandemic. The remaining natural hazards will be ranked at the next meeting.

Katherine discussed the fact that there are multiple ways to assess risk and began to present the material available in the 2016 Benton County NHMP that addressed Critical Facilities. The participants were asked to be prepared to review and update this list of facilities with Katherine later in the process.

The group then turned their attention to further developing the public engagement strategy. The group agreed that a dedicated webpage on the County's website would be useful. Using social media posts and accessing subscriber lists of participant agencies was another method that was identified. The idea of holding open houses was improved upon by the suggestion that NHMP update information could be part of other more broadly focused public events.

The meeting adjourned at 4:30 pm.

Next meeting August 18th 2:30-4:30 pm

Figure B-13. September SC meeting agenda

Benton County Natural Hazard Mitigation Plan Update
Steering Committee Meeting

Vulnerability Assessment – Part 2

September 15, 2022
2:30 – 4:30 pm
Virtual meeting: https://meet.goto.com/471696037
By phone: (312) 757-3121
Access Code: 471-696-037

AGENDA

Introduction and Meeting Objectives 2:30-2:40

- Introductions
- Review and accept meeting notes from 6/23/22 and 7/21/22 meetings
- Meeting Objectives
  - Project updates
  - Complete the Hazard Vulnerability Assessment (HVA)
  - Identify opportunities for public outreach on Risk Assessment/HVA

Project Updates 2:40-2:50

- IGA update
- Request additions to Steering Committee participants as interested parties to represent a broad range of sectors including representatives of community lifelines and non-profits that support underserved communities.

Complete Hazard Vulnerability Assessment 2:50 – 4:00

- Review method used and progress made in July
- Complete Hazard Vulnerability Assessment using the OEM Methodology factors History, Probability, Vulnerability, and Maximum Threat

Discussion about impact of climate change; sample OCCRI reports 4:00 – 4:10

Public Engagement Strategy for Risk Assessment phase 4:10 – 4:25

- Strategies identified for public engagement and outreach
  - County hosted webpage for NHMP update project
  - Social media posts
  - Accessing subscriber lists
  - Upcoming events of which NHMP Risk Assessment can be a part
- What materials can DLCD assist in preparing for public engagement and outreach by prospective plan holders on Risk Assessment?

Wrap up

Next meeting: October 20, 2022 2:30-4:30 4:25 to end of meeting

Figure B-14. September 15, 2022 SC meeting notes

Benton County Natural Hazard Mitigation Plan Update
Steering Committee Meeting

Vulnerability Assessment – Part 2

September 15, 2022
2:30 – 4:30 pm
Virtual meeting: https://meet.goto.com/471696037
By phone: (312) 757-3121
Access Code: 471-696-037

Adopted Meeting Notes

Convener: Bryan Lee, Benton County Emergency Manager
Project Manager: Katherine Daniel, DLCD Natural Hazards Planner
Attendees:
Chelsea Chytka, Emergency Services Planner
Kim Webster, Wren Emergency Preparedness Council
Jay Tappen, Hoskins-Kings Valley RFPD
Inga Williams, Benton County Senior Planner
Laurel Byer, Benton County Public Works, Engineering Manager
Jason Yaich, Corvallis Community Development, Planning Manager
Garry Black, Philomath Public Works Operations
Phil Plaza, Alsea Preparedness Council
Loren Emang, Benton County Health Dept.
Dave Busby, Corvallis Fire Planning and Administration Division Chief
Kevin Fear, Philomath Public Works Director
Jude Geist, Corvallis Parks, Parks Supervisor
Steven Martinenko, Monroe Chief Operating Officer
Toby Lewis, Benton County Planning, Floodplain Administrator
Mike Bamberger, Oregon State University Emergency Manager
Aaron Manley, City of Corvallis, Public Works Development Review Supervisor
Chuck Perino, City of Albany, Emergency Manager

Introduction and Meeting Objectives

Bryan opened the meeting at 2:30 pm and Katherine called on participants to identify themselves as present for the meeting notes. She requested a motion for the adoption of the meeting notes from the 6/23/22 and 7/21/22 meetings. Dave Busby moved to adopt both sets of meeting notes and Toby Lewis seconded the motion.

Katherine provided brief updates on the signing of IGAs and led a brief discussion of how the Steering Committee could add participants who represent underserved populations in the county. It was noted that presence of a representative from the Benton County Health Department serves this purpose. There was a discussion about the use of translation to reach populations whose first language is not

English. Cory noted that translation into about ten languages, Spanish, Hmong and Arabic in particular was a need in the county to reach non-English speakers. How to reach the hearing impaired was also discussed.

The remainder of the meeting was spent completing the Hazard Vulnerability Assessment exercise developed by OEM and FEMA by ranking the factors History, Probability, Vulnerability, and Maximum Threat for all the natural hazards identified by the Steering Committee.

Katherine briefly mentioned the Oregon Climate Change Research Institute's work to develop reports on how future climate projections may impact natural hazards. She indicated that sample reports from OCCRI would be available in Box for the Steering Committee members to read.

The topic of Public Outreach was tabled in favor of completing the HVA exercise.

The meeting adjourned at 4:30 pm.

Next meeting: October 20, 2022 2:30-4:30 pm

Figure B-15. October 20, 2022 SC meeting agenda

Benton County Natural Hazard Mitigation Plan Update
Steering Committee Meeting

Risk Assessment

October 20, 2022
2:30 – 4:30 pm
Virtual meeting: https://meet.goto.com/471696037
By phone: (312) 757-3121
Access Code: 471-696-037

AGENDA

Welcome and Meeting Objectives 10 minutes

- Welcome and Introductions of new attendees
- Review and accept meeting notes 9/15/22
- Meeting Objectives
  - Project updates
  - Review results of Hazard Vulnerability Assessment
  - Risk Assessment: Critical Facilities
  - Identify opportunities for public outreach on Risk Assessment/HVA

Project Updates 10 minutes

- IGA's and Cost Share
- Steering Committee Roster
- Box contents tour (sample OCCRI reports, HVA)

Results of Hazard Vulnerability Assessment 20 minutes

Mapped Hazard Review 20 minutes

Critical Facilities Identification 20 minutes

Public Engagement Strategy for Risk Assessment phase 20 minutes

- Strategies identified for public engagement and outreach
  - County hosted webpage for NHMP update project
  - Social media posts
  - Accessing subscriber lists
  - Upcoming events of which NHMP Risk Assessment can be a part
- What materials can DLCD assist in preparing for public engagement and outreach by prospective plan holders on Risk Assessment?

What's next:

Individual conversations about mitigation strategies from 2016 plan or to develop a new strategy
Next meeting: November 17, 2022 2:30-4:30

Figure B-16. October 20, 2022 SC meeting notes

Benton County Natural Hazard Mitigation Plan Update
Steering Committee Meeting

Risk Assessment

October 20, 2022
2:30 – 4:30 pm
Virtual meeting: https://meet.goto.com/471696037
By phone: (312) 757-3121
Access Code: 471-696-037

Adopted Meeting Notes

Convener: Bryan Lee, Benton County Emergency Manager
Project Manager: Katherine Daniel, DLCD Natural Hazards Planner
Attendees:
Laurel Byer, Benton County Public Works, Engineering Manager
Inga Williams, Benton County Senior Planner
Toby Lewis, Benton County Planning, Floodplain Administrator
James Wright, Benton County Associate Planner
Phil Plaza, Alsea Preparedness Council
Kim Webster, Wren Emergency Preparedness Council
Loren Emang, Benton County Health Department
Jay Tappen, Hoskins-Kings Valley RFPD
Chris Workman, Philomath City Manager
Garry Black, Philomath Public Works Operations
Kevin Fear, Philomath Public Works Director
Rich Saalsaa, Philomath Fire and Rescue Deputy Fire Chief
Pat Hare, Adair Village City Administrator
Dave Busby, Corvallis Fire Planning and Administration Division Chief
Greg Gescher, Corvallis PW Assistant Manager
Jason Yaich, Corvallis Community Development, Planning Manager
Steven Martinenko, Monroe Chief Operating Officer
Chuck Perino, City of Albany, Emergency Manager
Cynthia Smidt, Dept of Land Conservation and Development Planner

Link to file sharing Box: https://dlcd.box.com/s/5dizc26byljv93dqlu0x2jbpodcjmgt9

Welcome and Meeting Objectives

Bryan opened the meeting at 2:32 pm and welcomed the participants. Katherine identified who she had recorded as present from the steering committee and introduced others attending for the time. She reviewed the content of the 9/15/2022 meeting notes and asked for a motion to adopt the meeting notes. Loren Emang so moved and Inga Williams seconded the motion. The meeting notes will be finalized and uploaded to Box, the file sharing website in use by the steering committee.

Katherine reviewed the meeting objectives which included the following:

- Project Updates
- Review the results of Hazard Vulnerability Assessment
- Risk Assessment: Critical Facilities
- Identify opportunities for public outreach on Risk Assessment/HVA

Project Updates

Katherine provided the participants with an update on cost share reporting. The State of Oregon authorized funding to cover the 25% cost share participants committed to providing through the Intergovernmental Agreements (IGAs). The steering committee members continue to be committed to participating in the process to develop a meaningful plan for each jurisdiction and district. Katherine reported that the jurisdictions which have not signed IGAs will receive revised IGAs removing the language regarding the 25% cost share obligation. The jurisdictions which have signed IGAs will be provided an email that identifies that the cost share obligation is no longer required.

An update on the Steering Committee roster consisted of a reviewed of the Steering Committee Roster for completeness by the participants and was used to demonstrate how to collaborate on a document through Box. Katherine also provided a short introduction to the current contents of the Box file sharing website for the project.

Results of Hazard Vulnerability Assessment

Katherine reviewed how the OEM Hazard Vulnerability Assessment was conducted and revealed the final scores for the natural hazards identified and subsequently ranked by the steering committee in the prior two meetings. Many of the participants were surprised by the top ranking of Pandemic/Endemic above all the other natural hazards. A copy of the HVA results is provided below.

Phil described the risk assessment inquiries he has been making among residents of Alsea and that in general Pandemic/Endemic has been ranked very low among those surveyed to date. The residents of Alsea rank Wildfire, Winter Storm, Landslide and Flood as the hazards of greatest concern to them. Pat echoed the sentiment that Pandemic/Endemic has not been the principle natural hazard of concern to residents of Adair Village. Dave conveyed that he would also rank Pandemic/Endemic lower than Winter Storm in terms of risks posed to people in Corvallis.

There was a discussion about why this apparently overly high ranking of Pandemic/Endemic was the result of the exercise. Bryan raised the point that the difference between the ranking of the natural hazards in 2015 using this same methodology resulted in a somewhat different prioritization. He opined that recent hazard events affect the relative importance of hazards among NHMP Steering Committee participants when completing this exercise and that the composition of the group doing the ranking also makes a difference in the results. He suggested that Pandemic/Endemic is more difficult to develop a mitigation strategy for. A participant opined that the relative weighting of the factors used in the OEM HVA exercise had an impact on the final results. Toby asking what the Steering Committee would use the HVA ranking for. Katherine responded that the HVA exercise is part of assessing risk and that it is used to prioritize implementation of mitigation strategies.

There were a few suggestions about how to revise the list to better reflect the views of the Steering Committee. Among these was to leave Pandemic/Endemic on the list but modify the relative ranking of

this hazard. A suggestion for a method to do this was to consult with the participants for each jurisdiction and district through one on one conversations with jurisdictions or districts represented by a few Steering Committee members (Adair Village, Monroe and Hoskins-Kings Valley RFPD) and using a survey approach for jurisdictions with more than a few participants (Philomath, Corvallis, Benton County) Katherine will undertake these conversations and prepare a short survey to reflect the content of those conversations in order to adjust the HVA results for each jurisdiction and district participant group.

Mapped Hazard Review: tabled until the next meeting

Critical Facilities Identification
Katherine reviewed the critical facilities identified by each of the cities in the 2016 Benton County Multi-Jurisdictional NHMP by using the Box to access that plan.

Public Engagement Strategy for Risk Assessment phase
Katherine reviewed the strategies identified in previous meetings for public engagement and outreach. These included

- County hosted webpage for NHMP update project
- Social media posts
- Accessing subscriber lists to inform
- Upcoming events of which NHMP Risk Assessment can be a part

Katherine noted that the public engagement and outreach work is to be led by the jurisdictions. Bryan indicated that he would like to organize a webinar to both provide information and to engage the public in providing input to the project. Katherine indicated that DLCDs role is to assist in public engagement and outreach and offered to provide materials as needed. She indicated that there was both a general one-sheet information document and a Benton County specific flyer in the Outreach folder in Box.

The meeting adjourned at 4:30 pm.

What's next:
Individual conversations about mitigation strategies from 2016 plan or to develop a new strategy
Next meeting: November 17, 2022 2:30-4:30

Figure B-17. November 17, 2022 SC meeting agenda

Benton County Natural Hazard Mitigation Plan Update
Steering Committee Meeting

Complete Risk Assessment

November 17, 2022
2:30 – 4:30 pm
Virtual meeting: https://meet.goto.com/471696037
By phone: (312) 757-3121
Access Code: 471-696-037

AGENDA

Welcome and Meeting Objectives 10 minutes

- Welcome and Introductions of new attendees
- Review and accept meeting notes 10/20/22
- Meeting Objectives
  - Project updates
  - Hazard Vulnerability Assessment survey
  - Review Mapped Hazards
  - What is mitigation?

Project Updates 15 minutes

- IGA's
- Steering Committee Roster
- Planning for public engagement on HVA results
- Schedule update

Hazard Vulnerability Assessment survey 40 minutes

Mapped Hazard Review 20 minutes

What is mitigation? 15 minutes

What's next:
Complete individual jurisdiction conversations about mitigation strategies from 2016 plan or to develop a new strategy

Next meeting: Suggest January 19, 2023 2:30-4:30 pm

Figure B-18. November 17, 2022 SC meeting notes

Benton County Natural Hazard Mitigation Plan Update
Steering Committee Meeting

Complete Risk Assessment

November 17, 2022
2:30 – 4:30 pm
Virtual meeting: https://meet.goto.com/471696037
By phone: (312) 757-3121
Access Code: 471-696-037

Meeting Notes

Convener: Bryan Lee, Benton County Emergency Manager
Project Manager: Katherine Daniel, DLCD Natural Hazards Planner
Attendees:
Chelsea Chytka, Emergency Management, Benton County
Laurel Byer, Benton County Public Works, Engineering Manager
Toby Lewis, Benton County Planning, Floodplain Administrator
Loren Emang, Benton County Health Department
Jay Tappen, Hoskins-Kings Valley RFPD
Garry Black, Philomath Public Works Operations
Kevin Fear, Philomath Public Works Director
Rich Saalsaa, Philomath Fire and Rescue Deputy Fire Chief
Greg Gescher, Corvallis PW Assistant Manager
Jason Yaich, Corvallis Community Development, Planning Manager
Albert Felker, Public Works Operations Chief, Corvallis
Jude Geist, Corvallis Parks, Parks Supervisor

Welcome and Meeting Objectives
Bryan Lee opened the meeting at 2:30 and Katherine reviewed the agenda for the meeting. Katherine reviewed the meeting notes for the October 20, 2022 meeting and asked for a motion to approve and a second to that motion. Loren moved to approve the meeting notes and Bryan seconded the motion. The meeting notes will be available in the project Box.

Project Updates
Katherine provided updates on the jurisdictions and districts that have signed IGA's with DLCD for the completion of the NHMP update, the composition of the steering committee and interested parties for the project. She noted that the steering committee roster is available in the Box. Katherine introduced the topic of planning for public engagement on the results of the hazard assessment that the steering committee will be working to refine for each jurisdiction and district. Bryan suggested acting on some of the ideas for public outreach using a survey and through the use of the county's website. It was agreed that this outreach would be initiated in the new year and accomplished ideally in February 2023. Katherine concluded the updates by providing an updated schedule with will also be available in the Box. She anticipates meetings in January, February and May with a possible wrap up meeting in June.

Hazard Vulnerability Assessment survey
The principal focus of the meeting was the review of the Hazard Assessment ranking exercise as a means for differentiating the importance of the `natural hazards being addressed in the plan on a more localized basis. Some of the Steering Committee members completed the ranking surveys developed for each of the cities and the Hoskins Kings Valley RFPD. Katherine provided an overview of these results and the group discussed how they show the relative risk as it varies across the county.

Mapped Hazard Review
Katherine provided a summary of the mapped hazards that are included in the 2016 Benton County NHMP and reviewed the available public sources for this mapping. Among the sites for these maps, Katherine demonstrated how the following map viewers show mapped natural hazards in Benton County.
TOPICS | oregonexplorer | Oregon State University
Wildfire Risk Explorer (oregonexplorer.info)

What is mitigation?
The meeting concluded with an overview of what mitigation is and a summary of the authorities for and categories that mitigation actions may fall under.

What's next:
Katherine indicated that she would be setting up meeting times to have conversations with each of the groups of jurisdiction and district representatives to discuss and update mitigation strategies from 2016 plan or to develop new strategies.

The meeting adjourned and the next meeting was anticipated for the third Thursday in January.

Figure B-19. March 2, 2023 SC meeting agenda

Benton County Natural Hazard Mitigation Plan Update
Steering Committee Meeting

Multi-hazard Risk Report

March 2, 2023
1:30 – 3:30 pm
Virtual meeting: Click here to join the meeting
Meeting ID: 216 378 629 071
Passcode: FgyfKr
Or call in (audio only)
+1 503-446-4951,,588602978# United States, Portland
Phone Conference ID: 588 602 978#

AGENDA

Welcome and Meeting Objectives 10 minutes

- Welcome and Introductions
- Review and accept meeting notes 11/17/22
- Meeting Objectives
  - Project updates
  - Multi-Hazard Risk Report, DOGAMI

Project Updates 30 minutes

- Project Outreach (survey, website)
- Critical Facilities list development

Multi-Hazard Risk Report, Matt Williams, Geohazard Analyst, DOGAMI 60 minutes

What's next:
Review of Critical Facilities lists and Risk Assessment section updates for the county. Katherine will be uploading these drafts to Box and sending you a link asking for your review.

Next meeting: Suggest March 23, 2023 2:30-4:30 pm (fourth Thursday)

Figure B-20. March 2, 2023 SC meeting notes

Benton County Natural Hazard Mitigation Plan Update
Steering Committee Meeting

Multi-Hazard Risk Report presentation

March 2, 2023
1:30 – 3:30 pm
Virtual meeting: Click here to join the meeting
Meeting ID: 216 378 629 071
Passcode: FgyfKr

Meeting Notes

(Note: This meeting was recorded and the recording is available in the project Box)

Convener: Bryan Lee, Emergency Manager, Benton County
Project Manager: Katherine Daniel, DLCD Natural Hazards Planner
Attendees:

- Chelsea Chytka, Emergency Management, Benton County
- Laurel Byer, Benton County Public Works, Engineering Manager
- Inga Williams, Benton County Planning, Senior Planner
- Toby Lewis, Benton County Planning, Sr. Floodplain Administrator
- James Wright, Benton County Planning, Associate Planner
- Loren Emang, Benton County Health Department
- Phill Plaza, Alsea Emergency Preparedness Council
- Kim Webster, Wren Emergency Planning Committee
- Jay Tappen, Hoskins-Kings Valley RFPD
- Rich Saalsaa, Philomath Fire and Rescue Deputy Fire Chief
- Steve Martinenko, City of Monroe, City Administrator
- Dave Busby, Corvallis Fire Planning and Administration Division Chief
- Greg Gescher, Corvallis PW Assistant Manager
- Matt Grassel, Corvallis Public Works
- Jason Yaich, Corvallis Community Development, Planning Manager
- Jude Geist, Corvallis Parks, Parks Supervisor
- Pat Hare, Adair Village, City Administrator
- Brandon Christensen, Oregon State University Emergency Planner
- Matt Williams, Department of Geology and Mineral Industries (DOGAMI)
- Cynthia Smidt, Department of Land Conservation and Development
- Patrick Wingard, Department of Land Conservation and Development
- Cliff Carpentier, Linn-Benton Community College
- Sheldon Flom, Linn-Benton Community College
- Pete Zerr, Linn-Benton Community College
- Adam Weaver, Linn-Benton Community College
- Jason J. Dorsette, Linn-Benton Community College

Welcome and Meeting Objectives

Katherine Daniel opened the meeting at 1:30 and reviewed the agenda for the meeting. Katherine introduced guest attendees. She asked the group to adopt the meeting minutes from the November 17, 2022 meeting. Rich Saalsaa moved to adopt them, and Jay Tappen seconded the motion. The meeting notes will be available in the project Box.

Project Updates

Chelsea Chytka provided an update on the progress being made on developing and disseminating the survey. Toby Lewis asked for information about how and whether Darren Nichols, Benton County Planning Director was able to participate in crafting the survey. Chelsea confirmed that he would be engaged in the development of the survey before launching it. Katherine responded to the question

about who would be leading the community outreach effort by indicating that this aspect of the process is to be led by the county, cities and special district participating in the plan.

Katherine has provided draft addenda for the cities and special district to review and requested feedback. The documents are available in the project Box along with a section of the county's Basic Plan for context.

Katherine showed the attendees the critical facilities list that Bryan had shared with her. It is extensive and includes additional detail about many of the structures. The origin of this list was unknown to Bryan, but Toby offered that the list may have been initiated by OSU's Michael Bamberger and built upon by county staff member Jamie Glass during the 2016 NHMP update.

Multi-Hazard Risk Assessment Report
Matt Williams, Geohazard Analyst for DOGAMI, presented to the group the background, methods and preliminary results of the Multi-Hazard Risk Report being conducted for the purpose of providing exposure analysis and anticipated losses from hazard events in Benton County. The report will be a principal source of data for the Risk Assessment of the NHMP.

Toby asked a question about whether loss estimates will be calculated for structures in Approximate Zone A Special Flood Hazard Areas. Matt confirmed that the lack of detail in the SFHA does not allow analysis at the detailed level that a detailed AE zone would allow. Toby expressed concern about the high number of structures in unincorporated county where this is the case. Matt agreed that it would be useful for him to include information about the number of structures in Approximate Zone A SFHA.

Katherine addressed the way critical facilities will be considered in the MHRA. Matt indicated that he can analyze substations and other structures, but not linear facilities like water or sewer lines, roads and bridges.

What's next:
The next meeting will be to host a presentation by the Oregon Climate Change Research Institute on the potential for future climate change impacts to exacerbate natural hazard events.

The meeting adjourned and the next meeting was anticipated for early April, but a specific date will be identified in the near future.

Figure B-21. April 11, 2023 SC meeting agenda

Benton County Natural Hazard Mitigation Plan Update
Steering Committee Meeting

Future Climate Projections report

April 11, 2023
2:00 – 3:00 pm
Virtual meeting: Click here to join the meeting
Meeting ID: 245 875 166 030
Passcode: oABSG6
Download Teams | Join on the web
Or call in (audio only)
+1 503-446-4951,,873683537# United States, Portland
Phone Conference ID: 873 683 537#

AGENDA

Welcome and Meeting Objectives 5 minutes

- Welcome and Introductions
- ~~Review and accept meeting notes 11/17/22~~
- Meeting Objectives
  - Project updates
  - Future Climate Projections report, OCCRI

Project Updates 10 minutes

- Project Outreach (survey, website)

Future Climate Projections, Benton County, 45 minutes
Erica Fleishman, Director, Oregon Climate Change Research Institute

What's next:
Survey and public engagement

Figure B-22. April 11, 2023 SC meeting notes

Benton County Natural Hazard Mitigation Plan Update
Steering Committee Meeting

Future Climate Projections report

April 11, 2023
2:00 – 3:00 pm
Virtual meeting: Click here to join the meeting
Meeting ID: 245 875 166 030
Passcode: oABSG6

Meeting Notes

Project Manager: Katherine Daniel, DLCD Natural Hazards Planner
Attendees:

- Chelsea Chytka, Emergency Management, Benton County
- Laurel Byer, Benton County Public Works, Engineering Manager
- Inga Williams, Benton County Planning, Senior Planner
- Toby Lewis, Benton County Planning, Sr. Floodplain Administrator
- Loren Emang, Benton County Health Department
- Phill Plaza, Alsea Emergency Preparedness Council
- Jay Tappen, Hoskins-Kings Valley RFPD
- Dave Busby, Corvallis Fire Planning and Administration Division Chief
- Greg Gescher, Corvallis PW Assistant Manager
- Matt Grassel, Corvallis Public Works
- Jason Yaich, Corvallis Community Development, Planning Manager
- Jude Geist, Corvallis Parks, Parks Supervisor
- Lisa Franklin, Corvallis Development Services
- Pat Hare, Adair Village, City Administrator
- Kevin Fear, Philomath Public Works Director
- Garry Black, Philomath Public Works Operations Supervisor
- Erica Fleishman, Oregon Climate Change Research Institute Director
- Perino, Chuck Perino, City of Albany Emergency Manager

Welcome and Meeting Objectives
Katherine Daniel opened the meeting at 2:00 and reviewed the agenda for the meeting. Katherine introduced guest attendees.

Project Updates
Chelsea Chytka provided an update on the progress being made on developing and disseminating the survey. Katherine urged jurisdictions to use the survey created by Chelsea to solicit public input within each city and the special district.

Future Climate Projections report
Erica Fleishman, Oregon Climate Change Research Institute Director presented the methods and results of the Future Climate Projections report for Benton County and took questions about this work.

What's next:
The meeting adjourned and the next meeting will be scheduled when the survey results are available.

Figure B-23. August 2, 2023 SC meeting agenda

Benton County Natural Hazard Mitigation Plan Update
Steering Committee Meeting

Public Outreach and Mitigation Strategies

August 2, 2023
1:00 – 2:00 pm
Virtual meeting: Click here to join the meeting
Meeting ID: 254 797 412 431
Passcode: fbFTNs
Download Teams | Join on the web
Or call in (audio only)
+1 213-357-4434,,989130114# United States, Los Angeles
Phone Conference ID: 989 130 114#

AGENDA

Welcome and Meeting Objectives 5 minutes

- Welcome and Introductions
- Review and accept meeting notes DATE(s)
- Meeting Objectives

Project Updates 10 minutes

Public Outreach survey results review 45 minutes
Chelsea Chytka and Bryan Lee, Benton County Emergency Management

Use this link to launch the survey in your community:
https://www.surveymonkey.com/r/9YRXWWS

Mitigation Strategy review 45 minutes
Katherine Daniel, DLCD project manager

Final Steps 20 minutes

Prior to submission for OEM review

- Internal review period will be open until a date certain
- Next (final?) meeting: My purpose is to seek Steering Committee agreement to submit for OEM review. The Steering Committee may choose to use it as an opportunity for public review. Hold as a noticed public meeting? Provide public review period as well?

Steps after that

- FEMA Review
- Local Adoption
- FEMA Approval letter is issued after first local adoption is provided to FEMA. This sets the effective dates of the plan for all jurisdictions and districts that adopt the plan subsequently.

Figure B-24. August 2, 2023 SC meeting notes

Benton County Natural Hazard Mitigation Plan Update
Steering Committee Meeting

Public Outreach and Mitigation Strategies

August 2, 2023
1:00 – 2:00 pm
Virtual meeting: Click here to join the meeting
Meeting ID: 254 797 412 431
Passcode: fbFTNs

Meeting Notes

Project Manager: Katherine Daniel, DLCD Natural Hazards Planner
Convener: Bryan Lee, Emergency Manager
Attendees:

- Chelsea Chytka, Benton County Sheriff's Office
- Laurel Byer, Benton County Public Works
- Inga Williams, Benton County Planning
- Loren Emang, Benton County Health Department
- Jay Tappen, Hoskins-Kings Valley RFPD
- Kim Webster, Wren Emergency Planning Committee
- Brandon Christensen, Oregon State University Emergency Planner
- Steve Martinenko, Monroe City Administrator
- Rich Saalsaa, Philomath Fire and Rescue, Deputy Fire Chief
- Dave Busby, Corvallis Fire Planning and Administration Division Chief
- Greg Gescher, Corvallis PW Assistant Manager
- Matt Grassel, Corvallis Public Works
- Jude Geist, Corvallis Parks, Parks Supervisor
- Pat Hare, Adair Village, City Administrator

Welcome and Meeting Objectives
Katherine Daniel opened the meeting at 1:03 and reviewed the agenda for the meeting. She reviewed the meeting notes provided to the Steering Committee for the March 2, 2023 and April 11, 2023 meetings and asked for motions to adopt those meeting notes. No corrections were offered. For the March meeting notes, Rich Saalsaa moved to adopt them and Dave Busby seconded the motion. For the April meeting notes, Jay Tappen moved to adopt them and Pat Hare seconded the motion.

Katherine described the objectives of this meeting and turned the floor over to Chelsea Chytka and Bryan Lee.

Public Outreach survey results review
Chelsea informed the group that the survey had been launched in both English and Spanish and that the Benton County Health Department provided assistance in disseminating the survey through its contact lists as a way to reach more vulnerable individuals in the county. Both a link to the survey and a QR code were provided as methods for members of the public to access the survey.

Chelsea summarized the results to date and Bryan advised the group that the survey would be open until the end of August. Steering Committee members were urged to use the link and the QR code to solicit members of the public and interested parties to the plan development process to take the survey.

Mitigation Strategy review

Katherine summarized the progress made to date in small group meetings with each of the cities and the HKV RFPD to review or develop mitigation strategies to address the natural hazards of most concern to these jurisdictions. Mitigation strategy actions from the 2016 NHMP are being reviewed and revised to include specific, measurable, actionable, realistic and time sensitive (or SMART) mitigation action descriptions to the extent possible. The components of the mitigation strategy action work sheet were reviewed with the group. These include the action item description, the status of that action (for example descriptors such as complete, retained, progressing, removed), the coordinating and partner organizations, the timeline of the action and an assignment of priority.

Katherine asked the group how they would identify a high priority action. Aspects of a high priority action identified included actions that need to be taken or begun in the short term, or actions that would affect a large number of people. The severity of the hazard that the action addresses and the extent to which the action will lessen the impact of the hazard were also identified as being key features of high priority actions.

Mitigation strategy actions from the 2016 NHMP are the same across all the jurisdictions and Katherine described her work to make each jurisdictions' mitigation strategies reflect the specific work needed to reduce risk to the community. She provided an example of how the cities of Monroe and Philomath differentiated the implementation of the same 2016 mitigation strategy action as appropriate to their communities.

The capacity of jurisdictions to accomplish mitigation action items was discussed to provide additional information to the plan about how best to implement the mitigation strategy in Benton County. Staffing that allows jurisdictions to complete applications for grant funding and, if successful in winning the grant, staffing to manage the grant are limitations on the county's ability to implement mitigation actions. The cost share requirement to supply 25% of the grant amount from non-federal funds is also a challenge that limits jurisdictions' ability to implement mitigation strategies.

Katherine requested that representatives for each of the cities, the HKV RFPD and the county take time to review the draft sections of the plan as they become available. Katherine will post them in the Box file sharing site and also provide them by email if they are small enough. When the draft is satisfactory to the Steering Committee it will be provided to OEM for an initial review. Following any changes or edits requested by OEM, the draft will be forwarded to FEMA region 10 for final review. FEMA provides a provisional letter of approval called the Approval Pending Adoption letter (APA). At that point, the decision-making body of each jurisdictions (city councils, Board of County Commissioners or special district board) will adopt the plan through a resolution. The project manager will provide these resolutions to OEM/FEMA and that will trigger the issuance of the final letter of approval. The date of the first resolution of approval sets the effective dates of the plan for all jurisdictions and districts that adopt the plan subsequently.

Katherine inquired of the group how they would like to proceed in finalizing the draft plan. The consensus was to come to agreement on the draft plan as a Steering Committee before inviting elected officials or members of the public to a final meeting for the purpose of weighing in on the draft plan.

Next meeting date will be determined shortly and provided by email invitation to the Steering Committee.

Figure B-25. September 6, 2023 meeting agenda

Benton County Natural Hazard Mitigation Plan Update
Steering Committee Meeting

Finalizing the draft

September 6, 2023
1:00 – 2:30 pm
Virtual meeting: Click here to join the meeting
Meeting ID: 216 875 471 282
Passcode: Xqfj6T
Download Teams | Join on the web
Or call in (audio only)
+1 213-357-4434,,984714112# United States, Los Angeles
Phone Conference ID: 984 714 112#

AGENDA

Welcome and Meeting Objectives • Welcome and Introductions • Review and accept 8/2/23 meeting notes • Meeting Objectives	5 minutes
OCCRI Final Consultation	15 minutes
Public Outreach survey results summary Chelsea Chytka and Bryan Lee, Benton County Emergency Management	15 minutes
Mitigation Strategy review Katherine Daniel, DLCD project manager	30 minutes
Next Steps	20 minutes

Final drafts are available for review in the project Box at this link
https://dlcd.box.com/s/hmsvnr2oezfxrt586jxv3dtvsf3z78f1

Figure B-26. September 6, 2023 meeting notes

Benton County Natural Hazard Mitigation Plan Update
Steering Committee Meeting

Finalizing the draft

September 6, 2023
1:00 – 2:30 pm
Virtual meeting: Click here to join the meeting
Meeting ID: 216 875 471 282
Passcode: Xqfj6T

Meeting Notes

Project Manager: Katherine Daniel, DLCD Natural Hazards Planner
Convener: Bryan Lee, Emergency Manager
Attendees:

Chelsea Chytka, Benton County Sheriff's Office
Laurel Byer, Benton County Public Works
Toby Lewis, Benton County Planning
Kim Webster, Wren Emergency Planning Committee
Steve Martinenko, Monroe City Administrator
Rich Saalsaa, Philomath Fire and Rescue, Deputy Fire Chief
Dave Busby, Corvallis Fire Planning and Administration Division Chief
Jude Geist, Corvallis Parks, Parks Supervisor
Pat Hare, Adair Village, City Administrator
Erica Fleishman, OCCRI

Welcome and Meeting Objectives
Bryan opened the meeting at 1:00 pm. Katherine introduced Erica Fleishman from the Oregon Climate Change Research Institute and reviewed the meeting objectives.

OCCRI Final Consultation
Erica reviewed the Future Climate Projections report briefly and thanked the group for their feedback on the report.

Public Outreach survey results summary
Chelsea and Bryan reviewed the survey results and thanked the participants for disseminating the survey through their local channels. It boosted the number of responses significantly. However, the Spanish language version still had not received any responses despite dissemination to Spanish speaking populations within the county by the health department staff who identified at least three specifically Spanish speaking groups who received the survey. Several participants identified their intention to continue to spread the survey until it is closed.

The group discussed the differences between the Steering Committee's Risk Assessment and those highlighted in the survey. The group concluded that the higher importance of drought may be a result of the time of year the survey was launched. The public may be responding to the dry conditions experienced during the summer months. It was observed that drought and wildfire may be connected in the public's mind. The group concluded, however, that these results did not prompt them to change their initial assessments of risk.

Mitigation Strategy review

Katherine discussed the need to complete mitigation strategy actions by including lead agencies or positions within jurisdictions and to prioritize the actions. The importance of identifying funding sources was also noted based on recent FEMA plan reviews. The participants will work with Katherine independently to complete these aspects of the mitigation strategy.

Next Steps

The group decided to complete the draft and submit it to OEM for review. At that point the group would re-convene one more time to address any substantive comments from OEM and to determine readiness of the draft for release to elected officials and the public for final comments.

Final drafts are available for review in the project Box at this link
https://dlcd.box.com/s/hmsvnr2oezfxrt586jxv3dtvsf3z78f1

APPENDIX C: COMMUNITY PROFILE

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BENTON COUNTY COMMUNITY PROFILE

Community resilience can be defined as the community's ability to manage risk and adapt to natural hazard impacts. In order to help define and understand the county's sensitivity and resilience to natural hazards, the following capacities must be examined:

- **Natural Environment**
- **Socio-Demographic**
- **Economic**
- **Built Environment**
- **Community Connectivity**
- **Political**

The Community Profile describes the sensitivity and resilience to natural hazards of Benton County, and its incorporated cities, as they relate to each capacity. It provides a snapshot in time when the plan was updated in 2023 and will assist in preparation for a more resilient county. The information in this section, along with the hazard assessments located in the Hazard Annex, should be used as the local level rationale for the risk reduction actions identified in Section 3 – Mitigation Strategy. The identification of actions that reduce the county's sensitivity and increase its resiliency assist in reducing overall risk of disaster, the area of overlap in the figure below.

Natural Environment Capacity

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.[1] 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 and Climate

Benton County is located in western Oregon and covers about 669 square miles. The geography, topography, climate, and other natural attributes such as vegetation vary significantly with location in Benton County. The geographic diversity of Benton County is an important factor to consider in mitigation planning for natural and human-caused hazards.

For hazard mitigation planning, we consider two main physiographic regions within Benton County, based on nomenclature commonly used by the National Weather Service:

- The Coast Range in the western Benton County has a relatively small population, and is characterized by steep slopes, forestland, and the highest levels of annual precipitation in the county.
- The Willamette Valley in eastern Benton County is characterized by flat or gently hilly topography. This is the most populated area of Benton County.

The average annual rainfall in Benton County is about 43 inches. Average annual snowfall in the valley is about 7 inches. At higher elevations in the Coast Range, temperatures are typically lower, with much higher levels of precipitation (see Table C-1 and Figure C-2 below). Additionally, major rivers in Benton County include the Willamette River, the Alsea

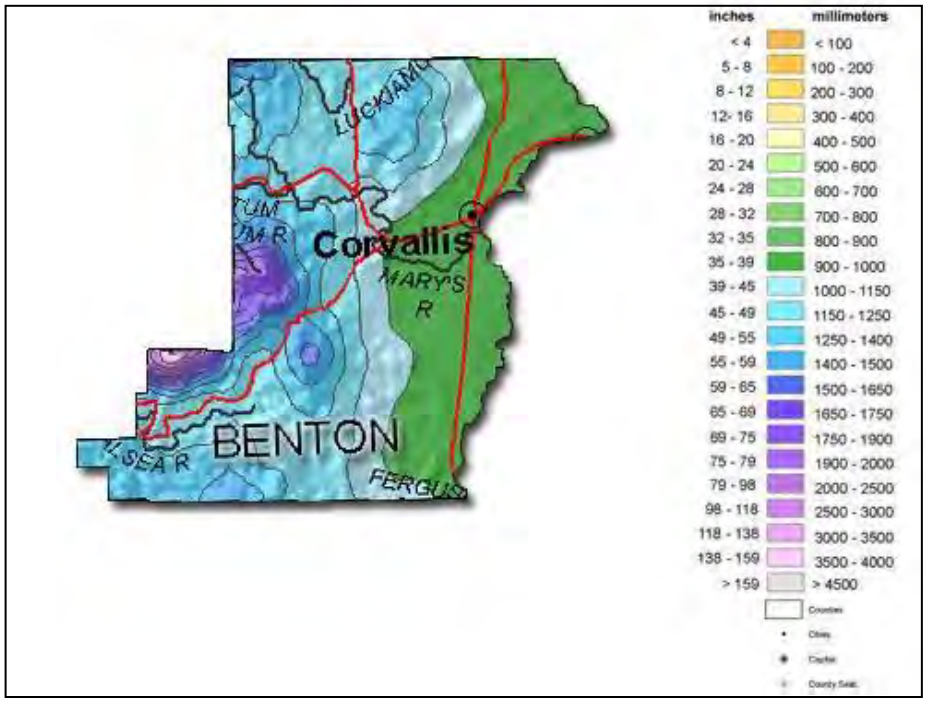
River and the Marys River.

Table C-1. Average Rainfall and Temperatures

Ecoregion	Mean Annual Rainfall Range (inches)	Mean Temperature Range (°F) January min/max	Mean Temperature Range (°F) July min/max
Coast Range			
Volcanics	70-200	30/46	50/76
Mid-Coastal Sedimentary	60-130	32/48	48/78
Willamette Valley			
Gallery Forest	40-50	33/46	50/85
Prairie Terraces	40-50	33/46	51/85
Valley Foothills	45-60	32/46	50/80

Source: US EPA. Ecoregions of Oregon

Figure C-1. Benton County Average Annual Precipitation



Source: The Oregon Climate Service, NOAA Climate Stations. "1971-2000 Climate of Benton County"

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

Total precipitation in the Pacific Northwest region may remain similar to historic levels but climate projections indicate the likelihood of increased winter precipitation and decreased summer precipitation.[2]

Increasing temperatures affects hydrology in the region. 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.[3]

Synthesis

The physical geography, weather, climate, and land cover of an area represent various interrelated systems that affect overall risk and exposure to natural hazards. The projected climate models representing the Willamette Valley indicate the potential for increased effects of hazards, particularly drought and wildfire. The Willamette Valley is projected to have warmer and drier summers with less precipitation. In addition, winter temperatures will be warmer, which means a decrease in mountain snowpack. These factors combined with periods of population growth and development intensification can lead to increasing risk of hazards, threatening loss of life, property, and long-term economic disruption if land management is inadequate.

Social/ Demographic Capacity

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

Population

Corvallis accounts for just under two-thirds of the county's population, another 20% live in unincorporated areas, while the remaining 15% is spread among the remaining three incorporated cities. Between 2010 and 2014, Benton County experienced a 3.5% increase in population. The County Coordinated Population Forecast projects that by 2035 Benton County's population will increase to 101,848, an 14.8% increase from the 2014 estimate.[4]

[2] Ibid.

[3] Mote, Philip W., et. al., "Variability and trends in Mountain Snowpack in Western North America," http://cses.washington.edu/db/pdf/moteetalvarandtrends436.pdf

Table C-2. Population Estimates for Benton County Cities

Jurisdiction	2010 Population	2010 Percent of County	2014 Population	2014 Percent of County	2022 Population	2022 Percent of County
Adair Village	840	1.0%	845	1.0%	1,370	1.4%
Albany*	6,587	7.7%	7,146	8.1%	9,220	9.6%
Corvallis	54,460	63.5%	56,535	63.7%	59,434	62.2%
Monroe	615	0.7%	620	0.7%	723	0.7%
Philomath	4,590	5.4%	4,630	5.2%	5,653	5.9%
Sub-Total	*67,092*	*78.3%*	*69,776*	*78.6%*	*76,400*	*79.9%*
Unincorporated	18,643	21.7%	18,964	21.4%	19,194	*20.0%*
Benton Total	85,734	100%	88,740	100%	95,594	*100%*

Source: Portland State University, Population Research Center, "Annual Population Estimates", 2014 and 2022.
* The majority of Albany's population is within Linn County.

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

Tourists

Tourists are not counted in population statistics; and are therefore considered separately in this analysis. The table below shows the estimated number of person nights in private homes, hotels and motels, and other types of accommodations. The table below from the 2016 MNHMP shows that, between 2012-2014, just under two-thirds of visitors in Benton County lodge in private homes, with just under one-third staying in hotels/ motels, the remaining visitors stay in other accommodations (vacation homes/ campgrounds). Visitors staying at hotel/ motels are less likely to benefit from local preparedness outreach efforts aimed at residents.

Table C-3. Annual Visitor Estimates in Person Nights 2012-2014

	2012 Person-Nights (1,000's)	2012 Percent	2013 Person-Nights (1,000's)	2013 Percent	2014 Person-Nights (1,000's)	2014 Percent
Benton	1,381	100%	1,401	100%	1,387	100%
Hotel/Motel	421	30%	442	32%	434	31%
Private Home	879	64%	875	62%	869	63%
Other	80	6%	83	6%	84	6%

Source: Oregon Tourism Commission, Oregon Travel Impacts: 1991-2014, Dean Runyan Associates

[4] Office of Economic Analysis. Long Term County Forecast.

Tourists are specifically vulnerable due to the difficulty of locating or accounting for travelers within the region. Tourists are often at greater risk during a natural disaster because of unfamiliarity with evacuation routes, communication outlets, or even the type of hazard that may occur. Knowing whether the region's visitors are staying in friends/ relatives homes in hotels/ motels, or elsewhere can be instructive when developing outreach efforts.[5]

Language

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

There are various languages spoken across Benton County; the primary language is English. Overall, 3.5% of the total population in Benton County is not proficient in English. Corvallis (2,574) has the largest population of residents who do not speak English "very well"; while Monroe (6.7%) has the greatest percentage of its population that does not speak English "very well". Outreach materials used to communicate with, plan for, and respond to non-English speaking populations, and those who do not speak English very well, should take into consideration the language needs of these populations.

Table C-4. Benton County Language Barriers

Population 5 years and over		Speak English less than "very well"	
	Estimate	Estimate	Percent
Benton County	90,932	4,140	4.6%
Adair Village	998	74	7.4%
Albany*	51,556	1,737	3.4%
Corvallis	57,416	3,426	6.0%
Monroe	757	63	8.3%
Philomath	5.050	189	3.7%

Source: U.S. Census Bureau, American Community Survey, 2021 5-year estimates Table S1601.
Note: The color of the number represents the change since the 2016 MNHMP. Increase, Decrease and No Change
* The majority of Albany's population is within Linn County.

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

Race

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

The majority of the population in Benton County identifies as racially white (76%); Corvallis and Albany have the largest percentage of people who do not identify as white, while the City of Monroe has the largest percentage of people who identify as Latino or Hispanic.

Table C-5. Benton County Racial Composition

	Benton County	Adair Village	Albany*	Corvallis	Monroe	Philomath
Total Population	95,184	994	56,472	59,922	647	5,350
White	75.8%	75.3%	75.8%	71.4%	70.9%	80.7%
Black or African American	1.0%	1.5%	0.8%	1.2%	0.2%	0.7%
American Indian and Alaska Native	0.5%	0.8%	0.9%	0.5%	1.1%	1.0%
Asian	6.7%	3.1%	1.7%	8.6%	0.8%	1.7%
Native Hawaiian and Other Pacific Island	0.3%	0.3%	0.3%	0.3%	0.3%	0.1%
Some Other Race	0.6%	0.1%	0.5%	0.6%	0.0%	0.2%
Two or More Races	6.1%	8.0%	5.9%	6.2%	7.7%	6.3%
Population with Hispanic or Latino identity	8,524	107	7,949	6,061	123	487
Percent Hispanic or Latino identity	9.0%	1.7%	14.1%	10.1%	19.0%	9.1%

Source: U.S. Census Bureau, 2020 Decennial Census, Table P9

* The majority of Albany's population is within Linn County.

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

Age

Of the factors influencing socio-demographic capacity, the most significant indicator in Benton County may be age of the population. As depicted in the table below, as of 2021, 16.3% of the county population is over the age of 65 up from 13.2% in 2014. The proportion of the population aged 65 or over is projected to rise to 17.9% by 2035. The Benton County age dependency ratio[8] is 48.2, up from 37.2 in 2014.; Adair Village continues to top the cities in Benton county having the highest Age Dependency Ratio at 74.2 based on the ACS 5-year estimates in 2021. This is up from 54.3 in 2014. Corvallis still has the lowest ratio, 36.3, although it too has increased from 29.5 in 2014.

The age dependency ratio indicates a higher percentage of dependent aged people to that of working age. The county's population has becoming more dependent on its working age population since 2014.

Table C-6. Benton County Population by Vulnerable Age Groups

Jurisdiction	Total	< 15 Years Old		> 65 Years Old		Age Dependency Ratio
		Number	Percent	Number	Percent	
Benton County	94,667	12,433	13.1%	15,390	16.3%	48.2
Adair Village	1,054	260	24.7%	116	11.0%	74.2
Albany*	55,776	11,760	21.1%	82,62	14.8%	67.3
Corvallis	59,407	6,630	11.2%	7,794	13.1%	36.3
Monroe	792	182	23.0%	123	15.5%	75.2
Philomath	5,353	1,100	20.1%	683	12.8%	59.7
2035						
Oregon	4,995,200	865,889	17.3%	1,082,781	21.7%	64.0
Benton County	101,846	13,589	13.3%	18,220	17.9%	45.4

Source: U.S. Census Bureau, 2021 5-year estimates, American Community Survey Table DP05 (Note: colors added by author to indicate change since the 2016 MNHMP of the same data. Increase, and Decrease); Office of Economic Analysis, Department of Administrative Services, Long Term County Forecast, "State and County Population Forecasts by Age and Sex, 2000-2040".
* The majority of Albany's population is within Linn County.

The age profile of an area has a direct impact both on what actions are prioritized for mitigation and how response to hazard incidents is carried out. School age children rarely make decisions about emergency management. Therefore, a larger youth population in an area will increase the importance of outreach to schools and parents on effective ways to teach children about fire safety, earthquake response, and evacuation plans. Furthermore,

[6] U.S. Census Bureau, 2010-2014 American Community Survey, Table DP05

[7] Ibid.

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

children are more vulnerable to the heat and cold, have few transportation options and require assistance to access medical facilities. Older populations may also have special needs prior to, during and after a natural disaster. Older populations may require assistance in evacuation due to limited mobility or health issues. Additionally, older populations may require special medical equipment or medications, and can lack the social and economic resources needed for post-disaster recovery.[1]

Families and Living Arrangements

Two ways the census defines households are by type of living arrangement and family structure. A householder may live in a "family household" (a group related to one another by birth, marriage or adoption living together); in a "nonfamily household" (a group of unrelated people living together); or alone. Benton County is predominately comprised of family households. Of all households, 31.2% are one-person non-family households (householder living alone) up from 28.6% in 2014. Corvallis (7,398, 30.9%) has the highest percentage, and largest population, of householders living alone. Corvallis also has the largest population, of people 65 years or older living alone (2,355 people, 9.8% of the population). Albany has a similar number of people 65 years or older or living alone, but a higher proportion of the population (2,233 people, 10.6% of the population).

This data is relevant to natural hazard mitigation planning in that older people living alone may require assistance to evacuate should that be necessary. The county has seen an increase in householders living alone who are 65 years old or older. The City of Adair Village has seen a dramatic increase in the percentage of this population rising from 2.6% in 2014 to 8.0% in 2021 based on the ACS 5-year estimates.

Table C-7. Householder Living Alone

	Total Households Estimate	Householder Living Alone		Householder Living Alone > 65	
		Estimate	Percent	Estimate	Percent
Benton County	38,831	12,112	31.2%	4,415	11.4%
Adair Village	338	56	16.6%	27	8.0%
Albany*	20,880	5,328	25.7%	2,223	10.6%
Corvallis	23,952	7,398	30.9%	2,355	9.8%
Monroe	281	71	25.3%	19	6.8%
Philomath	2,040	477	23.4%	107	5.2%

Source: U.S. Census Bureau, 2021 5-year estimates, American Community Survey, Table DP02
* The majority of Albany's population is within Linn County.

Household structure is another relevant demographic aspect of resilience. Table C-6 below shows household structures for families with children. The 2020 Census data shows a drop to 20.4% of family households that have children, down from nearly 22% reported in the 2016 MNHMP. Adair Village continues to have the highest percentage of family households with children among the jurisdictions (2020 Census reports 42%, down from 63.7%). Apart from Albany, which has a larger population in Linn County, Corvallis has the largest number

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

of families among the jurisdictions although the percentage of family households with children has decreased from the data reported in the 2016 MNHMP. There are about three times as many single parent households that are headed by females than by males in Benton County. Adair Village has the highest percentage of single parent households, while Corvallis has the second largest number following Albany. These people will likely require additional support during a disaster and may place strain the system if insufficiently provided for.

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

Total Households Estimate		Family Households with Children		Single Parent (male)		Single Parent (female)	
		Estimate	Percent	Estimate	Percent	Estimate	Percent
Benton County	37,447	7,649	20.4%	442	1.2%	1,139	3.0%
Adair Village	340	144	42.4%	9	2.6%	17	5.0%
Albany*	22,157	4,948	26.8%	363	1.6%	1,039	4.7%
Corvallis	23,876	4,188	17.5%	299	1.3%	773	3.2%
Monroe	257	61	23.7%	3	1.0%	5	1.9%
Philomath	2,102	600	28.5%	36	1.7%	108	5.1%

Source: U.S. Census Bureau, 2020 Decennial Census, Table DP1,
Note: The color of the number represents the change since the 2016 MNHMP. Decrease, Increase and No Change
Note: The table shows the percent of total households represented by each family household structure category.
* The majority of Albany's population is within Linn County.

Income

Household income and poverty status are indicators of socio-demographic capacity and the stability of the local economy. Household income can be used to compare economic areas as a whole but does not reflect how the income is divided among the area residents. The 2014 median household income across Benton County was $49,338; this was lower than the inflation adjusted 2010 figure, representing a 5.6% decline in real incomes during the prior plan development. No comparable analysis was completed during the 2022-23 update process.

Adair Village and Philomath continue to have the highest median household incomes, while Monroe and Corvallis have the lowest median household incomes.

Table C-9. Median Household Income

	Median Household Income	
	2014**	2022
Benton County	$ 49,338	$68,524
Adair Village	$ 58,542	$80,833
Albany*	$ 45,478	$65,587
Corvallis	$ 40,425	$58,315
Monroe	$ 37,576	$54,417
Philomath	$ 55,176	$70,806

Source: U.S. Census Bureau, 2010-2014 American Community Survey, and 2022 ACS 1-year estimates, US Census, Table DP03.
* The majority of Albany's population is within Linn County.
** no adjustment made for inflation.

The table below identifies the percentage of individuals and children under 18 that are below the poverty level in 2014. It is estimated that 22.7% of individuals and 14.1% of children under 18 live below the poverty level across the county. Corvallis (29.5%, 14,720) has the highest rate, and total population, in poverty, while also having the largest population of children under 18 in poverty, 1,345 (excluding Albany). Philomath (18.1%) and Adair Village (17.5%) have the highest poverty rates for children (excluding Albany).

Table C-10. Poverty Rates

	Total Population in Poverty		Children Under 18 in Poverty	
	Number	Percent	Number	Percent
Benton County	18,891	20.7%	2,252	15.4%
Adair Village	32	3.0%	0	0%
Albany*	5,994	11.1%	1,812	14.2%
Corvallis	13,795	25.6%	1,502	19.2%
Monroe	65	8.4%	0	0%
Philomath	319	6.0%	46	3.6%

Source: U.S. Census Bureau, 2022 1-year estimates, American Community Survey, Table S1701.
Note: The color of the number represents the change since the 2016 MNHMP. Decrease, and Increase
* The majority of Albany's population is within Linn County.

Although poverty in general has decreased across the board in Benton County since the analysis performed for the 2016 NHMP, poverty among children has increased in Corvallis and consequently for the county as a whole. This is despite drastic reductions in Adair Village and Monroe where no children under 18 were in poverty as estimated by the ACS 1-year estimates in 2022.

Research suggests that lack of wealth contributes to social vulnerability because individual and community resources are not as readily available. Affluent communities are more likely to have both the collective and individual capacity to more quickly rebound from a hazard event, while impoverished communities and individuals may not have this capacity which leads to increased vulnerability. Wealth can help those affected by hazard incidents to absorb the impacts of a disaster more easily. Conversely, poverty, at both an individual and community level, can drastically alter recovery time and quality.[2][10]

Federal assistance programs such as food stamps are another indicator of poverty or lack of resource access. Statewide social assistance programs like the Supplemental Nutritional Assistance Program (SNAP) and Temporary Assistance for Needy Families (TANF) provide assistance to individuals and families. In Benton County, 17.9% of children are living in households receiving SSI or food stamp assistance.[3] Those reliant on federal assistance are more vulnerable in the wake of disaster because of a lack of personal financial resources and reliance on government support.

[2] Cutter, S. L. (2003). Social Vulnerability to Environmental Hazards. *Social Science Quarterly*.
[3] 2021 American Community Survey 5-year estimates

Education

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

According to the U.S. Census, 94.9% of the Benton County population over 25 years of age has graduated from high school or received a high school equivalency, with 55.8 going on to earn a bachelor's degree up from 51.4% as reported in the 2016 Community Profile. Monroe (88.4%) has the lowest percentage of high school graduates. Corvallis has the highest percentage of their population with a bachelor's degree or higher, and Monroe (6.2%) has the lowest percentage.

Table C-11. Educational Attainment

Jurisdiction	Benton County	Adair Village	Albany*	Corvallis	Monroe	Philomath
Population 25 years and over	60,509	662	36,541	32,432	528	3,427
Less than 9th grade	1.5%	1.5%	2.7%	1.8%	5.9%	0.7%
9th to 12th grade, no diploma	2.2%	3.3%	5.1%	1.9%	7.2%	3.2%
High school graduate or GED	14.4%	12.1%	23.3%	10.2%	29.4%	18.0%
Some college, no degree	19.9%	18.1%	30.7%	18.0%	27.3%	21.5%
Associate's degree	8.6%	10.3%	11.0%	8.5%	6.3%	11.1%
Bachelor's degree	28.6%	36.4%	18.7%	29.8%	16.5%	26.5%
Graduate or professional degree	24.8%	18.3%	8.6%	29.9%	7.6%	19.0%
Percent without High School Degree	*3.7%*	*4.8%*	*7.8%*	*3.7%*	*13.1%*	*3.9%*
Percent High School Graduate or Higher	*94.9%*	*95.2%*	*92.3%*	*96.4%*	*86.9%*	*96.1%*
Percent Bachelor's Degree or Higher	*55.8%*	*54.7%*	*27.3%*	*59.6%*	*24.1%*	*45.5%*

Source: U.S. Census Bureau, 2021 5-year estimates American Community Survey, Table S1501.
Note: The color of the number represents the change since the 2016 MNHMP. Decrease, and Increase
* The majority of Albany's population is within Linn County.

Health

Human well-being, cultural and social attributes of a population contribute to the analysis of baseline resilience to natural hazards. Individual and community health play an integral role in community resiliency.

The University of South Carolina Hazards Vulnerability & Resilience Institute (HVRI) developed Baseline Resilience Indicators for Communities (BRIC) that considers six broad categories of community disaster resilience: social, economic, community capital, institutional, infrastructural, and environmental at the county level. Used as an initial baseline for monitoring existing attributes of resilience to natural hazards, BRIC can be used to compare places to one another, to determine the specific drivers of resilience for counties, and to monitor improvements in resilience over time. [4] People who have higher vulnerability to

[4] HVRI Data and Resources - College of Arts and Sciences | University of South Carolina

hazards will likely require additional community support and resources.

The table below describes disability status of the population. As of 2014, 10.4% of the Benton County non-institutionalized population identifies with one or more disabilities. Monroe has the highest percentage of it's total population with a disability (17.7%) and also the highest percentage of individuals 65 years and over with a disability (36.4%). The highest percentage (excluding Albany) of individuals under 18 years with a disability are in Adair Village (7.1%), while the largest number (excluding Albany) are in Corvallis (254).

Table C-12. Disability Status

	Total Population^	With a disability		>18 years with a disability		65 years and over with a disability	
	Estimate	Estimate	Percent	Estimate	Percent^^	Estimate	Percent^^
Benton County	94,454	10,685	11.3%	535	3.5%	4,255	27.8%
Adair Village	1,054	77	7.3%	3	0.9%	26	22.4%
Albany*	55,219	8,579	15.5%	1,052	7.5%	2,841	35.3%
Corvallis	59,229	6,313	10.7%	341	0.7%	2,273	29.5%
Monroe	792	135	17.0%	50	23.0%	36	29.3%
Philomath	5,342	539	10.1%	9	0.7%	237	34.7%

Source: U.S. Census Bureau, 2021 5-year estimates, American Community Survey, Table C18108.
^Non-institutionalized population, ^^Percent of age group
* The majority of Albany's population is within Linn County.

In January 2020 Community Services Consortium (CSC) supervised a point-in-time count of homeless individuals in Lincoln, Benton, and Linn counties. The CSC study found that 233 individuals in Benton County identify as homeless; 104 were sheltered whereas 127 were unsheltered.[5]

Synthesis

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

Economic Capacity

Economic capacity refers to the financial resources present and revenue generated in the community to achieve a higher quality of life. Income equality, housing affordability, economic diversification, employment and industry are measures of economic capacity. However, economic resilience to natural disasters is far more complex than merely restoring employment or income in the local community. Building a resilient economy requires an understanding of how the component parts of employment sectors, workforce, resources

[5] Benton County Health Dept., Community Services Consortium Point in Time count, 2020; 2020_pit_count_-_linn_benton_lincoln_co_-_comparative_-_200612_autosaved.pdf

and infrastructure are interconnected in the existing economic picture. Once any inherent strengths or systematic vulnerabilities become apparent, both the public and private sectors can take action to increase the resilience of the local economy.

Regional Affordability

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

Income Equality

Income equality is a measure of the distribution of economic resources, as measured by income, across a population. It is a statistic defining the degree to which all persons have a similar income. The table below illustrates the county and city level of income inequality. The Gini index is a measure of income inequality. The index varies from zero to one. A value of one indicates perfect inequality (only one household has any income). A value of zero indicates perfect equality (all households have the same income).[6]

The GINI index range for the cities within the county varies from a higher inequality index calculated for the City of Corvallis. The lowest income inequality was calculated for the City of Adair Village.

The relevance to natural hazard mitigation is based on social science research that suggests that a region's cohesive response to a hazard event may be affected by the distribution of wealth in communities.[7].

Table C-13. Regional Income Equality using the GINI Index for Benton County and incorporated cities

Jurisdiction	GINI Index
Benton County	0.4975
Adair Village	0.3035
Albany*	0.3876
Corvallis	0.5024
Monroe	0.3866
Philomath	0.3915

Source: U.S. Census Bureau, 2021 5-year estimates, American Community Survey, Table B19083
* The majority of Albany's population is within Linn County.

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

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

Housing Affordability

Housing affordability is a measure of economic security gauged by the percentage of an area's households paying less than 35% of their income on housing.[15] Households spending more than 35% are considered housing cost burdened. The table below displays the percentage of homeowners and renters reflecting housing cost burden across the region.

Among homeowners without a mortgage, Adair Village had the greatest rate of households with housing cost burdens. Among homeowners with a mortgage, Monroe, Adair Village, and Philomath have the highest rates of housing cost burden. Among renters, Corvallis, Philomath, and Adair Village renters have the greatest rates of housing cost burden. In general, the population that spends more of its income on housing has proportionally fewer resources and less flexibility for alternative investments in times of crisis.[16] This disparity imposes challenges for a community recovering from a disaster as housing costs may exceed the ability of local residents to repair or move to a new location. These populations may live paycheck to paycheck and are extremely dependent on their employer; in the event their employer is also impacted, it will further the detriment experienced by these individuals and families.

Table C-14. Households Spending > 35% of Income on Housing

Jurisdiction	Owners		Renters
	With Mortgage	Without Mortgage	
Benton County	23.4%	8.5%	51.3%
Adair Village	33.8%	20.0%	37.6%
Albany*	21.0%	12.2%	48.8%
Corvallis	22.3%	9.6%	52.0%
Monroe	38.5%	0.0%	16.8%
Philomath	31.0%	6.0%	43.0%

Source: U.S. Census Bureau, 2010-2014 American Community Survey, Tables B25070 and B25091
Note: not updated for 2023 MNHMP update.
* The majority of Albany's population is within Linn County.

Economic Diversity

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

Economic diversity is a general indicator of an area's fitness for weathering difficult financial times. One method for measuring economic diversity is through use of the Herfindahl Index, a formula that compares the composition of county and regional economies with those of states or the nation as a whole. Using the Herfindahl Index, a diversity ranking of 1 indicates the Oregon County with the most diverse economic activity compared to the state as a

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

[16] Ibid.

whole, while a ranking of 36 corresponds with the least diverse county economy. The table below describes the Herfindahl Index Scores for counties in the region.

Table C-16 shows that Benton County had an economic diversity rank of 21 at the time this analysis was done. It was not updated for the 2023 MNHMP update.

Table C-15. Regional Herfindahl Index Scores

	2008			2013		
County	Employment	Number of Industries	State Rank	Employment	Number of Industries	State Rank
Benton	26,433	199	23	25,247	201	21
Lane	123,008	260	4	114,670	260	5
Lincoln	14,286	183	29	13,491	179	30
Linn	36,360	225	5	33,934	222	4
Marion	105,758	252	3	101,571	245	3
Polk	12,837	178	18	12,179	167	9
Yamhill	27,797	209	9	27,860	209	6

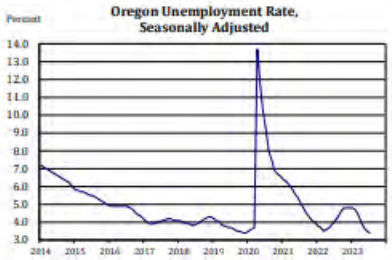
Source: Oregon Employment Department

While illustrative, economic diversity is not a guarantor of economic vitality or resilience. Benton County, as of 2015, is listed as an economically non-distressed community as prescribed by Oregon Law. The economic distress measure is based on indicators of decreasing new jobs, average wages, and income, and is associated with an increase of unemployment.[8]

[8] Business Oregon – Oregon Economic Data "Distressed Areas in Oregon", Business Oregon : Distressed Areas in Oregon : Reports, Publications, and Plans : State of Oregon

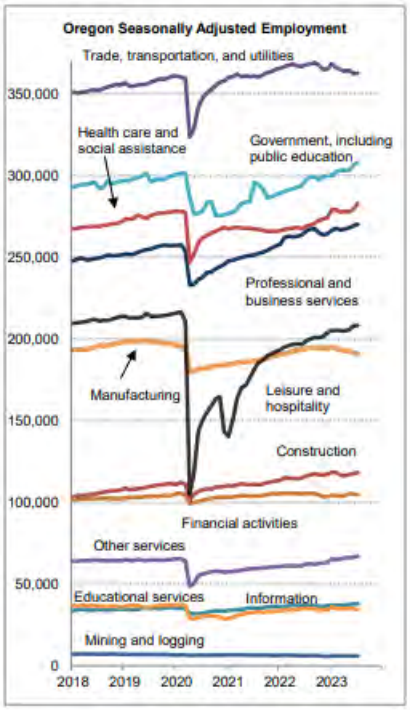
Employment and Wages

According to the Oregon Employment Department's Aug 16, 2023 *News*, Oregon's unemployment rate dropped to 3.4% in July, down from 3.5% in June. This was the sixth consecutive monthly drop in the unemployment rate, down from a recent high of 4.8% in January. The July rate equaled Oregon's record low of 3.4%, which was reached in November and December 2019. The U.S. unemployment rate was 3.5% in July, which was very close to Oregon's July rate.



Seasonal Expectations and Over-the-Month Employment Changes June to July 2023

INDUSTRY	Normal Seasonal Movement	Unadjusted Change	Seasonally Adjusted Change
Total nonfarm payroll employment	-22,300	-15,500	6,800
Total private	8,300	13,500	5,200
Mining and logging	100	100	0
Construction	1,500	2,400	900
Manufacturing	2,400	1,900	-500
Wholesale trade	400	1,000	600
Retail trade	900	1,200	300
Transportation, warehousing, and utilities	-100	-600	-500
Information	200	100	-100
Financial activities	1,100	500	-600
Professional and business services	-100	900	1,000
Private educational services	-1,400	-1,900	-500
Health care and social assistance	-900	2,500	3,400
Leisure and hospitality	4,600	5,100	500
Other services	-400	300	700
Government	-30,600	-29,000	1,600



Industry

Key industries are those that represent major employers and are significant revenue generators. Different industries face distinct vulnerabilities to natural hazards, as illustrated by the industry specific discussions below. Identifying key industries in the region enables communities to target mitigation activities towards those industry's specific sensitivities. It

is important to recognize that the impact a natural hazard event has on one industry can reverberate throughout the regional economy.

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

Employment by Industry

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

The table below identifies Employment by industry as reported in the 2016 MNHMP. The top five industry sectors in Benton County with the most employees, as of 2014, were state government, education and health services, trade, transportation, and utilities, professional and business services, and leisure and hospitality. The COVID-19 pandemic likely impacted the relative importance of leisure and hospitality, but an update of this information was not available for the 2023 MNHMP update.

Table C-16. Total Employment by Industry 2014, Expected Growth 2022

	2014				Change in Employment (2009-2013)	Employment Forecast^ (2012-2022)
Jurisdiction	Firms	Employment	Percent Employment	Average Wage		
Total Payroll Employment	2,473	35,106	100%	$ 46,281	2%	12%
Total Private	2,365	25,815	74%	$ 43,580	2%	13%
Natural Resources and Mining	103	1,072	3%	$ 35,217	-20%	15%
Construction	173	849	2%	$ 42,361	-2%	26%
Manufacturing	105	3,015	9%	$ 77,661	-10%	5%
Durable goods	61	941	3%	-	6%	7%
Trade, Transportation & Utilities	383	4,316	12%	$ 30,822	2%	9%
Wholesale Trade	88	407	1%	$ 79,056	-14%	9%
Retail Trade	243	3,431	10%	$ 24,154	6%	9%
Information	51	612	2%	$ 67,491	-27%	1%
Financial Activities	198	975	3%	$ 44,660	-2%	13%
Professional and Business Services	422	3,948	11%	$ 54,212	11%	24%
Education and Health Services	306	5,703	16%	$ 50,380	2%	17%
Health Care and Social Assistance	269	5,239	15%	$ 52,775	1%	-
Leisure and Hospitality	241	3,820	11%	$ 15,073	13%	13%
Other Services	379	1,500	4%	$ 26,895	22%	10%
Government	108	9,290	26%	$ 53,794	4%	7%
Federal	17	505	1%	$ 69,677	-14%	-5%
State	17	6,211	18%	$ 57,584	13%	9%
State Government Educational Services	4	6,064	17%	$ 57,682	14%	-
Local	74	2,573	7%	$ 41,550	-10%	5%
Local Government Educational Services	34	1,367	4%	$ 36,518	-15%	5%

Source: Oregon Employment Department, "2010 and 2014 Covered Employment and Wages Summary Reports" and "Regional Employment Projections by Industry & Occupation 2012-2022". http://www.qualityinfo.org. Accessed March 2016; not updated for 2022-23 NHMP update.

While Benton County has some basic industries, such as natural resources and mining

and manufacturing; four out of their five largest employers are of the non-basic nature and thus they rely on local sales and services. Trending towards basic industries can lead to higher community resilience.

High Revenue Sectors

In 2017, the three sectors with the highest revenue were Retail Trade, Health Care and Social Assistance, and Manufacturing. The table below shows the revenue generated by each economic sector (Note: not all sectors are reported). All of the sectors combined generated more than $3 billion in revenue for the county.

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

Table C-17. Revenue of Top Employment Sectors in Benton County

Sector Meaning (NAICS code)	Sector Revenue ($1,000)	Percent of Total Revenue
Retail trade	$903,295	27.1%
Health Care and Social Assistance, (both exempt and subject to federal taxes)	$728,071	21.8%
Manufacturing	$421,249	12.6%
Professional, scientific, and technical services	$407,119	12.2%
Other services (except public admin., both exempt and non-exempt)	$225,515	6.8%
Accommodation and food services	$214,554	6.4%
Wholesale trade	$176,665	5.3%
Real estate and rental and leasing	$ 82,403	2.5%
Administrative and support and waste management and remediation services	$ 63,130	1.9%
Educational services	$ 47,456	1.4%
Transportation and warehousing	$ 46,393	1.4%
Arts, Entertainment, and Recreation	$ 17,145	0.5%
Total	$3,332,995	100%

Source: U.S. Census Bureau, 2017 Economic Census, Table EC1700BASIC.

The *Retail Trade* sector generated $903.3 million, making it the largest earning sector in Benton County. The *Retail Trade* sector typically relies on local residents and tourists and their discretionary spending ability. Residents' discretionary spending diminishes after a natural disaster when they must pay to repair their homes and properties. In this situation, residents will likely concentrate their spending on essential items that would benefit some types of retail (e.g., grocery) but hurt others (e.g., gift shops). The potential income from tourists also diminishes after a natural disaster as people are deterred from visiting the impacted area. Retail trade is also largely dependent on wholesale trade and the transportation network for the delivery of goods for sale. Disruption of the transportation system could have severe consequences for retail businesses. In summary, depending on the type and scale, a disaster could affect specific segments of retail trade, or all segments.

Wholesale Trade generated nearly about $176.7 million. Wholesale Trade is closely linked with retail trade, but it has a broader client base, with local and non-local businesses as the

typical clientele. Local business spending will be likely to diminish after a natural disaster, as businesses repair their properties and wait for their own retail trades to increase. Distanced clients may have difficulty reaching the local wholesalers due to transportation disruptions from a natural disaster.

The *Manufacturing* sector was the third largest revenue generator, generating $421.2 million. It is highly dependent upon the transportation network in order to access supplies and send finished products to outside markets. As a base industry, manufacturers are not dependent on local markets for sales, which contribute to the economic resilience of this sector.

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

Synthesis

The current and anticipated financial conditions of a community are strong determinants of community resilience, as a strong and diverse economic base increases the ability of individuals, families, and the community to absorb disaster impacts for a quick recovery. Because education and health services, state government, and manufacturing are key to post-disaster recovery efforts, the region is bolstered by its major employment sectors. It is important to consider what might happen to the county economy if the largest revenue generators and employers are impacted by a disaster. Areas with less income equality, particularly in the smaller cities, higher housing costs, and overall low economic diversity are factors that may contribute to slower recovery from a disaster.

Built Environment Capacity

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

Land Use and Development Patterns

Benton County was created from Polk County in 1847 from an area originally inhabited by the Klickitat and Calapooia Native Americans. When created, Benton County extended from the Willamette River to the coast and south to the California border. Lane, Douglas, Jackson, Lincoln, Josephine, Curry, and Coos Counties were later created from portions of the original Benton County.

The city of Marysville, which became the county seat in 1851, was renamed Corvallis in 1853. Corvallis was incorporated as a city in 1857. Oregon State University was founded in

Corvallis in 1862 as the Oregon State Agricultural College and has since become a

major educational institution with more than 20,000 students. Oregon State University continues to serve as an important presence in Benton County.

The vast majority of Benton County is forestland, with smaller areas of agricultural lands. Forested lands are located along the western portion of the county and comprise part of the Coast Range of Oregon. Agriculture is concentrated throughout the flat regions of the Willamette Valley. Cities and rural residential areas are heavily concentrated along the rivers (Willamette River and Marys River) in the eastern part of the county. Local and state policies currently direct growth away from rural lands into Urban Growth Boundaries and, to a lesser extent, into rural communities. Within the rural areas, development radiates outward from the urban areas along rivers in a pattern that is likely to continue.

Regulatory Context

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

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

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

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

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

Goal 7

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

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

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

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

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

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

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

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

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

Housing

In addition to location, the characteristics of the housing stock affect the level of risk posed by natural hazards. The table below identifies the types of housing most common throughout the county. Of particular interest are mobile homes, which account for about 6.8% of the housing in Benton County (16.3% in Monroe). Mobile homes are particularly vulnerable to certain natural hazards, such as windstorms, and special attention should be given to securing the structures, because they are more prone to wind damage than wood-frame construction.[19] In other natural hazard events, such as earthquakes and floods, moveable structures like mobile homes are more likely to shift on their foundations and create hazardous conditions for occupants.

Table C-18. Housing Profile

	Housing Units	Single Family		Multi-Family		Mobile Homes^	
		Estimate	Percent	Estimate	Percent	Estimate	Percent
Benton County	39,636	25,493	64.3%	11,782	30.3%	2,361	6.0%
Adair Village	349	322	92.3%	18	5.2%	9	2.6%
Albany*	21,882	15,183	69.4%	5,439	24.9%	1,260	5.8%
Corvallis	25,518	13,848	54.3%	10,931	42.8%	739	2.9%
Monroe	292	187	64.0%	24	8.2%	81	27.7%
Philomath	2,109	1,423	67.5%	546	25.9%	160	7.6%

Source: U.S. Census Bureau, 2010-2014 American Community Survey, Table B25024

* The majority of Albany's population is within Linn County.

^ Also includes boats, RVs, vans, etc. that are used as a residence.

Aside from location and type of housing, the year structures were built has implications. Seismic building standards were codified in Oregon building code starting in 1974; more rigorous building code standards were passed in 1993 that accounted for a Cascadia Subduction Zone earthquake.[20] Therefore, homes built before 1993 are more vulnerable to seismic events. Also, in the 1970's, FEMA began assisting communities with floodplain mapping as a response to administer the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Upon receipt of floodplain maps, communities started to develop floodplain management ordinances to protect people and property from flood loss and damage.

The table below illustrates the estimated number and percent of homes built between 1970 and 2021. Regionally about one-third of the housing stock was built prior to 1970, before the implementation of floodplain management ordinances. As time goes on lower proportions of housing stock date from pre-seismic code times. Current estimates show that Adair Village now has over half of its housing units built since 1990. Countywide, about two-thirds of the housing stock was built before 1990 and the codification of seismic building standards. Approximately one-third of the county's housing stock was built after 1990; Adair Village and Philomath have the highest percentage of housing units built after 1990.

Table C-19. Year Structure Built

	Total Housing Units	Pre 1970		1970 to 1989		1990 or later	
		Number	Percent of Total	Number	Percent of Total	Number	Percent of Total
Benton County	39,636	13,079	33.0%	12,024	30.3%	14,533	36.7%
Adair Village	349	134	38.4%	34	9.7%	181	51.9%
Albany*	21,882	6,431	29.4%	6,185	28.3%	9,266	42.3%
Corvallis	25,518	8,753	34.3%	7,728	30.3%	9,037	35.4%
Monroe	292	132	45.2%	62	21.2%	98	33.6%
Philomath	2,109	523	24.8%	623	29.5%	963	45.7%

Source: U.S. Census Bureau, 2021, 5-year estimates, American Community Survey, Table B25034
* The majority of Albany's population is within Linn County.

The National Flood Insurance Program's (NFIP's) Flood Insurance Rate Maps (FIRMs) delineate flood-prone areas. They are used to determine whether flood insurance is required and to regulate construction so that in the event of a flood, damage is minimized. The table below shows the initial and current FIRM effective dates for Benton County communities. For more information about the flood hazard, NFIP, and FIRMs, please refer the Flood Hazard section and Risk Assessment in Volume I and the addenda for each city within Benton County (Volume II).

Table C-20. Community Flood Map History

	Initial FIRM	Current FIRM
Benton	August 5, 1986	December 8, 2016
Adair Village	N/A	N/A
Albany*	see Linn County	see Linn County
Corvallis	January 3, 1985	June 2, 2011
Monroe	September 26, 1975	June 2, 2011
Philomath	June 15, 1982	June 2, 2011

Source: Federal Emergency Management Agency, Community Information System
The majority of Albany's population is within Linn County.

Critical Facilities

Critical facilities are those facilities that are essential to government response and recovery activities (e.g., hospitals, police, fire and rescue stations, school districts and higher education institutions). The interruption or destruction of any of these facilities would have a debilitating effect on incident management.

Critical facilities in Benton County are identified below and within the City Addenda of Volume II.

Hospital:

- Good Samaritan Regional Medical Center (Corvallis), 134 beds (188 licensed), Level II Trauma
- Ambulance service is provided by Corvallis Fire Department and Albany Fire Department

Law Enforcement:

- Benton County Sheriff (offices in Corvallis, and Monroe), Jail (Corvallis)
- Philomath Police Department
- Corvallis Police Department

Fire Districts:

- Adair Rural Fire Protection
- Alsea Rural Fire Protection
- Albany Fire Department
- Blodgett-Summit Rural Fire Protection
- Corvallis Rural Fire Protection
- Hoskins-Kings Rural Fire Protection
- Monroe Rural Fire Protection
- North Albany Rural Fire Protection
- Palestine Rural Fire Protection
- Philomath Fire and Rescue

School Districts:

- Alsea School 7J
- Central School 13J
- Corvallis School 509J
- Greater Albany Public School 8J (three schools are in Benton County)
- Harrisburg School 7
- Monroe School 1J
- Philomath School 17J
- Santiam Christian School District

Infrastructure Profile

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

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

Potable Water

Water treatment plants are often located in flood prone areas and are subject to inundation when raw water enters the filters, sedimentation, or flocculation basins, resulting in loss of capability to treat incoming raw water properly. Water system control buildings and pump stations may also be subject to flood damages. Public or private water systems with wells as

the water source are subject to outages when flood waters contaminate well heads; this is a common problem for smaller water systems.

For Corvallis, neither the Taylor nor Rock Creek Water Treatment Plants are within the mapped 100-year floodplains, although they could experience flooding in events significantly larger than a 100-year flood.

Water transmission or distribution pipes are rarely damaged by flood waters, unless there are soil settlements or major erosion, because the lines are sufficiently pressurized (for water quality) to prevent intrusion of flood waters. Water transmission or distribution pipes are, however, subject to breakage when they cross landslide areas or in earthquakes. Water treatment plants are also subject to earthquake damages to the building and to process and control equipment.

Water systems, including Corvallis' water systems, are also highly vulnerable to electric power outages. Many water systems include pumped storage systems where water is pumped to storage tanks which are typically located 60 to 200 feet above the elevation of water system customers. Such tanks generally contain no more than 1 or 2 days of storage beyond typical daily usage (for reasons of water quality). Thus, electric power outages of more than 1 or 2 days may result in loss of potable water due to the inability of pumping plants to pump water. The most logical mitigation projects to minimize such outages are to provide back-up generators at key pumping plants or to provide quick connects so that portable generators (if available) can be quickly installed. Water treatment plants are also subject to outages due to loss of electric power.

For Corvallis, both water treatment plants have one commercial power source (CPI or PP&L). The Rock Creek plant has sufficient generator capacity to operate without commercial power. However, the generator at the Taylor plant provides only minimal backup power and the facility cannot operate without commercial power. This limitation poses significant risk to Corvallis for events which result in prolonged power outages. Four of the critical booster stations have on-site generators with enough capacity to operate the pumps. All of the other booster stations are pre-wired for quick connection of portable generators in the event of loss of commercial power.

For the Corvallis water system, seismic upgrades have been done for both water treatment plants and most of the reservoirs. Water pipes almost inevitably suffer damage in earthquakes regardless of their materials, although older cast-iron pipes typically have higher failure rates than ductile iron, welded steel, or PVC pipes. Upgrades of pipes are rarely feasible from an economic perspective for seismic reasons alone, except for critical locations for transmission pipes where failure may result in prolonged outages for many customers.

Critical locations include bridge crossings, liquefaction areas, landslide areas, and any other areas where the probability of failure is high.

Wastewater Systems

Wastewater systems are often highly vulnerable to flood impacts. Rising water may cause collection pipes to backup and overflow. Intrusion of storm water into collection systems may result in flows that exceed treatment plant capacities, resulting in release of untreated or only partially treated flows. Treatment plants are often located in floodplains, at low elevations, to facilitate gravity flow. However, such locations also facilitate flood damages.

Lift stations and treatment plants are also subject to loss of function due to electric power outages, with resulting overflows or releases. Collection pipes are also subject to breakage due to landslides. However, such impacts are not particularly common since most wastewater collection systems are in more urbanized areas with only selected areas subject to slides. Wastewater pipes are, however, subject to breakage in earthquakes. Wastewater treatment plants are also subject to earthquake damages to the building and to process and control equipment.

The Corvallis Wastewater Reclamation Plant is located within the 100-year floodplain. A seismic evaluation and retrofit have been completed. The plant's electric power is provided by two PP&L feeds, which provides some redundancy. There are two very small generators at the plant, which provide only minimal power. The plant cannot operate without commercial power. All but one of the wastewater lift stations have on-site backup generators with enough capacity to operate the pumps.

Natural Gas Systems

Natural gas transmission and distribution pipes are not usually affected by flooding, because the pipes are pressurized. However, compressor stations may be subject to inundation damage or loss of electrical power to run electrical and mechanical equipment.

Transmission and distribution pipes are also subject to rupture in slide areas and in earthquakes. Buried utility pipes are very subject to failure in small ground movements. Movements as small as an inch or two are often sufficient to break the pipes, especially for older cast-iron pipe which is more brittle than welded steel or polyethylene pipe. Possible mitigation actions include pipe upgrades for a few critical locations and nonstructural seismic mitigation for control equipment.

Telecommunications Systems

Telephone (land lines and cellular) systems, broadcast radio and TV systems, and cable TV systems may all be vulnerable to damages and services outages from hazards. However, in general, such systems have proved to be somewhat less vulnerable to service outages than other utility systems. System nodes (broadcast studios, switching offices and such) are subject to flooding if located in flood-prone areas. However, because of the importance of such facilities, few are located in highly flood-prone sites.

Similarly, few such facilities are likely to be located in landslide prone areas. Cellular towers in hilly areas, however, may be more subject to landslide hazards.

Buried communications (copper and fiber optic) and cable television cables are usually flexible enough to accommodate several feet of ground movement before failure. While major landslides may rupture such cables, minor settlements or small slides are not nearly as likely to impact such cables as they are to break buried gas or water pipes. Such lines typically perform relatively well in earthquakes.

Above ground communications and cable television cables are subject to wind-induced failures from tree falls and pole failures. However, such failures are a less common than failures of electric power lines. The better performance of communications cables arises in part because the electrical cables are always highest on the poles, thus a falling branch is

usually first resisted by the power cables. Also, because the voltage levels in communications cables are much lower than those in power cables, the communication cables are not subject to “burn down” or shorting if wind-swayed cables touch each other or get too close.

Some telecommunications facilities are subject to failure as a result of loss of electric power. However, key facilities almost always have backup battery power and/ or generators. Therefore, telecommunications facilities are generally much less vulnerable to outages from loss of electric power than are water or wastewater systems.

Dams

Dams are manmade structures built to impound water. Dams are built for many purposes including water storage for potable water supply, livestock water supply, irrigation, or fire suppression. Other dams are built for flood control, recreation, navigation, hydroelectric power or to contain mine tailings. Dams may also be multifunction, serving two or more of these purposes.

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

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

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

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

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

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

Dams assigned to the high hazard potential classification are those where failure or mis-operation will probably cause loss of human life. Failure of dams in the high classification

will generally also result in economic, environmental or lifeline losses, but the classification is based solely on probable loss of life.

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

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

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

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

Dam failures can occur rapidly and with little warning. Fortunately, most failures result in minor damage and pose little or no risk to life safety. However, the potential for severe damage still exists. The Oregon Water and Resources Department has inventoried all dams located in Oregon and Benton County. There is one dam categorized as high hazard; North Fork Dam located on the North Fork of Rock Creek (near Philomath); this dam is the reservoir for Corvallis' Rock Creek Water Treatment Plant and is owned by Corvallis. There is also one dam categorized as significant hazard; Thompson Dam located on Bark Creek.

Table C-21. Benton County Dam Inventory

Threat Potential	Number of Dams	Rivers
High	1	North Fork of Rock Creek (North Fork Dam)
Significant	1	Bark Creek (Thompson Dam)
Low	15	Burgett Creek, Reese Creek, Marys River, tributaries to Bummer, Oliver, and Soap Creek. Tributaries to Willamette River and Two Springs. Acres Pond Dam, Stewart Reservoir, McFadden Reservoir
Total	17	-

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

Benton County is also potentially at risk from dams upstream along the Willamette River and its tributaries, including nine (9) federally owned and operated dams in Lane County which are in the High Potential Hazard Category:

- Cottage Grove (Coast Fork Willamette River, 50,000 acre feet)
- Dorena (Row River, 131,000 acre feet)
- Fern Ridge (Long Tom River, 121,000 acre feet)
- Dexter (Middle Fork Willamette River, 29,900 acre feet)
- Lookout Point (Middle Fork Willamette River, 477,700 acre feet)
- Hills Creek (Middle Fork Willamette River, 356,000 acre feet)
- Fall Creek (Fall Creek, 125,000 acre feet)
- Blue River Dam (Blue River, 89,000 acre feet)
- Cougar (South Fork McKenzie River, 219,000 acre feet)

Electric Power Systems

There are no power plants located within Benton County. The county is served by several investor-owned, public, and cooperative and municipal utilities. The Bonneville Power Administration is the area's wholesale electricity distributor. Pacific Power and Light (Pacific Power) is the primary investor-owned utility company serving Benton County. The county is also served by Consumers Power, Inc.

The electric power system is central to the functioning of a modern society. The impacts of loss of electric power are large: residential, commercial, and public customers are all heavily dependent on electric power for normal functioning. Furthermore, as discussed above, other utility systems, especially water and wastewater systems, are heavily dependent on electric power for normal operations. Loss of electric power, therefore, may have large impacts on affected communities, especially if outages are prolonged.

Electric power for Corvallis is provided by Pacific Power and by Consumers Power. Electric power systems have somewhat complex operating characteristics, which are briefly summarized here. Electric power systems have three main parts: generation, transmission, and distribution.

Generation is the production of electric power. Generating plants can be hydroelectric, fossil fuel (oil, gas, or coal), nuclear, or various renewable fuels (wind, solar, biomass, etc.). Most

of the electric power consumed within Corvallis is produced elsewhere and transmitted via high-voltage transmission lines into the county. The Bonneville Power Administration (BPA) is the primary source of power for Corvallis. BPA's power comes from hydroelectric facilities (57%) operated by the Corps of Engineers or the Bureau of Reclamation, from a nuclear plant (3%), from interchanges and wheeling (37%) of power transmitted by BPA but not owned by BPA and from other sources (3%). Through the Pacific Interties (high voltage AC or DC transmission lines) power is moved back and forth between California, the Pacific Northwest and western Canada.

The transmission system is a network of high voltage lines (500 kV and 230 kV) and substations which transmit power between generation plants and the local distribution system. The distribution system is a network of lower voltage lines and substations which carries power from transmission system substations to neighborhoods and eventually to individual customers.

Power Outages due to wind/ winter storm events

Power outages in Benton County may result from disruption of the transmission lines carrying power from outside Benton County or from damage to the local distribution lines within Benton County. The generating plant system has sufficient redundancy so that failures of one or more plants do not usually lead to significant power outages. However, because of the absence of generating capacity within Benton County, major disruptions in the transmission system would result in substantial curtailment of available power. A major ice storm in the Columbia River area could conceivably result in failure of most of the 500 kV transmission lines feeding Benton County.

Furthermore, a severe ice storm with 2" to 4" of ice over much of Benton County could result in failure of most 500 kV and 230 kV transmission lines to and within Benton County. Such a failure, which is unlikely, but certainly not impossible, would probably entail widespread power outages in Benton County for at least 2 to 5 days.

The most frequent power outages, however, are due to failure of the local sub transmission or distribution system lines. Winter storms are the most frequent cause of significant electric power outages, with wind being the primary culprit. Electric distribution lines, the low voltage lines that deliver power to neighborhoods, are the most vulnerable electric system component in winter storms. Failures most commonly result from tree falls or from "burn downs" when wind-swayed cables touch or get too close to each other and short circuit. Distribution system failures may also be due to utility pole failures. Distribution lines may also fail due to ice loading in excess of design specifications or from landslides or debris flows or flooding which knock out utility poles.

Once a portion of a power distribution circuit fails, all customers, in all or part of the circuit, lose power, pending on the circuit's design. The duration of the power outage depends on the number of outages and the number of repair crews available for repairs. A typical power utility repair crew (2 or 3 people with a cherry picker) can restore power to a distribution circuit with common types of damage in 1 or 2 hours after arriving at the damage site.

Electric transmission lines (110 kV and higher) are less vulnerable to winter storm damage because of more robust design specifications. These lines are usually higher above the ground and much less prone to tree branches falling on lines. Furthermore, because of the

higher voltage (compared to distribution lines), power utilities must diligently pursue tree trimming programs to avoid flashovers from lines being too close to trees. Nevertheless, transmission lines do sometimes fail due to large tree falls, rapid growth of trees near lines, unusually high winds, or heavy ice loads.

Benton County is subject to outages of electric power primarily due to line failures. One possible failure mode would be the transmission lines that feed Benton County from the north. More common failure modes would be failures of the trunk distribution lines within Benton County and failures of distribution circuits or service drops from distribution lines to individual buildings. The local failures are most likely due to tree falls during wind storm events.

Transportation

Transportation networks, systems for power transmission, and critical facilities such as hospitals and law enforcement stations are all vital to the functioning of the region. Due to the fundamental role that infrastructure plays both pre-and post-disaster, it deserves special attention in the context of creating more resilient communities. The information documented in this section of the profile can provide the basis for informed decisions about how to reduce the vulnerability of Benton County's infrastructure to natural hazards.

Communities in Benton County are linked by State Highway 99W, U.S. Highway 20, State Highway 34, State Highway 223, State Highway 200 and a network of rural highways and county roads. Highway 99W runs north to south, providing connections to Salem, Monroe, and Eugene. Highway 20 runs east to west, providing access to the coast and rural areas of Benton County. According to the U.S. Census, 78 percent of Benton County's population commutes by personal vehicle; 67 percent drive alone and 11 percent carpool, and about 1.7 percent of the commuters use public transit.

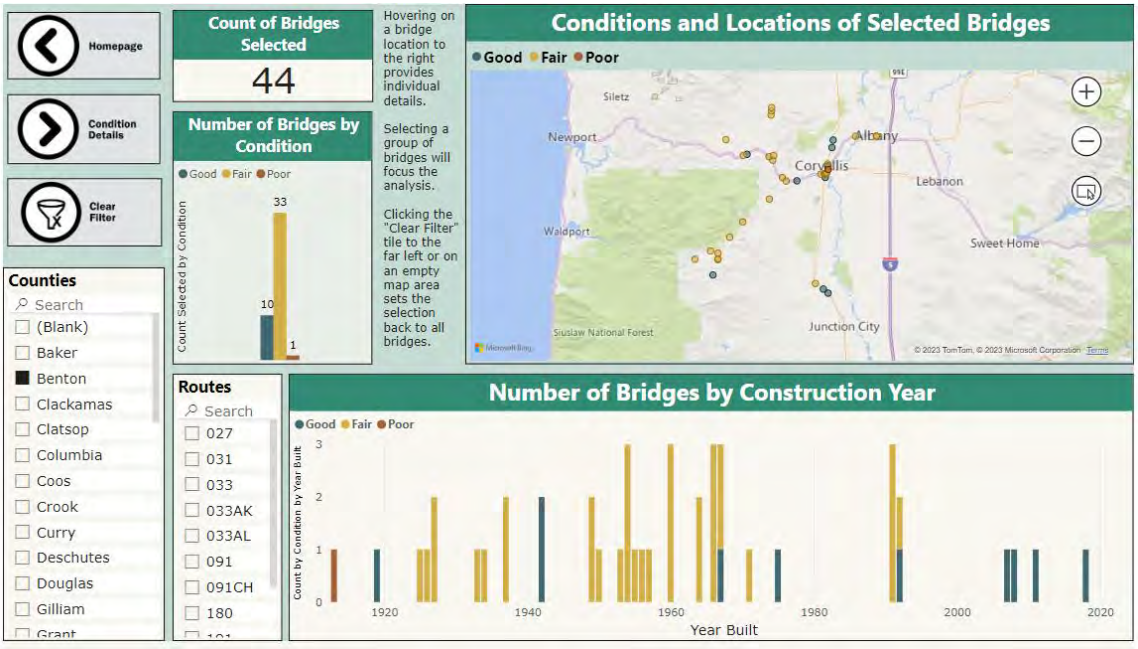
Public transportation providers include the Linn-Benton Loop Bus and Corvallis Transit Systems. Railroads and airports provide other modes of transportation in the county. Rail service within Benton County is provided by the Willamette & Pacific Railroad (WPRR) and the Portland & Western Railroad (PNWR). Facilities that support air travel include one public airport, nine private airstrips, and one helipad.

Bridges

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

Bridges require ongoing management and maintenance based on the age and type of bridge. Modern bridges, which require minimum maintenance and are designed to withstand earthquakes, consist of pre-stressed reinforced concrete structures set on deep steel piling foundations.

Figure C-2. Interactive Bridge Report Condition Summary for Benton County



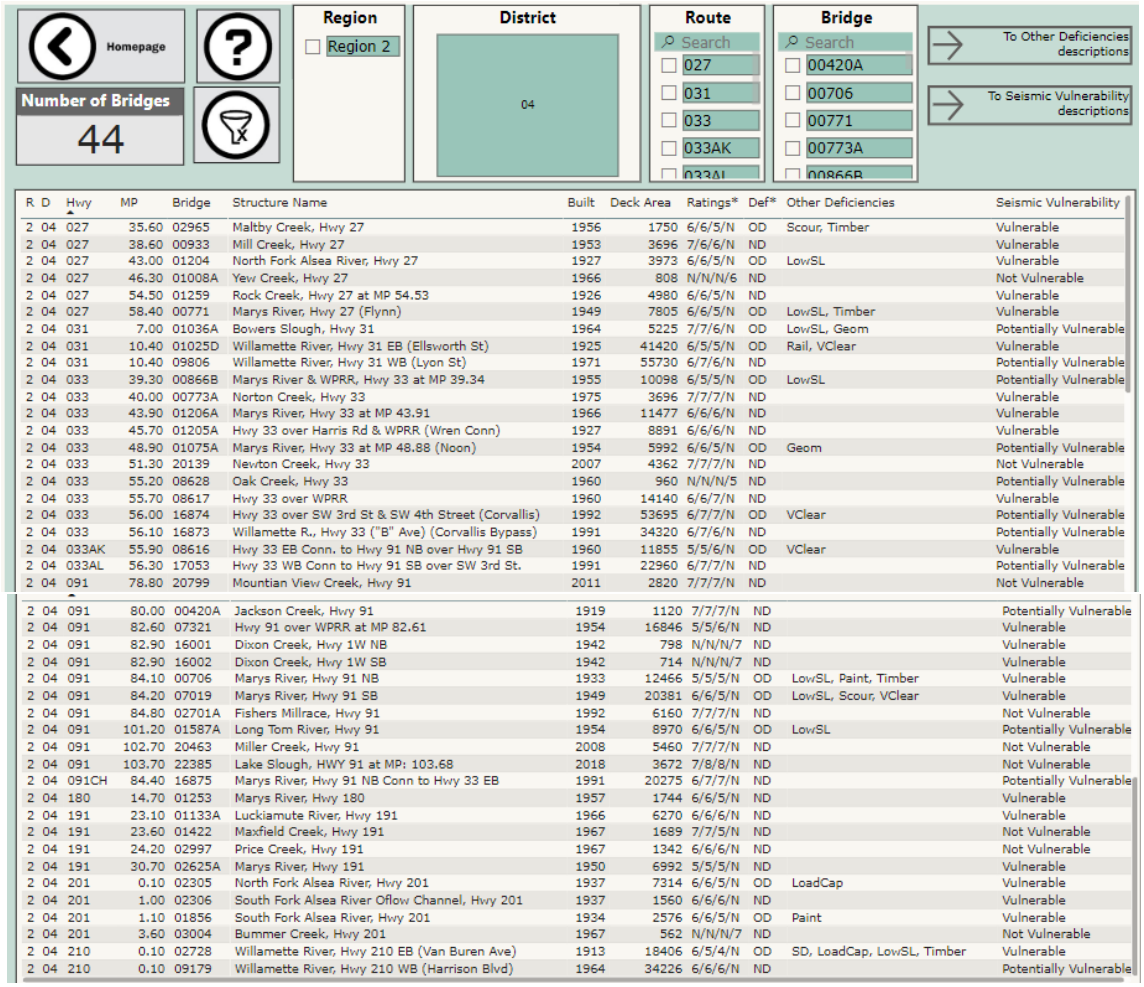
The figure above shows the structural condition of state-owned bridges in the county.

The details of the Interactive Bridge Report identify location, bridge name, date built, deck area and ratings for the deck, the superstructure, the substructure, and culvert ratings as well as whether the bridge has deficiencies, what those deficiencies are and whether the bridge is vulnerable to earthquakes. Of the forty-four state-owned bridges in Benton County, fifteen of them have deficiencies. The single state-owned bridge in Poor Condition in Benton County is the eastbound Van Buren Avenue bridge built in 1913 in Corvallis that crosses the Willamette River and carries 9,913 vehicles per day.

The Willamette River separates Linn and Benton County, and there are no land connections between the two counties. Only five bridges link the two counties; two are on Highway 20 in Albany and three are on Highway 34 in Corvallis.

The county's bridge maintenance and engineering divisions work in coordination to inspect and maintain the bridges within the county. All bridges within Benton County are inspected at two-year intervals or more frequently if special conditions exist. Bridges that are found to be in critical condition during an inspection are prioritized for immediate replacement.

Figure C-3. Bridge Condition Report Details for state-owned bridges in Benton County



R	D	Hwy	MP	Bridge	Structure Name	Built	Deck Area	Ratings*	Def*	Other Deficiencies	Seismic Vulnerability
2	04	027	35.60	02965	Maltby Creek, Hwy 27	1956	1750	6/6/5/N	OD	Scour, Timber	Vulnerable
2	04	027	38.60	00933	Mill Creek, Hwy 27	1953	3696	7/6/6/N	ND		Vulnerable
2	04	027	43.00	01204	North Fork Alsea River, Hwy 27	1927	3973	6/6/5/N	OD	LowSL	Vulnerable
2	04	027	46.30	01008A	Yew Creek, Hwy 27	1966	808	N/N/N/6	ND		Not Vulnerable
2	04	027	54.50	01259	Rock Creek, Hwy 27 at MP 54.53	1926	4980	6/6/5/N	ND		Vulnerable
2	04	027	58.40	00771	Marys River, Hwy 27 (Flynn)	1949	7805	6/6/5/N	OD	LowSL, Timber	Vulnerable
2	04	031	7.00	01036A	Bowers Slough, Hwy 31	1964	5225	7/7/6/N	OD	LowSL, Geom	Potentially Vulnerable
2	04	031	10.40	01025D	Willamette River, Hwy 31 EB (Ellsworth St)	1925	41420	6/5/5/N	OD	Rail, VClear	Vulnerable
2	04	031	10.40	09806	Willamette River, Hwy 31 WB (Lyon St)	1971	55730	6/7/6/N	ND		Potentially Vulnerable
2	04	033	39.30	00866B	Marys River & WPRR, Hwy 33 at MP 39.34	1955	10098	6/5/5/N	OD	LowSL	Potentially Vulnerable
2	04	033	40.00	00773A	Norton Creek, Hwy 33	1975	3696	7/7/7/N	ND		Vulnerable
2	04	033	43.90	01206A	Marys River, Hwy 33 at MP 43.91	1966	11477	6/6/6/N	ND		Vulnerable
2	04	033	45.70	01205A	Hwy 33 over Harris Rd & WPRR (Wren Conn)	1927	8891	6/6/6/N	ND		Vulnerable
2	04	033	48.90	01075A	Marys River, Hwy 33 at MP 48.88 (Noon)	1954	5992	6/6/5/N	OD	Geom	Potentially Vulnerable
2	04	033	51.30	20139	Newton Creek, Hwy 33	2007	4362	7/7/7/N	ND		Not Vulnerable
2	04	033	55.20	08628	Oak Creek, Hwy 33	1960	960	N/N/N/5	ND		Potentially Vulnerable
2	04	033	55.70	08617	Hwy 33 over WPRR	1960	14140	6/6/7/N	ND		Vulnerable
2	04	033	56.00	16874	Hwy 33 over SW 3rd St & SW 4th Street (Corvallis)	1992	53695	6/7/7/N	OD	VClear	Potentially Vulnerable
2	04	033	56.10	16873	Willamette R., Hwy 33 ("B" Ave) (Corvallis Bypass)	1991	34320	6/7/6/N	ND		Potentially Vulnerable
2	04	033AK	55.90	08616	Hwy 33 EB Conn. to Hwy 91 NB over Hwy 91 SB	1960	11855	5/5/6/N	OD	VClear	Vulnerable
2	04	033AL	56.30	17053	Hwy 33 WB Conn to Hwy 91 SB over SW 3rd St.	1991	22960	6/7/7/N	ND		Potentially Vulnerable
2	04	091	78.80	20799	Mountian View Creek, Hwy 91	2011	2820	7/7/7/N	ND		Not Vulnerable
2	04	091	80.00	00420A	Jackson Creek, Hwy 91	1919	1120	7/7/7/N	ND		Potentially Vulnerable
2	04	091	82.60	07321	Hwy 91 over WPRR at MP 82.61	1954	16846	5/5/6/N	ND		Vulnerable
2	04	091	82.90	16001	Dixon Creek, Hwy 1W NB	1942	798	N/N/N/7	ND		Vulnerable
2	04	091	82.90	16002	Dixon Creek, Hwy 1W SB	1942	714	N/N/N/7	ND		Vulnerable
2	04	091	84.10	00706	Marys River, Hwy 91 NB	1933	12466	5/5/5/N	OD	LowSL, Paint, Timber	Vulnerable
2	04	091	84.20	07019	Marys River, Hwy 91 SB	1949	20381	6/6/5/N	OD	LowSL, Scour, VClear	Vulnerable
2	04	091	84.80	02701A	Fishers Millrace, Hwy 91	1992	6160	7/7/7/N	ND		Not Vulnerable
2	04	091	101.20	01587A	Long Tom River, Hwy 91	1954	8970	6/6/5/N	OD	LowSL	Potentially Vulnerable
2	04	091	102.70	20463	Miller Creek, Hwy 91	2008	5460	7/7/7/N	ND		Not Vulnerable
2	04	091	103.70	22385	Lake Slough, HWY 91 at MP: 103.68	2018	3672	7/8/8/N	ND		Not Vulnerable
2	04	091CH	84.40	16875	Marys River, Hwy 91 NB Conn to Hwy 33 EB	1991	20275	6/7/7/N	ND		Potentially Vulnerable
2	04	180	14.70	01253	Marys River, Hwy 180	1957	1744	6/6/5/N	ND		Vulnerable
2	04	191	23.10	01133A	Luckiamute River, Hwy 191	1966	6270	6/6/6/N	ND		Vulnerable
2	04	191	23.60	01422	Maxfield Creek, Hwy 191	1967	1689	7/7/5/N	ND		Not Vulnerable
2	04	191	24.20	02997	Price Creek, Hwy 191	1967	1342	6/6/6/N	ND		Not Vulnerable
2	04	191	30.70	02625A	Marys River, Hwy 191	1950	6992	5/5/5/N	ND		Vulnerable
2	04	201	0.10	02305	North Fork Alsea River, Hwy 201	1937	7314	6/6/5/N	OD	LoadCap	Vulnerable
2	04	201	1.00	02306	South Fork Alsea River Oflow Channel, Hwy 201	1937	1560	6/6/6/N	ND		Vulnerable
2	04	201	1.10	01856	South Fork Alsea River, Hwy 201	1934	2576	6/6/5/N	OD	Paint	Vulnerable
2	04	201	3.60	03004	Bummer Creek, Hwy 201	1967	562	N/N/N/7	ND		Not Vulnerable
2	04	210	0.10	02728	Willamette River, Hwy 210 EB (Van Buren Ave)	1913	18406	6/5/4/N	OD	SD, LoadCap, LowSL, Timber	Vulnerable
2	04	210	0.10	09179	Willamette River, Hwy 210 WB (Harrison Blvd)	1964	34226	6/6/6/N	ND		Potentially Vulnerable

Utility Lifelines

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

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

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

bridges to facilitate emergency services response after a disaster.[9]

System connectivity and key geographical features were used to identify a three-tiered seismic lifeline system. Routes identified as Tier 1 are considered to be the most significant and necessary to ensure a functioning statewide transportation network. The Tier 2 system provides additional connectivity to the Tier 1 system; it allows for direct access to more locations and increased traffic volume capacity. The Tier 3 lifeline routes provide additional connectivity to the systems provided by Tiers 1 and 2. The figure below shows Tiers 1, 2, and 3 seismic lifeline routes.[10]

The Lifeline Routes in the Mid/ Southern Willamette Valley affecting Benton County consists of the following:

- Tier I: Interstate 5
- Tier II: Highway 99W
- Tier III: OR34

A generalized summary of the probable impacts of utility disruptions and road closures in Benton County is given in Table C-22.

Table C-22. Probable Impacts of Utility Disruptions and Road Closures

Inventory	Probable Impacts
Portion of County affected	*Impacts may be localized for damage to local utility distribution systems or street closures or effect the entire county/ city for damage to transmission lines or closures of major highways.*
Buildings	Negligible impacts to buildings, but loss of utilities may substantially affect function of buildings.
Streets within County/ Cities	Some incidents may include temporary street closures.
Roads to/from County/ Cities	Some incidents may include temporary road closures.
Electric Power	Some incidents may include temporary loss of electric power in localized parts of cities or for the entire County. Duration of disruptions can range from an hour to up to a probable maximum outage of 1 or 2 days for most wind/ice events. Longer outages are possible for extreme wind/ice events or for major earthquakes.
Water Utilities	Failure of the major water transmission lines on the Marys River bridge crossings would result in almost complete loss of water to Corvallis, with a high likelihood of long duration water outages. Prolonged power outages may also result in widespread water outages throughout the county.
Wastewater	Power outages affecting treatment plants would result in nearly complete loss of treatment capability.
Natural Gas	Localized loss of service from pipe breaks in earthquakes is expected.
Telecommunications	Prolonged power outages would likely affect some modes. Seismic damage to the telephone central offices might impact nearly all telephone communications.
Casualties	Low potential for direct casualties, but some incidents such as loss of electric power during cold weather may require evacuations and displacement of people (especially fragile or special needs population) to temporary shelters.

Source: Adapted by OPDR from the Regional All Hazard Mitigation Master Plan for Benton, Lane, and Linn Counties (Phase I, II)

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

Synthesis

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

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

Community Connectivity Capacity

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

Social Systems and Service Providers

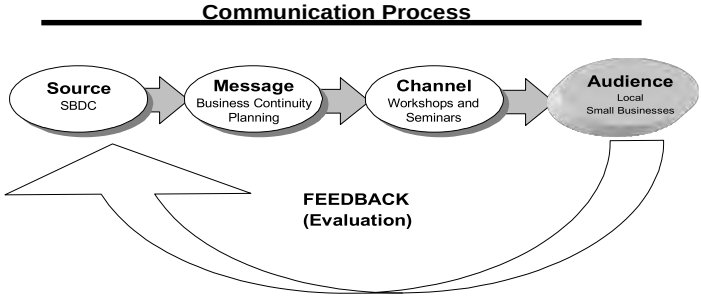
Social systems include community organizations and programs that provide social and community-based services, such as employment, health, senior and disabled services, professional associations, and veterans' affairs for the public. In planning for natural hazard mitigation, it is important to know what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

The following is a brief explanation of how the communication process works and how the community's existing social service providers could be used to provide natural hazard related messages to their clients. There are five essential elements for communicating effectively to a target audience:

- The source of the message must be credible;

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

Figure C-4. Communication Process



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

The existing social service providers within Benton County utilize the three involvement methods identified below:

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

Civic Engagement

Civic engagement and involvement in local, state, and national politics are important indicators of community connectivity. Those who are more invested in their community may have a higher tendency to vote in political elections. Other indicators such as volunteerism, participation in formal community networks and community charitable contributions are examples of other civic engagement that may increase community connectivity.

Cultural Resources

Historic Places

Historic and cultural resources such as historic structures and landmarks can help to define a community and may also be sources for tourism revenue. Protecting these resources from the impact of disasters is important because they have an important role in defining and supporting the community. According to the National Register Bulletin, "a contributing resource is a building, site, structure, or object adds to the historic associations, historic architectural qualities, or archeological values for which a property is significant because it was present during the period of significance, related to the documented significance of the property, and possesses historical integrity or is capable of yielding important information

about the period; or it independently meets the National Register criteria."[1126] If a structure does not meet these criteria, it is considered to be non-contributing.

The table below identifies the number of eligible/ significant (ES) and eligible/ contributing (EC) historical sites in Benton County. Overall, there are a total of 1,474 historically places in Benton County.

Table C-23. Benton County Historic Places

Eligible Sites	Total Sites	Listed on the National Register
ES-Significant	67	60
EC-Contributing	1,407	348
Total	1,474	408

Source: Oregon Historic Sites Database

Historic and cultural resources such as historic structures and landmarks can help to define a community and may also be sources of tourism dollars. Because of their role in defining and supporting the community, protecting these resources from the impact of disasters is important.

The following individually listed eligible and significant properties are listed on the National Register of Historic Places:

- Avery—Helm Historic District, Corvallis, Oregon
- Belknap, Ransom A., House, west of Monroe, Oregon
- Benton County Courthouse, Corvallis, Oregon
- Benton County State Bank Building (Madison Building), Corvallis, Oregon
- Benton Hotel, Corvallis, Oregon
- Bethers, George W., House (Wyatt, William, House), Philomath, Oregon
- Bexell, John, House, Corvallis, Oregon
- Bosworth, Dr. Ralph Lyman, House, Corvallis, Oregon
- Bryson, J.R., House, Corvallis, Oregon
- Burnap-Rickard, House, Corvallis, Oregon
- Caton, Jesse H., House, Corvallis, Oregon
- College Hill West Historic District, Corvallis, Oregon
- Corvallis Hotel, Corvallis, Oregon
- Crystal Lake Cemetery, Corvallis, Oregon
- Episcopal Church of the Good Samaritan (Corvallis Arts Center), Corvallis, Oregon
- Fairbanks, J. Leo, House, Corvallis, Oregon
- Farra, Dr. George R., House, Corvallis, Oregon
- Fiechter, John, House (Failing Cottage), William L. Finley National Wildlife Refuge, Oregon
- First Congregational Church (DeMass-Durdan Mortuary), Corvallis, Oregon
- Fort Hoskins Site, Kings Valley, Oregon
- Gaylord, Charles, House, Corvallis, Oregon

[11] U.S. Department of the Interior, National Park Service, Cultural Resources, National Register Bulletin 16A: "How to Complete the National Register Registration Form".

- Hadley-Locke House, Corvallis, Oregon
- Harris Bridge, west of Wren, Oregon
- Hayden Bridge, west of Alsea, Oregon
- Helm-Hout House, Corvallis, Oregon
- Hull-Oakes Lumber Company, Monroe, Oregon
- Irish Bend Bridge, northeast of Monroe, Oregon
- Irwin, Richard S., Barn (Cheadle Barn), Corvallis, Oregon
- Julian Hotel, Corvallis, Oregon
- Kappa Alpha Theta Sorority House, Old (Pi Kappa Alpha Fraternity House), Corvallis, Oregon
- King, Charles, House, Philomath, Oregon
- King, Isaac, House and Barn, north of Philomath, Oregon
- Kline, Lewis G., Building, Corvallis, Oregon
- Kline, Lewis G., House, Corvallis, Oregon
- Lewisburg Hall and Warehouse Company (Mountain View Grange No. 429), Corvallis, Oregon
- Monroe State Bank Building, Monroe, Oregon
- North College Hill District, Corvallis, Oregon
- Pernot, Dr. Henry S., House, Corvallis, Oregon
- Philomath College, Philomath, Oregon
- Pi Beta Phi Sorority House (Phi Kappa Theta Fraternity House), Corvallis, Oregon
- Rickard, Peter, Farmstead, Corvallis, Oregon
- Schuster, Charles L., House, Corvallis, Oregon
- Soap Creek School, Corvallis, Oregon
- Starr, Edwin and Anna, House, Monroe, Oregon
- Taylor, George, House (Oliver George House), Corvallis, Oregon
- Taylor, Jack, House, Corvallis, Oregon
- Watson—Price Farmstead, Philomath, Oregon
- Willamette Valley and Coast Railroad Depot—Corvallis, Corvallis, Oregon
- Wilson, James O., House, Corvallis, Oregon
- Woodward, Elias, House, Corvallis, Oregon

Libraries and Museums

Libraries and museums develop cultural capacity and community connectivity as they are places of knowledge and recognition, they are common spaces for the community to gather, and can serve critical functions in maintaining the sense of community during a disaster. They are recognized as safe places and reflect normalcy in times of distress.

Cultural Events

Other such institutions that can strengthen community connectivity are the presence of festivals and organizations that engage diverse cultural interests. Not only do these events bring revenue into the community, but they also have potential to improve cultural competence and enhance the sense of place. Cultural connectivity is important to community resilience, as people may be more inclined to remain in the community because they feel part of the community and culture.

Community Stability

Residential Geographic Stability

Community stability is a measure of rootedness in place. Cutter et al. hypothesized that resilience to disaster stems in part from familiarity with place, not only in navigating the community during a crisis, but also in accessing services and other supports for economic or social challenges.[12] The table below estimates residential stability across the region. It is calculated by the number of people who have lived in the same house and those who have moved within the same county a year ago, compared to the percentage of people who have migrated into the region. As this data from 2014 presented in the 2016 MNHMP shows, Benton County overall has geographic stability rating of about 87.5% (i.e., 87.5% of the population lived in the same house or moved within the county). The data was not updated because this is assumed to be a fairly stable characteristic of Benton County and its cities.

The figures of community stability were relatively consistent across the region in 2014 with the smaller cities having greater geographic stability. County wide 7.2% of residents in 2014 lived in a different Oregon County one year before (11.8% of Corvallis residents); 5.4% lived outside of Oregon one year before (7.2% of Corvallis residents).

Table C-24. Regional Residential Stability

Jurisdiction	Population	Geographic Stability	From Different County in Oregon	From Outside Oregon
Benton County	85,323	87.5%	7.2%	5.4%
Adair Village	860	96.6%	1.7%	1.6%
Albany*	50,720	93.0%	12.0%	2.0%
Corvallis	54,289	82.9%	11.8%	7.2%
Monroe	746	95.3%	2.3%	2.4%
Philomath	4,497	94.8%	2.4%	2.8%

Source: U.S. Census Bureau, 2010-2014 American Community Survey, Table B07003.
* The majority of Albany's population is within Linn County.

Homeownership

Housing tenure describes whether residents rent or own the housing units they occupy. Homeowners are typically more financially stable but are at risk of greater property loss in a post-disaster situation. People may rent because they choose not to own, they do not have the financial resources for home ownership, or they are transient.

As reported in the 2016 NHMP, about 57% of the occupied housing units in Benton County are owner-occupied; about 43% are renter occupied. Corvallis (55.7%) has the highest rate of renter-occupied units. Corvallis (9.6%) and Monroe (12.8%) have the highest vacancy rates within the county; Corvallis (2,271) also has the greatest number of vacant units. In addition, seasonal or recreational housing accounts for approximately 1.2% of the county's housing stock (1.0% in Corvallis).

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

Table C-25. Housing Tenure and Vacancy

	Occupied Units	Owner-occupied		Renter-occupied		Vacant^	
		Estimate	Percent	Estimate	Percent	Estimate	Percent
Benton County	33,376	19,168	57.4%	14,208	42.6%	2,885	7.9%
Adair Village	267	182	68.2%	85	31.8%	9	3.3%
Albany*	19,512	11,519	59.0%	7,993	41.0%	1,399	6.7%
Corvallis	21,251	9,419	44.3%	11,832	55.7%	2,271	9.6%
Monroe	294	175	59.5%	119	40.5%	43	12.8%
Philomath	1,732	1,227	70.8%	505	29.2%	135	7.2%

Source: U.S. Census Bureau, 2010-2014 American Community Survey, Tables DP04 & B25004.
^ = Functional vacant units, computed after removing seasonal, recreational, or occasional housing units from vacant housing units.
* The majority of Albany's population is within Linn County.

According to Cutter, wealth increases resiliency and recovery from disasters. Renters often do not have personal financial resources or insurance to assist them post-disaster. On the other hand, renters tend to be more mobile and have fewer assets at risk of damage from natural hazards.[13] In the most extreme cases, renters lack sufficient shelter options when lodging becomes uninhabitable or unaffordable post-disaster.

Synthesis

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

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

Political Capacity

Political capacity is recognized as the government and planning structures established within the community. In terms of hazard resilience, it is essential for political capital to encompass diverse government and non-government entities in collaboration; as disaster losses stem from a predictable result of interactions between the physical environment, social and demographic characteristics and the built environment[14]. Resilient political capital seeks to involve various stakeholders in hazard planning and works towards integrating the Natural Hazards Mitigation Plan with other community plans, so that all planning approaches are consistent.

Government Structure

[13] Cutter, S. L. (2003). Social Vulnerability to Environmental Hazards. *Social Science Quarterly*.
[14] Mileti, D. 1999. Disaster by Design: a Reassessment of Natural Hazards in the United States. Washington D.C. Joseph Henry Press.

Benton County's governing jurisdiction includes all unincorporated areas that are not governed by the Siuslaw Nation Forest, William L. Finley Wildlife Refuge, U.S. Forest Service, Bureau of Land Management land, and state-owned land. Benton County has three (3) elected County Commissioners, as well as an elected sheriff and district attorney. County departments and divisions consist of the following:

Administrative Service: serves citizen needs by providing election services, recording property documents, collecting property taxes, issuing marriage and dog licenses, and engaging the community to make Benton County a healthy environment for children and families. Administrative Services supports the internal county organization by providing business support services including payroll and accounting, information technology, budget development and oversight, and human resources services.

Assessment: responsible for assessing all properties in Benton County. The assessment department is also responsible for maps, property information, and special tax exemption designations.

Community Development: ensures that the building and land use laws of the state of Oregon and Benton County are followed in a fair and equitable manner. A one-stop permit service coordinates the issuance of permits for other county departments involved in development activities. The community development department also maintains the county Flood Insurance Rate Maps (FIRM), which are used in determining vulnerability and risk of flood.

Health Department: works to create and sustain the conditions in which all people in the community can be healthy. To that end, public health serves three core functions: to assess the health status of the entire population, to advise policy development, and to ensure that adequate, competent services are available throughout the community.

Natural Areas and Parks: serves the interests and pursuits of Benton County residents by providing access to natural, historic, and recreational areas and conserving, restoring and developing parkland investments.

Public Works: responsible for keeping the community accessible, safe, and environmentally responsible by providing citizens with efficient road and transportation systems, rural utility services, public facilities, and land use services.

Incorporated communities have the following government structures as illustrated in the table below.

Existing Plans and Policies

Communities often have existing plans and policies that guide and influence land use, land development, and population growth. Such existing plans and policies can include comprehensive plans, zoning ordinances, and technical reports or studies. Plans and policies already in existence have support from local residents, businesses, and policy makers. Many land-use, comprehensive, and strategic plans get updated regularly, and can adapt easily to changing conditions and needs.[15]

The Benton County Natural Hazards Mitigation Plan includes a range of mitigation strategy

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

action items that, when implemented, will reduce the county's vulnerability to natural hazards. These mitigation strategy actions are consistent with the goals and objectives of the county's existing plans and policies. Linking existing plans and policies to the Natural Hazards Mitigation Plan helps identify what resources already exist that can be used to implement the action items identified in the plan. Implementing the natural hazard mitigation plan's action items through existing plans and policies increases their likelihood of being supported and maximizes the county's resources. In addition to the plans listed below the county and incorporated cities also have zoning ordinances including floodplain development regulations and building codes.

Benton County's current plans and policies include the following:

Benton County Comprehensive Plan

- Date of Last Revision: 2014
- Author/ Owner: Benton County
- Link: Comprehensive Plan | Benton County Oregon
- Description: The Comprehensive Plan is the official policy guide for decisions about growth, development, and conservation of natural resources in Benton County.
- Relationship to Natural Hazard Mitigation Planning: The Goal 7 Policies within Benton County's Comprehensive Plan provide the framework for evaluating land use actions for their exposure to potential harm from natural hazards. The policies guide the identification of areas subject to natural hazards, regulation of development in those areas, and protection of citizens, property, and the environment from the effects of natural hazard events. The protection methods prescribed by these policies include prevention and preparedness, land use regulation, use of natural systems to mitigate hazards, public education, and collaboration with other organizations. These policies guided development of this natural hazards mitigation plan. Likewise, the risk assessment and mitigation action items identified within the Benton County Multi-jurisdictional Natural Hazard Mitigation Plan should influence the findings and land use policies found in the Benton County Comprehensive Plan.

Benton County Community Wildfire Protection Plan

- Date of Last Revision: 2023
- Author/ Owner: Benton County Fire Defense Board, Oregon Department of Forestry, and the Benton County Community Development Department/ Benton County Community Development Department
- Link: Community Wildfire Protection Plan | Benton County Oregon
- Description: The mission of the Community Wildfire Protection Plan (CWPP) is to make Benton County residents, businesses, and resources less vulnerable to the negative effects of wildland fires. The vision of the CWPP is to promote awareness of the countywide wildland fire hazard and propose workable solutions to reduce the wildfire potential.
- Relationship to Natural Hazard Mitigation Planning: The Community Wildfire Protection Plan (CWPP) is intended to be adopted for incorporation within the Benton County Natural Hazards Mitigation Plan. The CWPP contains goals and actions that seek to minimize the county's risk to wildfire hazards.

Benton County Hazard Analysis – Emergency Operations Plan

- Date of Last Revision: 2020
- Author/ Owner: Benton County
- Link: Benton Operational Area EOP
- Description: The Integrated Benton County and Corvallis Emergency Operations Plan (EOP) is based on a thorough analysis of the natural and human-made hazards that could affect the county. This analysis is the first step in planning for mitigation, response, and recovery actions. The method used in this analysis provides a sense of hazard priorities, or relative risk. It does not predict the occurrence of a particular hazard, but it does "quantify" the risk of one hazard compared with another. By doing this analysis, planning can then be focused where the risk is the greatest.
- Relationship to Natural Hazard Mitigation Planning: the EOP includes information that is relevant to the Benton County Natural Hazards Mitigation Plan. Hazard rankings from the EOP were included in the risk assessment performed for the Benton Couny Multi-jurisdictional Natural Hazards Mitigation Plan (MNHMP) update. Ideally, the EOP and Natural Hazards Mitigation Plan will eventually share, and benefit from one risk assessment. As such, information from the MNHMP may be integrated into the EOP.

Benton County Stormwater Management Plan

- Date of Last Revision: 2022
- Author/ Owner: Benton County
- Link: Benton County Stormwater Management Plan
- Description: Outlines the different components of Benton County's Stormwater Management Program: (1) Public Education and Outreach; (2) Public Participation/ Involvement; (3) Unlawful Discharge Detection and Elimination (Illicit Discharge); (4) Construction Site Runoff Control; (5) Post-Construction Runoff Control; (6) Pollution Prevention / Good Housekeeping. The program is intended to meet the requirements of the National Pollutant Discharge Elimination System (NPDES) Program as developed under the federal Clean Water Act.
- Relation to Natural Hazard Mitigation Planning: Benton County's Stormwater Management Program develops and implements education and outreach strategies related to stormwater management. Existing connections with the public can be utilized to disseminate educational materials related to natural hazards mitigation. Additionally, mitigation actions that seek to reduce the hazards associated with urban flooding can be implemented through the county's Stormwater Management Plan and the program can also influence the Benton County MNHMP.

Benton County Transportation Systems Plan

- Date of Last Revision: 2019
- Author/ Owner: Benton County
- Link: Benton County Transportation System Plan | Benton County Oregon
- Description: The Transportation System Plan (TSP) is required to provide a transportation system that accommodates the expected 20-year growth in population and employment resulting from implementation of the currently adopted Benton County comprehensive land use plan.
- Relation to Natural Hazard Mitigation Planning: Transportation systems are important in evacuating and responding to natural disasters. Mitigation actions that focus on strengthening the transportation system can be incorporated into the Transportation

Systems Plan.

Other plans (including a debris management plan) via the county website or by contacting staff.

Appendix D: Economic Analysis 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 an 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, law enforcement, 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.

Mitigation Strategy Economic Analyses Approaches

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.

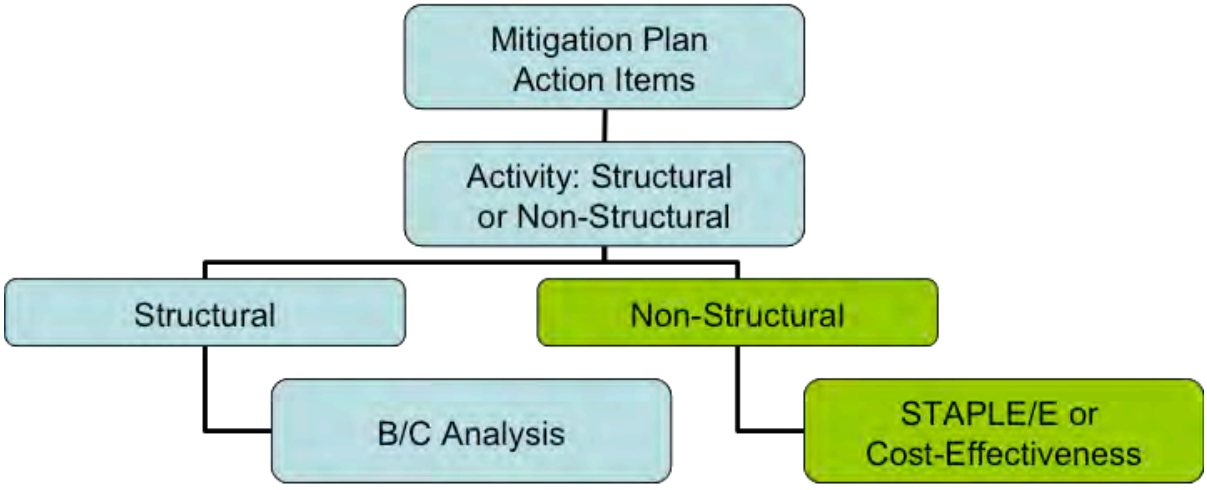
- How will the action impact the environment?
- Will the action need environmental regulatory approvals?
- Will it meet local and state regulatory requirements?
- Are endangered or threatened species likely to be affected?

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 D-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

Federal Emergency Management Agency, *Report on the Costs and Benefits of Natural Hazard Mitigation*. Publication 331, 1996.

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.

Goettel & Horner Inc., *Benefit/Cost Analysis of Hazard Mitigation Projects* Volume V, Earthquakes, Prepared for FEMA's Hazard Mitigation Branch, Ocbober 25, 1995.

Horner, Gerald, *Benefit/Cost Methodologies for Use in Evaluating the Cost Effectiveness of Proposed Hazard Mitigation Measures*, Robert Olsen Associates, Prepared for Oregon Military Department – Office of Emergency Management, July 1999.

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 E:
GRANT PROGRAMS AND RESOURCES

Introduction

There are numerous local, state, and federal funding sources available to support natural hazard mitigation projects and planning. The following section includes a list of common funding sources utilized by local jurisdictions in Oregon. Because grant programs often change, it is important to periodically review available funding sources for current guidelines and program descriptions.

Grant Programs and Resources

Federal: Pre-/Post-Disaster

Building Resilient Infrastructure and Communities (BRIC) Grant Program, FEMA

http://www.fema.gov/pre-disaster-mitigation-grant-program

The BRIC Grant Program provides funds to states, territories, 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. BRIC grants are available on an annual basis. Applicants need to submit a letter of interest to the State Hazard Mitigation Officer, annually in September. The grant is administered by FEMA.

Climate Resilience Regional Challenge, NOAA

https://coast.noaa.gov/funding/ira/resilience-challenge/

Approximately $575 million will be available for projects that build the resilience of coastal communities to extreme weather (e.g., hurricanes and storm surge) and other impacts of climate change (e.g., sea level rise, drought). Funding is made possible by the Inflation Reduction Act, a historic, federal government-wide investment that is advancing NOAA's efforts to build Climate-Ready Coasts. This new, competitive grant program provides the opportunity to collaboratively implement transformational regional projects that build immediate and long-term resilience in coastal areas.

Community Development Block Grant (CDBG) Program

https://www.hud.gov/program_offices/comm_planning/cdbg-dr

The CDBG Program, administered by HUD, promotes viable communities by providing decent housing, quality living environments, and economic opportunities, especially for low- and moderate-income persons. Eligible activities most relevant to natural hazards mitigation

include acquisition of property for public purposes, construction/reconstruction of public infrastructure, and 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. Grants are awarded based on specific projects as they are identified.

Community Development Block Grant Mitigation Program (CDBG-MIT)

https://www.hud.gov/program_offices/comm_planning/cdbg-dr/cdbg-mit

The CDBG-MIT Program funds pose a unique opportunity for eligible grantees to use this assistance in areas impacted by recent disasters to carry out strategic and high-impact activities to mitigate disaster risks and reduce future losses. The CDBG-MIT defines mitigation as activities that increase resilience to disasters and reduce or eliminate the long-term risk of loss of life, injury, damage to and loss of property, and suffering and hardship by lessening the impact of future disasters. CDBG-MIT activities should align with other federal programs that address hazard mitigation to create a more cohesive effort at the federal, state, and local level.

Dam Emergencies Collaborative Technical Assistance (CTA) Program, FEMA

https://www.fema.gov/emergency-managers/risk-management/dam-safety/technical-assistance

FEMA is offering a Collaborative Technical Assistance (CTA) series to help communities at risk of dam-related flooding to better understand their risk landscape and the potential consequences of dam-related emergencies. The CTA will include planning for emergencies related to operational discharges or dam-related infrastructure failure.

Disaster Loan Assistance, SBA

http://www.sba.gov/category/navigation-structure/loans-grants/small-business-loans/disaster-loans

There are four types of loans available from the U.S. Small Business Administration (SBA): home and personal property loans; business physical disaster loans; economic injury loans; and military reservist injury loans. When physical disaster loans are made to homeowners and businesses following disaster declarations by the SBA, up to 20% of the loan amount can go towards specific measures taken to protect against recurring damage in similar future disasters.

Disaster Resources, HUD

https://www.hud.gov/disaster_resources

The U.S. Department of Housing and Urban Development (HUD) provides a variety of disaster resources listed below. We also partner with Federal and state agencies to help implement disaster recovery assistance. Under the National Response Framework, FEMA and the Small Business Administration (SBA) offer initial recovery assistance.

Emergency Management Performance Grants (EMPG), FEMA

https://www.fema.gov/grants/preparedness/emergency-management-performance

Emergency Management Performance Grant program helps state and local governments to sustain and enhance their all-hazards emergency management programs.

Flood Mitigation Assistance (FMA) Program, FEMA

http://www.fema.gov/flood-mitigation-assistance-program

The overall goal of the 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.

Food and Nutrition Service (FNS) Disaster Resources, USDA

https://www.fns.usda.gov/disaster/disaster-assistance

The FNS coordinates with state, local, and voluntary organizations to provide nutrition assistance to those most affected by a disaster or emergency. USDA Foods are currently stored in every state and U.S. territory and may be used by state agencies or local disaster relief organizations to provide food to shelters or people who are sheltering in place. If retail food stores are operating in the impacted area, state agencies may request to operate a Disaster Supplemental Nutrition Assistance Program (D-SNAP).

Hazard Mitigation Assistance (HMA), FEMA

https://www.fema.gov/grants/mitigation

Detailed program and application information for federal post-disaster and pre-disaster programs can be found in the Hazard Mitigation Assistance Program and Policy Guide, dated March 23, 2023, note that guidance regularly changes. Verify that you have the most recent edition. Flood mitigation assistance is usually offered annually; applications are submitted online. Applicants need a user profile approved by the State Hazard Mitigation Officer (SHMO), which should be garnered well before the application period opens.

For Oregon Department of Emergency Management (OEM) grant guidance on Federal Hazard Mitigation Assistance, visit:
https://www.oregon.gov/OEM/emresources/Grants/Pages/HMA.aspx

Contact: Anna Feigum, State Hazard Mitigation Officer (SHMO),
anna.r.feigum@oem.oregon.gov

Hazard Mitigation Grant Program (HMGP), FEMA

https://www.fema.gov/grants/mitigation/hazard-mitigation

The 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. The HMGP involves a paper application which is first offered to the counties with presidentially declared disasters within the past year, then becomes available statewide if funding is still available. The grant is administered by FEMA.

HOME Investments Partnerships Program (IPP), HUD

https://www.hud.gov/program_offices/comm_planning/home

The HOME IPP provides grants to states, local government and consortia for permanent and transitional housing (including support for property acquisition and rehabilitation) for low-income persons.

National Dam Safety Program (NDSP) State Assistance Grant Program, FEMA

https://www.fema.gov/emergency-managers/risk-management/dam-safety/grants

The primary purpose of the NDSP State Assistance Grant Program is to provide financial assistance to the states for strengthening their dam safety programs. The states use NDSP funds for the following types of activities:

- Dam safety training for state personnel
- Increase in the number of dam inspections
- Increase in the submittal and testing of Emergency Action Plans
- More timely review and issuance of permits
- Improved coordination with state emergency preparedness officials
- Identification of dams to be repaired or removed
- Conduct dam safety awareness workshops and creation of dam safety videos and other outreach materials

National Estuary Program Watersheds Grant, Restore America's Estuaries

Restore America's Estuaries, in close coordination with and financial support from EPA, administers the National Estuaries Program (NEP) Watersheds Grants. This grant program funds projects within one or more of the NEP boundary areas and supports the following Congressionally set priorities:

- Loss of key habitats resulting in significant impacts on fisheries and water quality such as seagrass, mangroves, tidal and freshwater wetlands, forested wetlands, kelp beds, shellfish beds, and coral reefs;

- Coastal resilience and extreme weather events including flooding and coastal erosion related to sea level rise, changing precipitation, warmer waters, or salt marsh, seagrass, or wetland degradation or loss and accelerated land loss;
- Impacts of nutrients and warmer water temperatures on aquatic life and ecosystems, including low dissolved oxygen conditions in estuarine waters;
- Stormwater runoff which not only can erode stream banks but can carry nutrients, sediment, and trash into rivers and streams that flow into estuaries;
- Recurring harmful algae blooms;
- Unusual or unexplained marine mammal mortalities; and
- Proliferation or invasion of species that limit recreational uses, threaten wastewater systems, or cause other ecosystem damage.

Neighborhood Stabilization Program (NSP), HUD

https://www.hud.gov/program_offices/comm_planning/nsp

The NSP was established for the purpose of providing emergency assistance to stabilize communities with high rates of abandoned and foreclosed homes, and to assist households whose annual incomes are up to 120 percent of the area median income.

Preparedness Grants, FEMA

https://www.fema.gov/grants/preparedness

FEMA's Preparedness grants support citizens and first responders to ensure we work together as a nation to build, sustain and improve our capability to prepare for, protect against, respond to, recover from and mitigate terrorism and other high-consequence disasters and emergencies.

Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT), FHWA

https://www.fhwa.dot.gov/environment/protect/discretionary/

The vision of the PROTECT Discretionary Grant Program is to fund projects that address the climate crisis by improving the resilience of the surface transportation system, including highways, public transportation, ports, and intercity passenger rail. Projects selected under this program should be grounded in the best available scientific understanding of climate change risks, impacts, and vulnerabilities.

Public Assistance (PA) Grant Program, FEMA

http://www.fema.gov/public-assistance-local-state-tribal-and-non-profit

The objective of the FEMA Public Assistance 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.

Regional Catastrophic Preparedness Grant Program (RCPGP), FEMA

www.fema.gov/grants

The RCPGP plays an important role in the implementation of the National Preparedness System. RCPGP supports the building of core capabilities essential to achieving the National Preparedness Goal of a secure and resilient nation by providing resources to close known capability gaps in Housing and Logistics and Supply Chain Management, encouraging innovative regional solutions to issues related to catastrophic incidents, and building on existing regional efforts.

Housing was added as a strategic priority for this grant program in 2023 to accompany equity, climate resilience, and readiness. Priority will also be given to projects that address the needs of disadvantaged communities that might be at special risk as a result of current and/or future hazards, including those associated with climate change.

Rehabilitation of High Hazard Potential Dam (HHPD) Grant Program, FEMA

https://www.fema.gov/emergency-managers/risk-management/dam-safety/rehabilitation-high-hazard-potential-dams

The Rehabilitation of HHPD awards provide technical, planning, design and construction assistance in the form of grants for rehabilitation of eligible high hazard potential dams. A state or territory with an enacted dam safety program, the State Administrative Agency, or an equivalent state agency, is eligible for the grant.

Rural Development Assistance – Utilities, USDA

https://www.rd.usda.gov/about-rd/agencies/rural-utilities-service

USDA's Rural Utilities Service (RUS) provides much-needed infrastructure or infrastructure improvements to rural communities. These include water and waste treatment, electric power and telecommunications services. All these services help to expand economic opportunities and improve the quality of life for rural residents.

Rural Development Assistance – Housing, USDA

https://www.rd.usda.gov/about-rd/agencies/rural-housing-service

USDA's Rural Housing Service (RHS) offers a variety of programs to build or improve housing and essential community facilities in rural areas. We offer loans, grants and loan guarantees for single- and multifamily housing, childcare centers, fire and police stations, hospitals, libraries, nursing homes, schools, first responder vehicles and equipment, housing for farm laborers and much more. The RHS also provide technical assistance loans and grants in partnership with non-profit organizations, Indian tribes, state and federal government agencies, and local communities.

Safeguarding Tomorrow Revolving Loan Fund Program, FEMA

https://www.fema.gov/grants/mitigation/storm-rlf

The Safeguarding Tomorrow through Ongoing Risk Mitigation (STORM) Act became law on January 1, 2021, and authorizes FEMA to provide capitalization grants to states, eligible federally recognized tribes, territories and the District of Columbia to establish revolving loan funds that provide hazard mitigation assistance for local governments to reduce risks from natural hazards and disasters. These low interest loans will allow jurisdictions to reduce vulnerability to natural disasters, foster greater community resilience and reduce disaster suffering.

WaterSMART Grants, USBR

https://www.usbr.gov/watersmart/

Through WaterSMART Grants, the U.S. Bureau of Reclamation (USBR) provides financial assistance to water managers for projects that seek to conserve and use water more efficiently, implement renewable energy, investigate and develop water marketing strategies, mitigate conflict risk in areas at a high risk of future water conflict, and accomplish other benefits that contribute to sustainability in the western United States. Cost-shared projects that can be completed within two or three years are selected annually through a competitive process. Three categories of WaterSMART Grants are offered through separate funding opportunities: Water and Energy Efficiency Grants; Small-Scale Water Efficiency Projects; and Water Marketing Strategy Grants.

Federal: Fire Resources

Assistance to Firefighters Grant (AFG) Program Resources, FEMA

https://www.fema.gov/grants/preparedness/firefighters/assistance-grants

FEMA's Assistance to Firefighters Grant Program provides a variety of resources listed below. The purpose of the grant is to provide equipment, protective gear, emergency vehicles, training, and other resources needed to protect the public and emergency personnel from fire and related hazards. The funds are available to fire departments, non-affiliated emergency medical services organizations, and state fire training academies. The funds enhance operations efficiencies, foster interoperability, and support community resilience.

Community Wildfire Defense Grant (CWDG) Program, USDA-FS

https://www.fs.usda.gov/managing-land/fire/grants

The CWDG is intended to help at-risk local communities and Tribes; plan for and reduce the risk of wildfire. The program, which was authorized by the Bipartisan Infrastructure Law, prioritizes at-risk communities in an area identified as having high or very high wildfire hazard potential, are low-income, or have been impacted by a severe disaster that affects the risk of wildfire. The program provides funding to communities for two primary purposes:

- Develop and revise Community Wildfire Protection Plans (CWPP).
- Implement projects described in a Community Wildfire Protection Plan that is less than ten years old.

The CWDG also helps communities in the wildland urban interface (WUI) implement the three goals of the National Cohesive Wildland Fire Management Strategy.

Fire Management Assistance Grant (FMAG) Program, FEMA

https://www.fema.gov/assistance/public/fire-management-assistance

Fire Management Assistance Grant (FMAG) Program is available to states, local and tribal governments, for the mitigation, management, and control of fires on publicly or privately owned forests or grasslands, which threaten such destruction as would constitute a major disaster.

Fire Prevention and Safety (FP&S), FEMA

https://www.fema.gov/grants/preparedness/firefighters/safety-awards

The FP&S grant property is part of the AFG program noted above, and support projects that enhance the safety of the public and firefighters from fire and related hazards. The primary goal is to reduce injury and prevent death among high-risk populations.

National Fire Plan (NFP), USDA/USDOI

http://www.forestsandrangelands.gov/

The NFP provides technical, financial, and resource guidance and support for wildland fire management across the United States. This plan addresses five key points: firefighting, rehabilitation, hazardous fuels reduction, community assistance, and accountability.

Staffing For Adequate Fire and Emergency Response (SAFER)

https://www.fema.gov/grants/preparedness/firefighters/safer

The SAFER program was created to provide funding directly to fire departments and volunteer firefighter interest organizations to help them increase or maintain the number of trained, "front line" firefighters available in their communities.

Wildfire Smoke Preparedness in Community Buildings Grant Program, EPA

https://www.epa.gov/indoor-air-quality-iaq/wildfire-smoke-preparedness-community-buildings-grant-program?utm_content=&utm_medium=email&utm_name=&utm_source=govdelivery&utm_term=#Eligible

Wildfire Smoke Preparedness in Community Buildings is a new federal grant program to support enhancing community wildfire smoke preparedness. It provides grants and cooperative agreements to States, federally recognized Tribes, public pre-schools, local educational agencies, and non-profit organizations for the assessment, prevention, control, and/or abatement of wildfire smoke hazards in community buildings and related activities.

Federal: Hazard Mapping and Technical Support

Decision, Risk and Management Science Program (DRMS), National Science Foundation

https://new.nsf.gov/funding/opportunities/decision-risk-management-sciences-drms

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.

Clean Water State Revolving Fund (CWSRF), EPA

https://www.epa.gov/cwsrf

The EPA administers this fund. The purpose is to fund water quality projects, including all types of nonpoint source projects, watershed protection or restoration projects, estuary management projects, and more traditional municipal wastewater treatment projects. Grant awards are based on specific projects as they are identified.

Community Action for a Renewed Environment (CARE), EPA

https://www.epa.gov/international-cooperation/community-action-renewed-environment-care-roadmap-10-step-plan-improve

The administrator of this funding source is the EPA. The purpose is to fund the removal or reduction of toxic pollution. The grant award is based on specific projects as they are identified.

Cooperating Technical Partners (CTP), FEMA

https://www.fema.gov/flood-maps/guidance-partners/cooperating-technical-partners

The CTP mission is to strengthen the effectiveness of the NFIP and support FEMA's mitigation objectives. The CTP Program leverages partnerships to deliver high-quality hazard identification and risk assessment products, provide outreach support and empower communities to take action to reduce risk based on informed, multi hazard-based data and resources.

Earthquake Resilience Guide for Water and Wastewater Utilities

There are three steps in this guide: Step 1 – Understand the Earthquake Threat. Step 2 – Identify Vulnerable Assets and Determine Consequences. Step 3 – Pursue Mitigation and Funding Options.

Emergency Response for Drinking Water and Wastewater Utilities, EPA

https://www.epa.gov/waterutilityresponse

The Environmental Protection Agency (EPA) has a variety of tools and guidance to support drinking water and wastewater utility preparedness and response. Resources include:

Emergency Watershed Protection (EWP) Program, USDA-NRCS

https://www.nrcs.usda.gov/programs-initiatives/ewp-emergency-watershed-protection

The EWP Program 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.

Federal Funding for Water and Wastewater Utilities in National Disasters, EPA

https://www.epa.gov/fedfunds

The Federal Funding for Water and Wastewater Utilities in National Disasters (Fed FUNDS website gives utilities information about federal disaster funding programs. Although Fed FUNDS focuses on major disasters, you can use the information for any incident that disrupts water or wastewater services or damages critical infrastructure.

Federal Land Transfer / Federal Land to Parks Program, USDOI-NPS

http://www.nps.gov/ncrc/programs/flp/index.htm

The National Park Service Identifies, assesses, and transfers available federal real property for acquisition for state and local parks and recreation, such as open space.

National Coastal Zone Management (CZM) Program, NOAA

https://coast.noaa.gov/czm/

The National CZM Program comprehensively addresses the nation's coastal issues through a voluntary partnership between the federal government and coastal and Great Lakes states and territories. Authorized by the Coastal Zone Management Act of 1972, the program provides the basis for protecting, restoring, and responsibly developing our nation's diverse coastal communities and resources. The CZM Program provides grants for planning and implementation of non-structural coastal flood and hurricane hazard mitigation projects and coastal wetlands restoration.

National Earthquake Hazard Reduction Program (NEHRP), National Science Foundation

http://www.nehrp.gov/

Through broad based participation, the NEHRP attempts to mitigate the effects of earthquakes. Member agencies in NEHRP include the US Geological Survey (USGS), National Science Foundation (NSF), Federal Emergency Management Agency (FEMA), and 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.

National Flood Insurance Program (NFIP), FEMA

https://www.fema.gov/flood-insurance

The NFIP provides insurance to help reduce the socio-economic impact of floods. The NFIP insurance is made available to residents of communities that adopt and enforce minimum floodplain management requirements.

NFIP Flood Maps, FEMA

https://www.fema.gov/flood-maps

Floods occur naturally and can happen anywhere. They may not even be near a body of water, although river and coastal flooding are two of the most common types. Heavy rains, poor drainage, and even nearby construction projects can put the community at risk for flood damage. Flood maps (referred to as Flood Insurance Rate Maps or "FIRM") are one tool that communities use to know which areas have the highest risk of flooding. FEMA maintains and updates data through flood maps and risk assessments.

North American Wetland Conservation (NAWC), USDOI-FWS

https://www.fws.gov/program/north-american-wetlands-conservation

NAWC fund provides cost-share grants to stimulate public/private partnerships for the protection, restoration, and management of wetland habitats. The grant funds projects for wetlands conservation in the United States, Canada, and Mexico.

Partners for Fish and Wildlife (PFW), USDOI-FWS

https://www.fws.gov/program/partners-fish-and-wildlife

The PFW program provides financial and technical assistance to private landowners interested in pursuing restoration projects affecting wetlands and riparian habitats.

Secure Rural Schools and Community Self-Determination Act of 2000, USDA-FS

https://www.fs.usda.gov/working-with-us/secure-rural-schools

Reauthorized for fiscal year 2022, 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.

USGS Natural Hazards

https://www.usgs.gov/mission-areas/natural-hazards

The USGS Natural Hazards Mission Area includes six science programs including Coastal & Marine Geology, Earthquake Hazards, Geomagnetism, Global Seismographic Network, Landslide Hazards, and Volcano Hazards. Through these programs, the USGS provides alerts and warnings of geologic hazards and interactive maps and data.

Wetlands Reserve Easements (WRE), USDA-NCRS

https://www.nrcs.usda.gov/programs-initiatives/wre-wetland-reserve-easements

The WRE program provides assistance to protect and restore wetlands through easements and restoration agreements.

State

Coastal Grants, DLCD

https://www.oregon.gov/lcd/OCMP/Pages/Grants.aspx

The Oregon Coastal Management Program (OCMP) at Oregon Department of Land Conservation and Development (DLCD) is pleased to announce a new National Oceanic and Atmospheric Administration (NOAA) funding opportunity designed to build a Climate Ready Nation under the 2021 Bipartisan Infrastructure Law (also known as the Infrastructure Investment and Jobs Act (IIJA)) and available only through coastal management programs. The objective of this initiative is to increase resilience through landscape-scale habitat restoration and conservation in coastal ecosystems nationwide and promote coastal resilience in underserved coastal communities as well as those most vulnerable to climate impacts.

Community Risk Reduction Grants, OSFM

https://www.oregon.gov/osp/programs/sfm/Pages/OSFM-Grants.aspx

The Oregon State Fire Marshall (OSFM) grant programs provides the following funding sources.

Community Wildfire Risk Reduction Grant

This grant program is open to local governments, special districts, structural fire service agencies, and non-governmental organizations. This grant funds wildfire risk reduction projects, equipment, and staff.

Oregon Fire Service Capacity Program

The Fire Service Capacity Program is for small- to medium-sized agencies that need more permanent positions for firefighters and fire prevention staff. This grant is available to Oregon's local fire districts and departments for funds to support up to two firefighters and two fire prevention personnel.

Engine Program

This $25-million program is purchasing and strategically placing new firefighting equipment across Oregon. The OSFM is purchasing type 3, type 6, and tactical tenders to assist local host agencies in keeping fires small and away from communities.

Community Wildfire Protection Plan (CWPP) Investments

In February 2023, the OSFM made a strategic one-time $2.7 million investment at the local and county levels through CWPP. Projects will happen in 25 CWPP planning areas located in Baker, Benton, Clackamas, Coos, Crook, Curry, Deschutes, Douglas, Gilliam, Hood River, Jackson, Jefferson, Josephine, Lake, Lane, Lincoln, Linn, Malheur, Marion, Morrow, Multnomah, Polk, Wallowa, Wheeler, and Yamhill counties. Projects include promoting wildfire-specific community risk reduction efforts, community education, defensible space projects, home assessments, media campaigns, signage, fuel mitigation programs, and grant funds.

Community Grants, DLCD

https://www.oregon.gov/lcd/cpu/pages/community-grants.aspx

The DLCD Community Services Division offers grants to empower local and tribal governments to improve planning. The grants can pay to update comprehensive plans, modernize land use ordinances, or augment other planning activities. The general fund grant program, administered by the community services division, is funded by the Oregon legislature. Changes to the grant program can arise based on changes in state priorities, the economy, and other factors. In general, the funding follows the state's two-year budget cycle and is part of DLCD's agency budget.

Grants and Supports for Emergency Shelter, ODHS

https://www.oregon.gov/dhs/EmergencyManagement/Pages/emergency-shelter.aspx

Oregon Department of Human Services (ODHS) proves assistance for local governments, Tribal Nations and public education providers to address shelter needs for:

- Cleaner air shelters during wildfire smoke and other poor air quality events
- Cooling and warming shelters

Oregon Senate Bill 80 (SB 762 fixes) proposes to extend eligibility to non-profits and faith-based organizations.

Landscape Resiliency Program, ODF

https://www.oregon.gov/odf/pages/landscape-resiliency-program.aspx

This grant program funded landscape-scale projects that reduce wildfire risk on public and private forestlands and rangelands, and in communities near homes and critical infrastructure through restoration of landscape resiliency and reduction of hazardous fuels. Oregon Department of Forestry (ODF), with input from the Landscape Resiliency Project work group and the public, has awarded $20 million for nine projects during the 2021–23 biennium.

Oregon Watershed Enhancement Board (OWEB)

http://www.oregon.gov/OWEB/Pages/index.aspx

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 effort 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.

Seismic Rehabilitation Grant Program (SRGP), Business Oregon

https://www.oregon.gov/biz/programs/SRGP/Pages/default.aspx

The Seismic Rehabilitation Grant Program (SRGP) provides state funds to strengthen public schools and emergency services buildings so they will be less damaged during an earthquake. Reducing property damage, injuries, and casualties caused by earthquakes is the goal of the SRGP.

Small Forestland Grant Program, ODF

https://www.oregon.gov/odf/pages/small-forestland-grant-program.aspx

The Small Forestland Grant Program (SFGP) offered the following two funding opportunities: the Small Forestland Grant and the Firewise Community Grant. Both opportunities require grant dollars are spent reducing the risk of high severity wildfire through the reduction of hazardous fuel on small forestland owner properties. Both opportunities were scored prioritizing high-risk watersheds, but lower risk watersheds were not excluded from applying. All invoices from both program components must be submitted by successful recipients no later than June 15, 2023.

Smoke Management-Community Response Plan Grant, DEQ

https://www.oregon.gov/deq/aq/Pages/Smoke-Resources.aspx

Communities throughout Oregon are at various stages of planning and preparing for the potential impacts from prescribed fire and wildfire smoke. To create a successful community response plan for smoke, communities need to partner with local stakeholders and apply the best practices and resources to meet the needs of their residents. In 2022, Oregon Department of Environmental Quality (DEQ) awarded grants to 20 local and tribal governments to develop comprehensive community response plans for smoke management and to three local entities and businesses to pilot projects promoting alternatives to open burning. Once the grant period is completed, DEQ will share community response plans and best practices from the grant awardees.

State Interagency Hazard Mitigation Team (IHMT)

http://www.oregon.gov/oem/Councils-and-Committees/Pages/IHMT.aspx

Find IHMT meeting dates and locations, agendas, minutes and meeting materials. The State IHMT is made up of about 18 state agencies involved with natural hazards. The State IHMT meets quarterly to understand losses arising from natural hazards, coordinate recommended strategies to mitigate loss of life, property, and natural resources, and maintain the Oregon Natural Hazards Mitigation Plan.

State Preparedness and Incident Response Equipment (SPIRE), OEM

https://www.oregon.gov/oem/emresources/Grants/Pages/Spire.aspx

Oregon House Bill 2687 became effective in August 2017. It established a grant program to distribute emergency preparedness equipment to local governments and other recipients to be used to decrease risk of life and property resulting from an emergency. Items purchased must qualify as capital assets, meaning individual items must cost at least $5,000. A total of $5,000,000 is available to procure emergency preparedness equipment to help Oregon communities prepare, respond, and recover from emergencies. During the 2021 Legislative Session, HB 2426 added Urban Search and Rescue (USAR) equipment to the list and required that USAR equipment receive the highest priority. The contact for the SPIRE program is Carole Sebens, Grants Coordinator, Carole.L.Sebens@oem.oregon.gov/

Local

Local funding depends on the funding mechanisms your jurisdiction has authority to use. A few common types of funding for hazard mitigation projects include:

Capital Improvement Project (CIP)

Many jurisdictions put together a set of their big-ticket items into a budget package called a CIP budget or 'Capital Projects' budget. These projects usually have been on the organizational 'to do' list for some time or have gained priority status through another mechanism such as a planning, design, or strategic planning process. Once a project moves into this status, an array of budget tools is deployed.

Deferred and Lifetime Maintenance Funding

Other considerations about how to use lines of funding amount to either a future line of funding or a deficit (such as an unfunded mandate or deferred maintenance). Lifetime Maintenance funding is a component of a project that can be included in a CIP or other project budget. This includes the expected operations and maintenance (O&M) costs of the project, and it rolls those costs into the upfront costs so there is a budget available for them. The alternative to this is a piece of equipment or other asset that does not receive the maintenance it needs due to budget cuts, which then has a shorter life and thus a higher annual cost to the jurisdiction and its customers.

General Obligation Bond (GO Bond)

A general obligation bond, or GO Bond, is a municipal bond backed solely by the credit and taxing power of the issuing jurisdiction rather than the revenue from a given project. General obligation bonds are issued with the belief that a municipality will be able to repay its debt obligation through taxation or revenue from projects. No assets are used as

collateral. In Oregon Revised Statutes, the rules for issuing GO Bonds are regulated by type of entity. For example, sanitary and water districts have a discrete set of rules specific to their authorities in 2020 ORS, Vol. 12, Chapter 450: https://www.oregonlaws.org/ors/chapter/450.

Road Fund

A "county road fund" means a separate fund in the county treasury designated to receive deposit of revenues that are dedicated to roads or road improvements. The county road fund must be used in establishing, laying out, opening, surveying, altering, improving, constructing, maintaining and repairing county roads and bridges on county roads (with exceptions).

See 2020 ORS, Vol. 10, Ch.238, Section 238.705: https://www.oregonlaws.org/ors/368.705

Pursuant to ORS 373.240, the "general road fund" of any city shall consist of the road money set apart for the city as a road district or otherwise, under the laws of the state, out of the road tax levied by the county, which the county treasurer shall pay to the city, and any other money placed in the road fund of the city by the orders of the city governing body.

Special Tax District

Some districts, like Ports, may have authority to create special tax levies, such as a "bond sinking fund," that is "a special tax upon all taxable real and personal property situated within the port. Such annual levy shall not exceed one-tenth of one percent."

See 2020 ORS, Vol. 19, Ch. 777, Section 777.520. https://www.oregonlaws.org/ors/777.520

Foundational

Meyer Memorial Trust (MMT)

https://mmt.org/

Since 1982, the MMT has awarded grants and program-related investments totaling more than $814 million to more than 3,380 organizations around the Pacific Northwest. Today, MMT focuses on work in Oregon in four areas Oregonians have identified as crucial to making the state better for all its residents: housing, education, the environment and building stronger communities.

Oregon Community Foundation (OCF)

https://oregoncf.org

The OCF provides grants and scholarships across Oregon. As a statewide community foundation, they work alongside donors, stewarding their priorities into strategic giving to support diverse communities across Oregon, creating lasting, transformative change. They have five offices and professional advisors to assist donors in setting up advised funds to serve seven areas of impact.

APPENDIX F:
BENTON COUNTY NATURAL HAZARDS SURVEY

The Benton County Emergency Management Coordinator composed a survey to solicit public input on the Benton County Multi-Jurisdictional Natural Hazard Mitigation Plan. The survey was designed to inform the natural hazard planning process. Communities in Benton County can use the results of this survey to enhance action item rationale and ideas for implementation, and to better inform hazard outreach strategies, mitigation, response, and recovery.

The survey was conducted from March through October and received 231 responses from people living all across the county. About 53% of respondents reported that they live in Corvallis, 13% in Philomath with the remaining respondents living in the many smaller communities across the county.

The survey was provided in English and Spanish, with translation available via google translate. Specific efforts were made by the County Public Information Officers in every Department and by the Steering Committee representatives to engage multi-lingual and access and functional needs communities across the County. The County used the following communications methods to distribute the survey; this list does not include the Steering Committee member outreach:

- Benton County Website
- Benton County Social Media Accounts- reshared across all Departments
    - LinkedIn, Twitter, Nextdoor, Facebook, Instagram
- Benton County Newsletter (11k+)
- Flash Alert- also sent to media partners
- KORC community radio
- Philomath News
- Alsea Valley Voice
- Corvallis Advocate
- Steering Committee Websites, social media accounts
- Farmers Markets
- Fliers shared at community events and facilities

The survey results formed part of the information used by the Steering Committee to assess risk from the range of natural hazards experienced in Benton County. The other types of data used to assess risk and the process of assessing risk are discussed in Volume I.

In this appendix you will find graphs and data for the tabulated responses and a summary of the open-ended responses. A full copy of the survey data can be obtained by contacting the plan convener.

Figure 1. List and graph of responses to Question 1: In which geographic community do you live?

Answer Choices	Responses	
Adair Village	0.95%	2
Alsea	3.32%	7
Alpine	0.95%	2
Alpine Junction	0.00%	0
Bellfountain	0.47%	1
Blodgett	0.47%	1
City of Corvallis	53.08%	112
City of Monroe	0.47%	1
City of Philomath	13.27%	28
Dawson	0.47%	1
Glenbrook	0.47%	1
Greenberry Gap	0.00%	0
Hoskins	0.95%	2
Kiger Island	0.47%	1
Kings Valley	2.84%	6
Lewisburg	5.21%	11
Lobster Valley	0.00%	0
North Albany	5.69%	12
Soap Creek	3.32%	7
Summit	0.47%	1
Wren	7.11%	15
Other (please specify)		23
	Answered	**211**
	Skipped	**20**

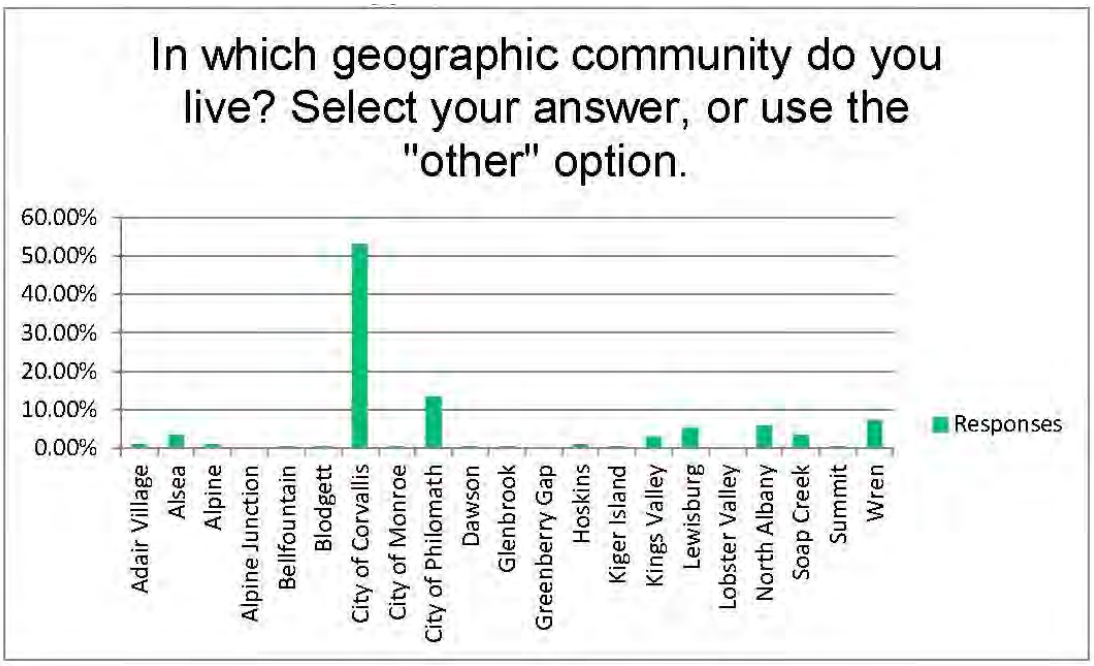
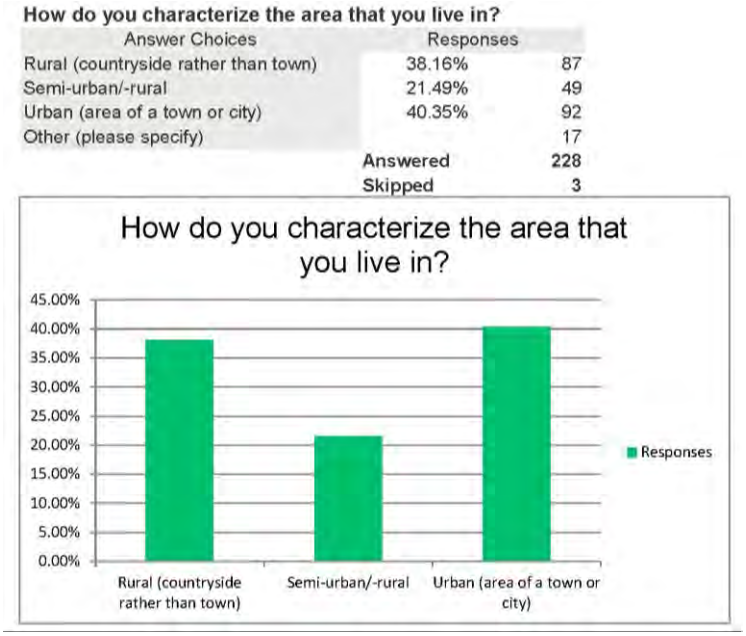


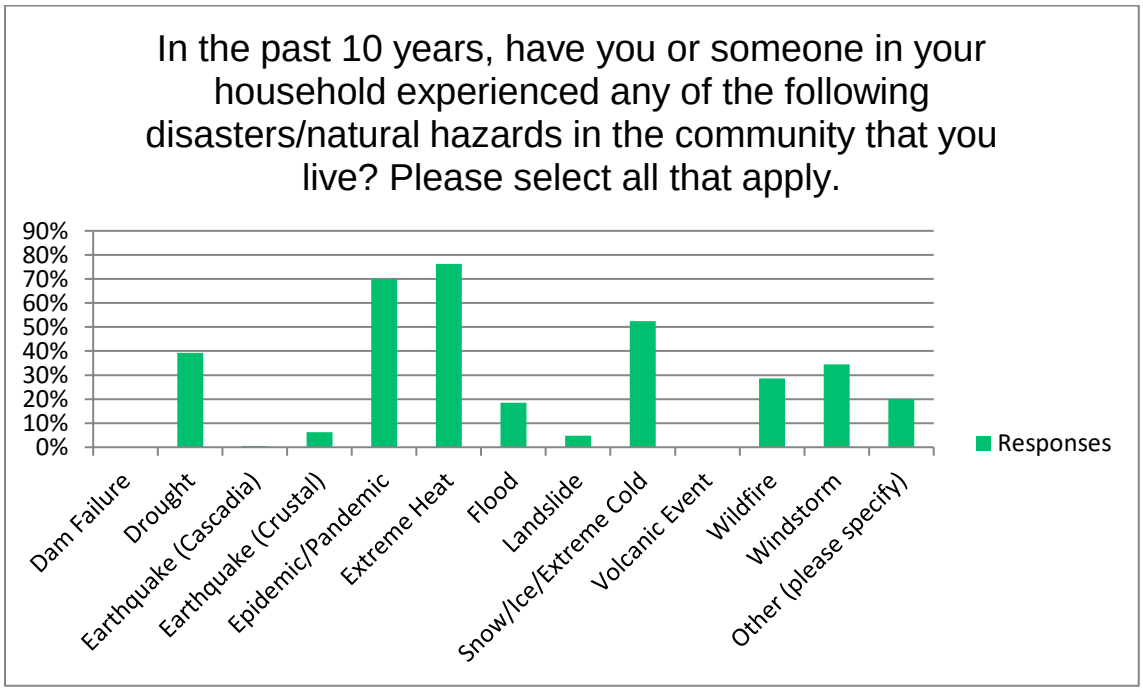
Figure 2. Graph of responses to Question 2: How do you characterize the area that you live in?



How do you characterize the area that you live in?

Answer Choices	Responses	
Rural (countryside rather than town)	38.16%	87
Semi-urban/-rural	21.49%	49
Urban (area of a town or city)	40.35%	92
Other (please specify)		17
	Answered	228
	Skipped	3

Figure 3. Graph of responses to Question 3: In the past 10 years, have you or someone in your household experienced any of the following disasters/natural hazards in the community in which you live?



Question 4: If you were impacted by a disaster/natural hazard, please share how you were impacted. If you've not been impacted by a disaster/natural hazard, please skip this question.

This question was presented as open-ended, with the disasters/natural hazards listed for reference. For each example, respondents had the option to give more details about the impacts of the disaster/natural hazard. Two out of the twelve options had no impact on the respondents and have been removed from the list below: Dam Failure, Volcanic Event.

The disaster/natural hazards with the most to the least impact, and an impacts summary of the responses are as follows:

Epidemic/Pandemic, 69.75%	Death of family, loss of income, isolation, supply chain interruptions, decreased medical services.
Extreme Heat, 68.52%	Increased water needs for crops and livestock, loss of crops and livestock, increased fire danger, increase to power and water bills, health impacts, sought public cooling centers and shelter.
Snow/Ice/Extreme Cold, 51.23%	Power bill increase, transportation/road impacts, power outages due to damaged trees and lines, isolation, damages to property, sought public warming centers and shelter, sought public services due to medical equipment needs.
Drought, 36.42%	Impacts to local food production, recreational activities, wells dried out, loss of crops and livestock, increase of wildfire precautions, stressed vegetation.
Wildfire, 46.91%	Evacuation, air quality and underlying health impacts, increase in power bills due to added mitigation measures in the home- air purifiers, intense smoke, and ash, sheltering evacuees.
Windstorm, 37.04%	Damage to property, trees, power lines, and outdoor structures, power outages, unsafe driving conditions, loss of communications.
Flood, 20.99%	Increase in insurance needs, unsafe driving conditions and road closures, isolation of certain areas, property damages and erosion, loss of crops and income.
Earthquake (Crustal), 3.70%	Property damage
Landslide, 3.09%	Property damages, loss of property value due to neighboring landslide, isolation
Earthquake (Cascadia), 0.62%	Retrofitted foundation of home

Figure 4. Graph of responses to Question 5: Rank the likelihood of these disasters/natural hazards in your community.

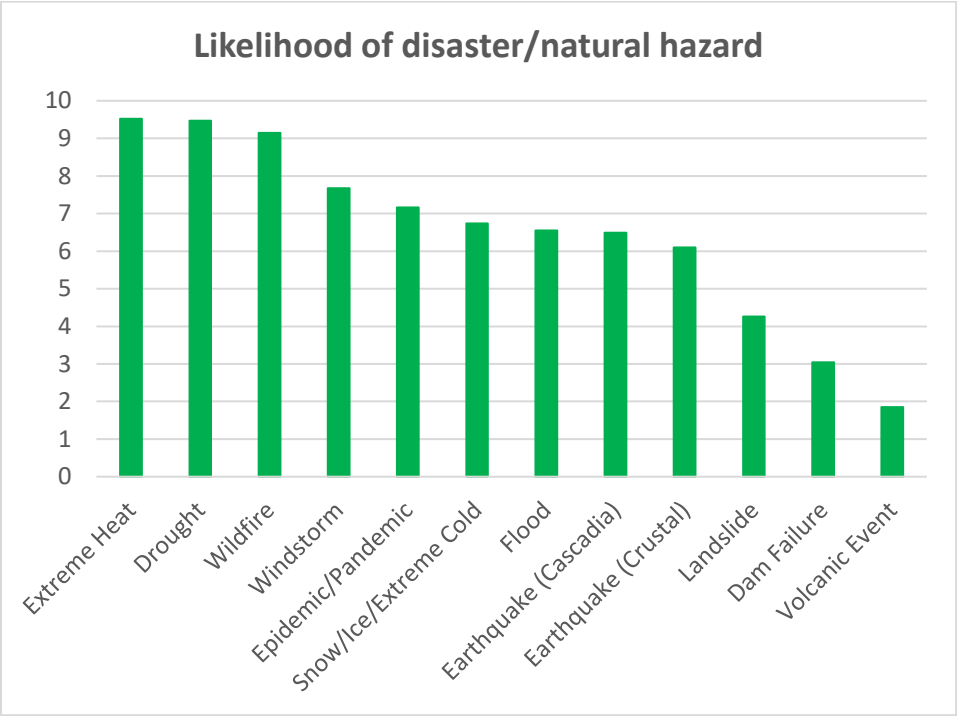


Figure 5. Graph of responses to Question 6: Rank your community's vulnerability to these disasters/natural hazards.

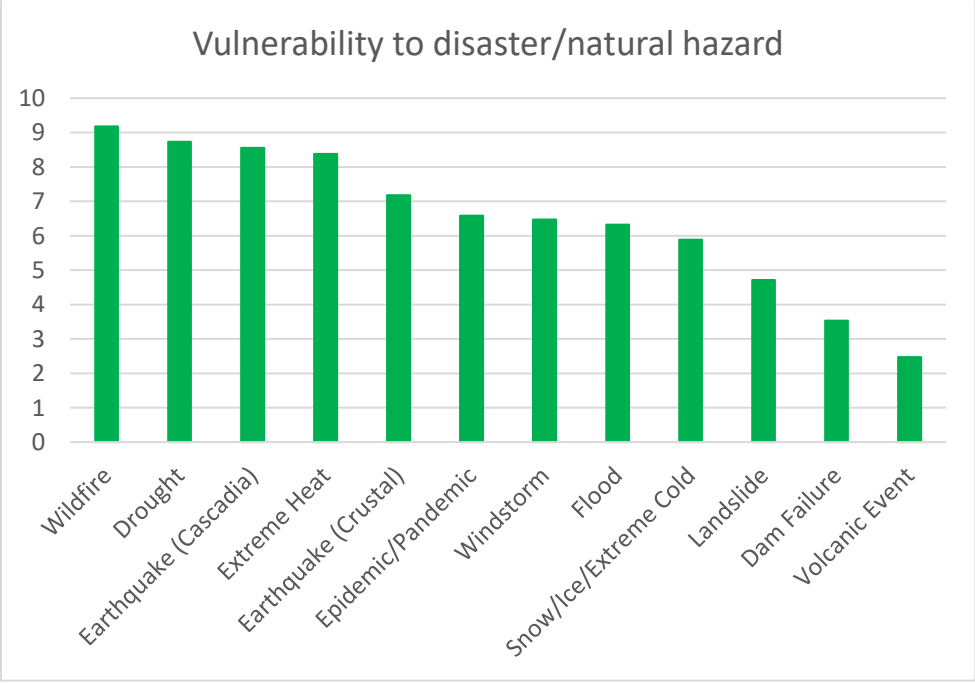
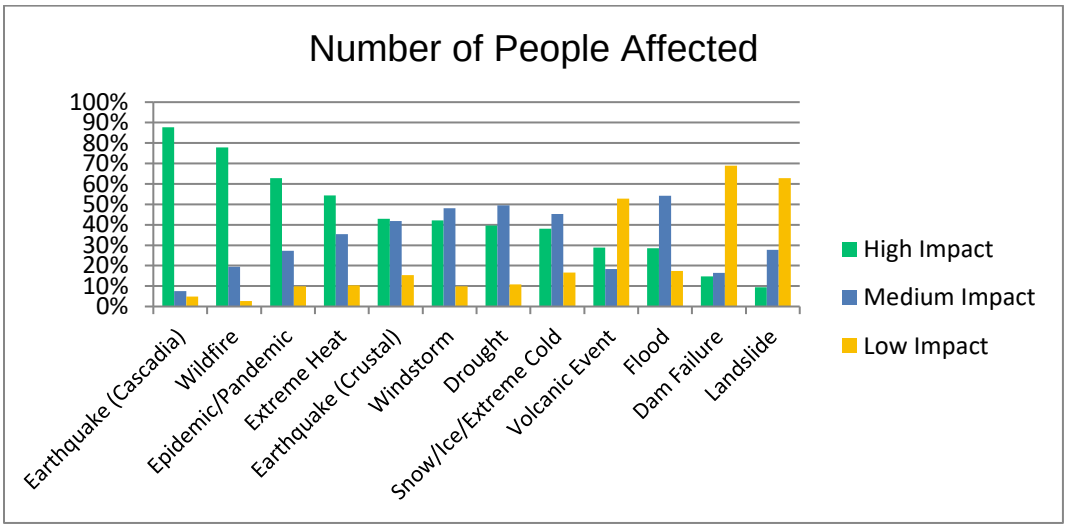
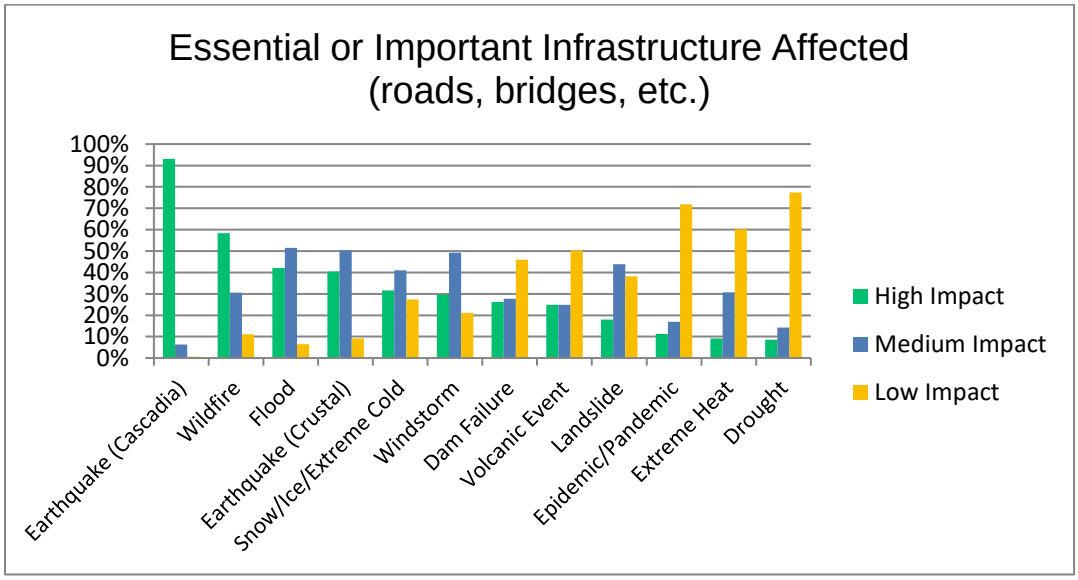


Figure 6. Graph of responses to Question 7: How do you rate the impact of disaster/natural hazards people, infrastructure, and services?





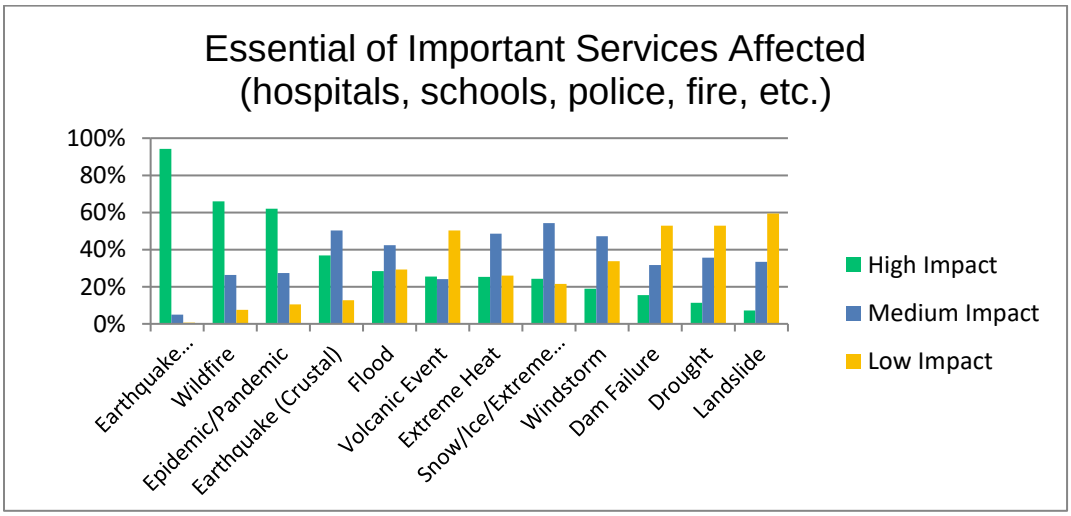
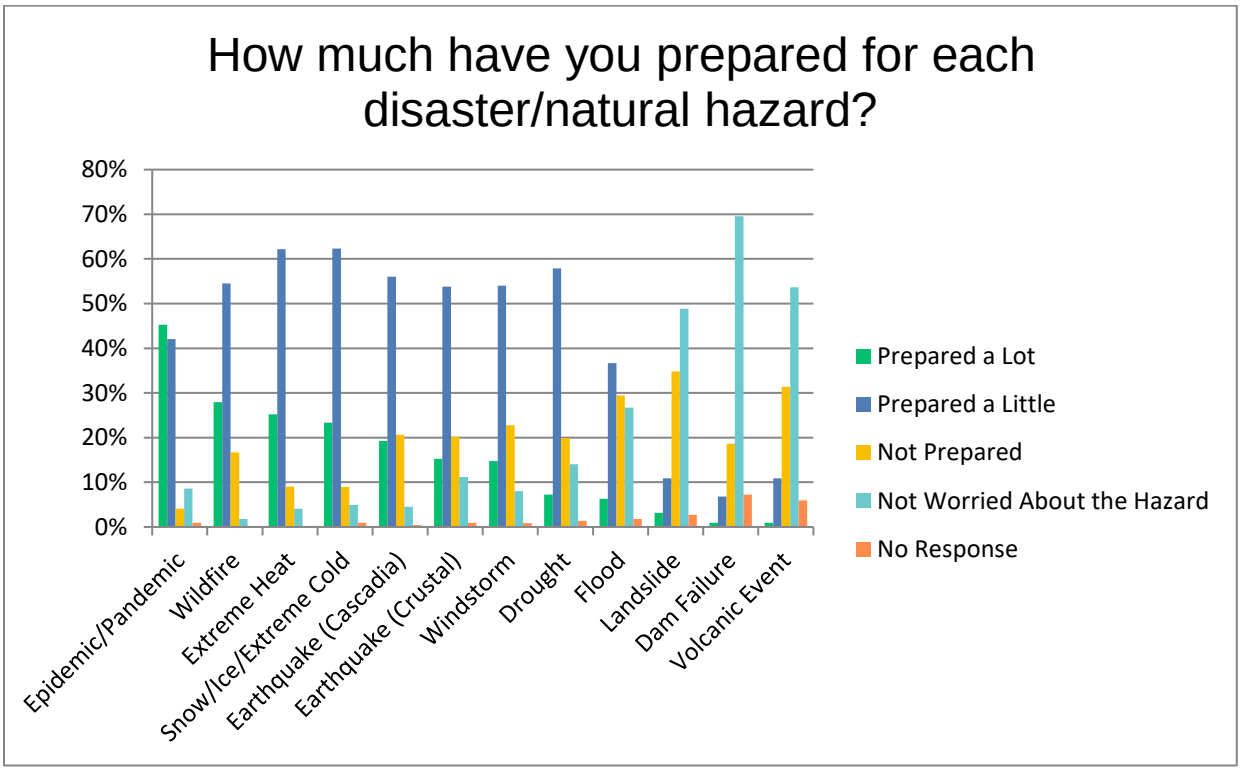


Figure 7. Graph of responses to Question 8: How much have you prepared for each disaster/natural hazard?



Question 9: What is one thing that would help you *feel* more prepared?

This question was presented as open-ended. The summary of the responses can be categorized in the following areas:

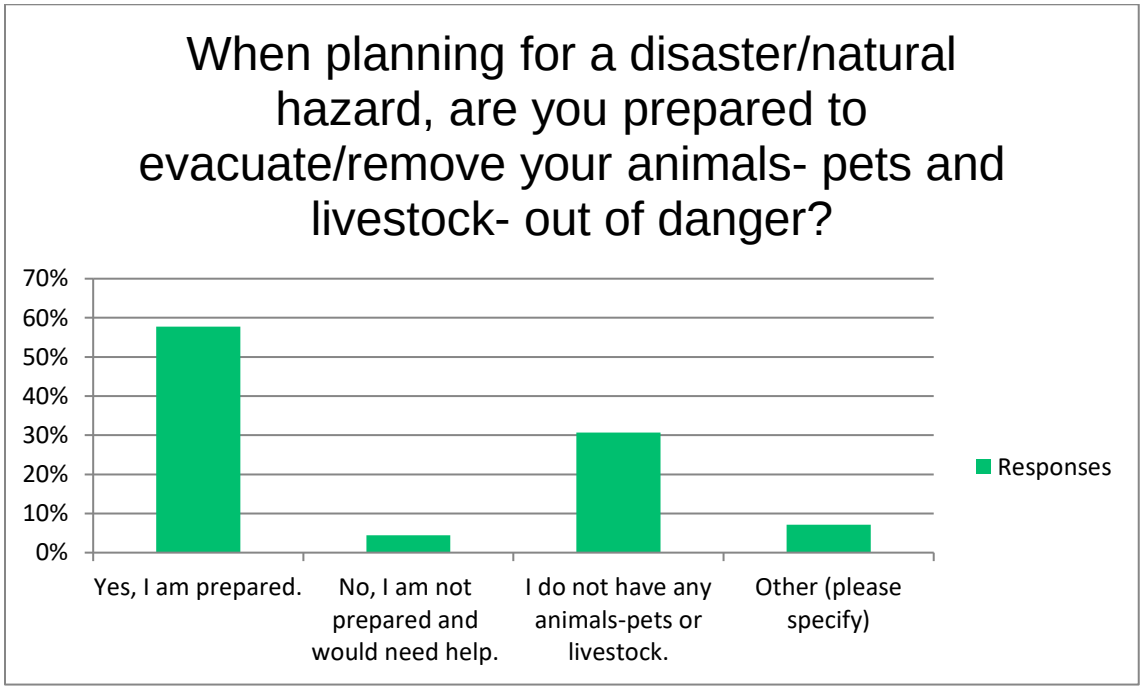
- Evacuation drills done at the individual and local level
- Community all-hazard educational opportunities on response capabilities and coordination efforts across local response disciplines
- Community planning- neighborhood programs like Firewise, CERT, Know Your Neighbors
- Enhance infrastructure (buildings, bridges, roads) to withstand all-hazard disaster impacts
- Evacuation route enhancements on an all-hazard level
- Neighborhood, public, and private land maintenance (brush clearing, preventative burning), to decrease the risk of wildfire
- Knowledge of insurance requirements and potential needs depending on the local hazards
- Completing individual emergency lists, kits, and preparations for all-hazards disaster impacts

Question 10: What is one thing that would help you *be* more prepared?

This question was presented as open-ended. The summary of the responses can be categorized in the following areas:

- Neighborhood, local and state caching of supplies- water, food, shelter
- Individual preparedness as income is available- water storage, food, shelter options, evacuation routes, home drills, backup electricity, insurance policies
- Enforcing defensible space in Wildland Urban Interface zones
- Advanced communication of disaster events that impact those will access and functional needs, those with large numbers of livestock, or mobility issues
- Create neighborhood networks to increase community preparedness involvement and accountability
- Communications plan and cell/radio stability resources brought to rural areas

Figure 8. Graph of responses to Question 11: Are you prepared to move your animals during a disaster/natural hazard event?



Question 12: What are some projects or actions to take in your community that would help reduce the impact of disasters/natural hazards on important infrastructure (e.g. community centers, buildings, roads, water systems, etc.)?

This question was presented as open-ended. The summary of the responses can be categorized in the following project areas:

- Land/infrastructure Stewardship projects focused on an all-hazard approach: larger culverts, Firewise and defensible space enforcement, vulnerable population disaster relocation, floodplain education, power line hardening, communication tower hardening
- Offer community training for free: Community Emergency Response Team, First Aid/CPR/AED, Stop the Bleed, Firewise neighborhoods, Defensible Space, neighborhood disaster planning/Map Your Community
- Community emergency caches available in all rural areas
- Community funding to help individuals fulfill basic preparedness needs
- Emergency plans prepared and communicated to the public, update the public on main transportation arteries in the County
- Move electrical mains underground, hardening of power lines and power stations
- Conduct periodic emergency response exercises to identify strengths and weaknesses of the system

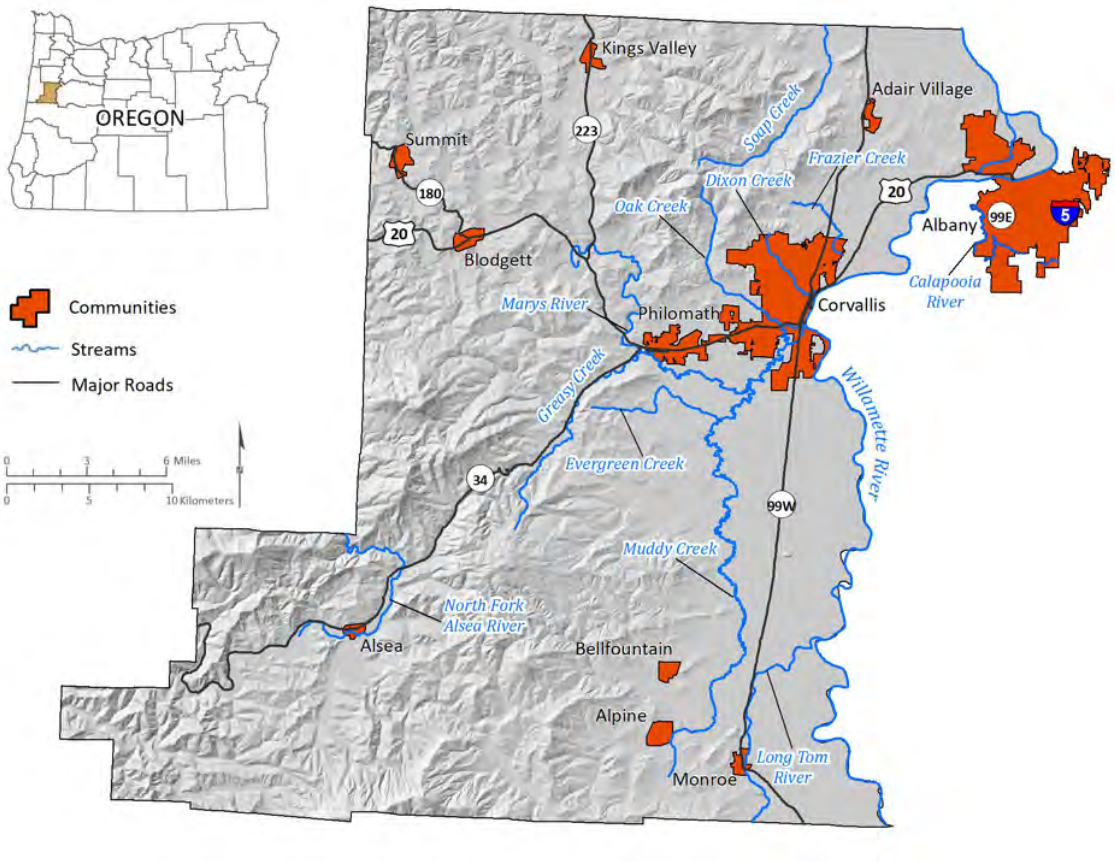
APPENDIX G:
DOGAMI MULTI-HAZARD RISK REPORT FOR BENTON COUNTY

State of Oregon
Oregon Department of Geology and Mineral Industries
Ruarri J. Day-Stirrat, State Geologist

OPEN-FILE REPORT O-23-06

MULTI-HAZARD RISK REPORT FOR BENTON COUNTY, OREGON

INCLUDING THE CITIES OF ADAIR VILLAGE, ALBANY, CORVALLIS, MONROE, AND PHILOMATH, AND THE UNINCORPORATED COMMUNITIES OF ALPINE, ALSEA, BELLFOUNTAIN, BLODGETT, KINGS VALLEY, AND SUMMIT



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Cover image: Study area of the Benton County Risk Report. Map depicts Benton County, Oregon and communities included in this report.

WHAT'S IN THIS REPORT?

This report describes the methods and results of a natural hazard risk assessment for Benton County communities. The results quantify the impacts of natural hazards to each community and enhance the decision-making process in planning for disaster.

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GEOGRAPHIC INFORMATION SYSTEM (GIS) DATA

See the digital publication folder for files.
Geodatabase is Esri® version 10.7 format. Metadata are embedded in the geodatabase and are also provided as separate .xml format files.

Benton_County_Risk_Report_Data.gdb

Feature dataset: Asset_Data
feature classes:
Building_footprints (polygons)
Communities (polygons)
UDF_points (points)

Metadata in .xml file format:
Each dataset listed above has an associated, standalone .xml file containing metadata in the Federal Geographic Data Committee Content Standard for Digital Geospatial Metadata format.

EXECUTIVE SUMMARY

This report was prepared for the communities of Benton County, Oregon, with funding provided by the Federal Emergency Management Agency (FEMA). It describes the methods and results of a natural hazard risk assessment performed in 2022 by the Oregon Department of Geology and Mineral Industries (DOGAMI) within the study area. The purpose of this project is to provide communities with detailed risk assessment information to enable them to compare hazards and act to reduce their risk. The risk assessment results quantify the impact of natural hazards to each community and enhance the decision-making process in planning for disaster.

We arrived at our findings and conclusions by completing three main tasks: compiling an asset database, identifying and using the best available hazard data, and performing a natural hazard risk assessment.

- In the first task, we created a comprehensive asset database for Benton County by synthesizing assessor data, U.S. Census information, FEMA Hazus®-MH general building stock information, and building footprint data. This work resulted in a single dataset of building points and their associated building characteristics (i.e., construction materials, number of floors, usage, etc). Using these data, we were able to represent accurate spatial locations and vulnerabilities on a building-by-building basis.
- The second task was to identify and use the most current and appropriate hazard datasets for the study area. Most of the hazard datasets used in this report were created by DOGAMI and produced using peer-reviewed methods and with high-resolution, lidar topographic data. Although not all the data sources used in the report provide complete, countywide information, each hazard dataset used was the best available at the time of the analysis. Data sources and coverage are discussed in detail for each hazard in **Assessment Overview and Results.**
- In the third task, we analyzed risk using Esri® ArcGIS Desktop® software. We took two risk assessment approaches: (1) estimated loss (in dollars) to buildings from floods and earthquakes using the Hazus-MH methodology, and (2) calculated the number of buildings, their value, and associated populations exposed to earthquake, and flood scenarios, or susceptible to varying levels of hazard from landslides, channel migration, and wildfire. Details on recurrence intervals, susceptibility, hazard levels and other particulars are discussed in detail for each hazard in **Assessment Overview and Results.**

The findings and conclusions of this report show the wide range of potential impacts hazards could have on the communities of Benton County. A Cascadia Subduction Zone (CSZ) earthquake (Mw-9.0) will cause extensive damage and losses throughout the county, with most of the critical facilities at high risk. The Turner and Mill Creek Fault Mw-6.6 earthquake showed localized high damages for areas in the northeastern portion of Benton County. We demonstrate the potential for reduction in earthquake damages and losses through seismic retrofits using the building code simulations in the Hazus-MH earthquake model. We also find that the highest potential for population displacement is associated with earthquake, flood, and landslide hazards. Flooding is identified as a threat for some communities in the county (Alsea, Corvallis, Philomath, and Albany) and we quantify the number of elevated structures that are less vulnerable to flood hazard. Our analysis shows that areas with moderate to steep slopes or at the base of steep hillsides are at the greatest risk from landslide hazards, which are present throughout the communities and rural county. Over 400 buildings along Marys River and North Fork Alsea River were

exposed to channel migration hazard. Wildfire exposure analysis shows a higher risk for buildings within the wildland-urban interface (WUI) in the western and northern parts of the county.

The information presented in this report is designed to increase awareness of natural hazard risk, to support public outreach efforts, and to aid local decision-makers in developing comprehensive plans and natural hazard mitigation plans. This study can help emergency managers identify vulnerable critical facilities and develop contingencies in their response plans. The results of this study are designed to be used to help communities identify and prioritize mitigation actions that will improve community resilience.

Results were broken out for the following geographic areas:

- Unincorporated Benton County (rural)
- City of Albany*
- City of Millersburg
- City of Philomath
- Community of Alsea
- Community of Blodgett
- Community of Summit
- City of Adair Village
- City of Corvallis
- City of Monroe
- Community of Alpine
- Community of Bellfountain
- Community of Kings Valley

*The portion of the city of Albany within Linn County is included in this report.

Selected countywide results
Total buildings: 61,091
Total estimated building value: $19 billion

Cascadia Subduction Zone Magnitude 9.0 Earthquake Scenario
Red-tagged buildings[a]: 2,552
Yellow-tagged buildings[b]: 8,936
Loss estimate: $2.9 billion

Turner and Mill Creek Fault Magnitude-6.6 Earthquake Scenario
Red-tagged buildings[a]: 1,898
Yellow-tagged buildings[b]: 5,956
Loss estimate: $2 billion

100-year Flood Scenario
Number of buildings damaged: 2,067
Loss estimate: $88 million

Landslide Exposure (High and Very High-Susceptibility)
Number of buildings exposed: 2,078
Exposed building value: $497 million

Channel Migration Zone* (Erosion Hazard Area – 30-year):
Number of buildings exposed: 402
Exposed building value: $96 million

Wildfire Exposure (High and Moderate Risk):
Number of buildings exposed: 1,777
Exposed building value: $481 million

[a]Red-tagged buildings are considered uninhabitable due to complete damage
[b]Yellow-tagged buildings are considered limited habitability due to extensive damage
*Results are limited the study area of Appleby and others (2021), which covers the North Fork Alsea River and Marys River.

1.0 INTRODUCTION

A *natural hazard* is an environmental phenomenon that can negatively impact humans, and *risk* is the likelihood that a hazard will result in harm. A natural hazard risk assessment identifies the applicable hazards and analyzes their impacts on the built environment and population, including the cost of recovery. Risk assessments provide key foundational information that can be used to develop mitigation plans, strategies, and actions, so that steps can be taken to prepare for a potential hazard event.

Key Terms:

- *Vulnerability:* Characteristics that make people or assets more susceptible to a natural hazard.
- *Risk:* Likelihood of occurrence multiplied by consequence; the degree of probability that a loss or injury may occur as a result of a natural hazard.

This is a multi-hazard risk assessment analyzing the impacts to buildings and resident population in Benton County. It provides a detailed and comprehensive analysis of natural hazard risk and provides a comparative perspective not previously available. In this report, we describe our assessment results, which quantify the various levels of risk that each hazard presents to Benton County communities.

Benton County is situated in the northwestern part of Oregon in the Willamette Valley and is subject to natural hazards including: earthquake, riverine flooding, landslides, channel migration, and wildfire. This region of the state is moderately to heavily developed, composed of dense urban areas transitioning to suburban development in unincorporated parts of the study. There are also large uninhabited areas where the county jurisdiction extends into the Oregon Coast Range. Where natural hazards have the potential to damage assets or harm people, the result is natural hazard risk. The primary goal of the risk assessment is to inform communities of the risk posed by various natural hazards and to be a resource for risk reduction actions.

1.1 Purpose

The purpose of this project is to help communities in the study area better understand their risk and increase resilience to earthquakes (including ground shaking, liquefaction and coseismic landslides), riverine flooding, landslides, channel migration, and wildfire. This is accomplished by using the best available, most accurate and detailed information about these hazards to assess the number of people and buildings at risk.

The main objectives of this study are to:

- compile a database of critical facilities, tax assessor data, buildings, and population distribution data,
- incorporate and use existing data from the most current geologic, hydrologic, and wildfire hazard studies,
- perform exposure and Hazus–based risk analyses, and
- share this report widely so that all interested parties have access to its information and data.

The body of this report describes our methods and results. Two primary methods (Hazus-MH loss estimation and exposure) were used to assess risk, depending on the type of hazard. These methods are described in the **Methods** section. Countywide results are reported for each hazard in **Community Risk Profiles**. Results for individual communities are detailed in **Appendix A: Community Risk Profiles**. **Appendix B** contains the detailed risk assessment tables used to generate the countywide results and community risk profiles. **Appendix C** provides additional explanation of the Hazus-MH methodology.

Appendix D defines acronyms and other terms used in this report. **Appendix E** contains tabloid-size maps showing the spatial extent of the hazards, assets, and population across Benton County. These appendices can be helpful in clarifying the summarized results in each hazard section.

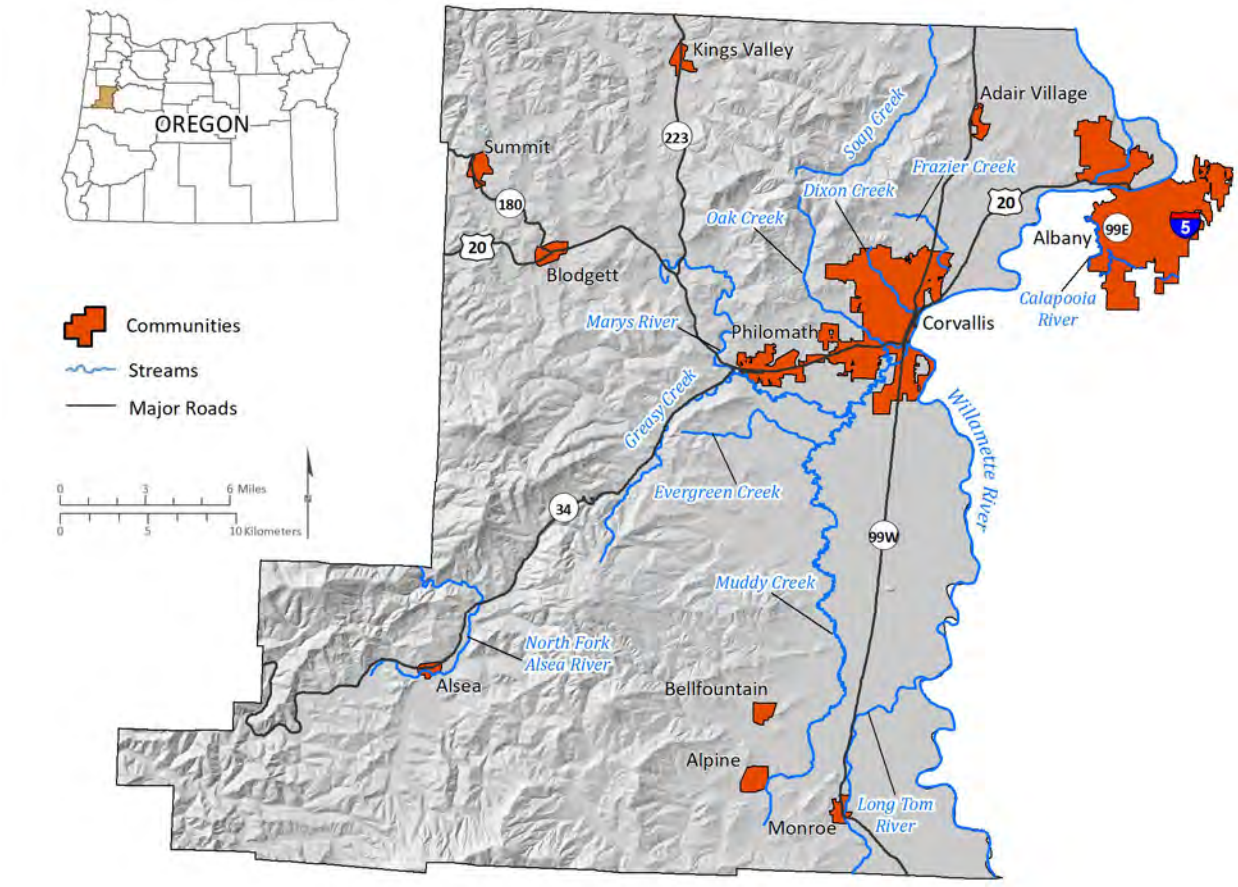
1.2 Study Area

The study area for this project includes the entirety of Benton County, Oregon as well as the portion of the City of Albany that is within Linn County (**Figure 1-1**). Benton County is located in the northwestern portion of the state; the county is bordered by Polk County to the north, Linn County to the east, Lane County to the south, and Lincoln County to the west. The entire eastern boundary of Benton County with Linn County is defined by the Willamette River. The total area of Benton County is 1,756 square kilometers (678 square miles). Starting in the west, the study area transitions from timberland, to farmland, to suburbs, and then to urban development in the east.

The geography of western Benton County consists of the heavily forested Oregon Coast Range. Marys Peak, located west of Philomath, is the highest peak in the Oregon Coast Range at 1,249 meters (4,097 feet). The Siuslaw National Forest makes up a significant portion of the county's western half. The eastern half of the county transitions from the heavily forested mountains to gently rolling farmland and then onto the broad flat floor of the Willamette Valley.

The population of Benton County is approximately 144,000 based on an estimated population for each community in 2020 from the Portland State University (PSU) Population Research Center https://www.pdx.edu/population-research/population-estimate-reports. Most of the residents reside in the eastern half of the county. The City of Corvallis, which is the county seat and location of Oregon State University, has a population of approximately 60,000. The incorporated communities of the study area are Adair Village, Albany, Corvallis, Monroe, and Philomath (**Figure 1-1**). The portion of Albany that is within Linn County is also included in this study. The unincorporated communities that were examined in this study were Alpine, Alsea, Bellfountain, Blodgett, Kings Valley, and Summit.

Figure 1-1. Study area: Benton County with communities in this study identified. Countywide results for each hazard are presented in Chapter 3. Individual community risk profiles are presented in Appendix A.



1.3 Project Scope

For this risk assessment, we limited the project scope to natural hazard impacts on buildings and population because of data availability, the strengths and limitations of the risk assessment methodology, and funding availability. We did not directly analyze impacts to the local economy, community lifelines, stored hazardous materials, land values, socially vulnerable populations, infrastructure (transportation, power, water, gas, communication, and sewage), or the environment. Depending on the natural hazard, we used one of two methodologies: loss estimation or exposure. Loss estimation was modeled using Hazus®-MH (FEMA, 2012a, 2012b, 2012c), a tool developed by FEMA for calculating damage to buildings from flood and earthquake. Exposure is a simpler method, in which buildings are categorized based on their location relative to various hazard zones. City and county population numbers from the PSU Population Research Center data was used to distribute people into residential structures based on square footage (https://www.pdx.edu/population-research/population-estimate-reports).

A critical component of this risk assessment is a countywide building inventory developed from building footprint data and the Benton County tax assessor database (acquired 2022). The other key component is a suite of datasets that represent the currently best available science for a variety of natural hazards. The geologic hazard scenarios were selected by DOGAMI staff based on their expert knowledge of the datasets; most datasets are DOGAMI publications. In addition to geologic hazards, we included wildfire hazard in this risk assessment. The following is a list of hazards considered in this study and what risk assessment methodologies were applied. See **Table 1-1** for data sources.

Earthquake Risk Assessment

- Hazus-MH loss estimation from a CSZ earthquake magnitude (Mw)-9.0 scenario. Includes earthquake induced or "coseismic" liquefaction, soil amplification class, and landslides.
- Hazus-MH loss estimation from a Turner and Mill Creek Fault Mw-6.6 scenario. Includes coseismic liquefaction, soil amplification class, and landslides.

Flood Risk Assessment

- Hazus-MH loss estimation to four recurrence intervals (10%, 2%, 1%, and 0.2% annual chance)
- Exposure to 1% annual chance recurrence interval

Landslide Risk Assessment

- Exposure based on Landslide Susceptibility Index and landslide deposit mapping

Channel Migration Risk Assessment

- Exposure based on the 30-year erosion hazard area

Wildfire Risk Assessment

- Exposure based on Overall Wildfire Risk

Table 1-1. Hazard data sources for Benton County.

Hazard	Scenario or Classes	Spatial Extent	Data Source
Earthquake	CSZ Mw-9.0	Regional	DOGAMI (Madin and others, 2021)
	Turner and Mill Creek Fault Mw-6.6	Countywide	USGS (Personius, 2002) accessed via Hazus fault database
-Coseismic landslide	Susceptibility – wet (3-10 hazard classes)	Statewide	DOGAMI (Madin and others, 2021)
-Coseismic liquefaction	Susceptibility (1-5 classes)	Countywide	DOGAMI (Hairston-Porter and others, 2021)
-Coseismic soil amplification class	National Earthquake Hazards Reduction Program (A-F classes)	Countywide	DOGAMI (Hairston-Porter and others, 2021)
Flood	Depth Grids: 10% (10-yr) 2% (50-yr) 1% (100-yr) 0.2% (500-yr)	Countywide	DOGAMI (Appleby and others, 2021) – derived from FEMA (2016) data
Landslide	Susceptibility (Low, Moderate, High, Very High)	Statewide	DOGAMI (Burns and others, 2016)
	Deposits	Countywide	DOGAMI (Hairston-Porter and others, 2021)
Channel Migration	Susceptibility (Not Exposed, Exposed)	Marys and North Fork Alsea Rivers	DOGAMI (Appleby and others, 2021)
Wildfire	Overall Wildfire Risk (Low, Moderate, High)	Regional (Pacific Northwest, US)	ODF (Gilbertson-Day and others, 2018)

1.4 Previous Studies

One previous risk assessment has been conducted that included the study area by DOGAMI. Wang (1998) used Hazus-MH to estimate the impact from a Mw-8.5 CSZ earthquake scenario on the state of Oregon. The results of this study were arranged into individual counties. Benton County was estimated to experience a 9.5% loss ratio in the Mw-8.5 CSZ scenario due to its proximity to the earthquake source.

Burns and others (2008) developed earthquake and landslide hazard maps and used Hazus-MH to estimate future earthquake damage for the Mid/Southern Willamette Valley which included Benton County. The Hazus-MH analysis used the Corvallis Fault, magnitude (Mw) 6.5 and CSZ, Mw-9.0. Both scenarios aggregated results at the census tract level using the default Hazus-MH general building stock database. Estimated loss ratios for Benton County were 31% for the Corvallis Fault and 32% for the CSZ scenarios.

We did not compare the results of these projects with previous studies because of the difference in level of detail and accuracy of building information and earthquake inputs.

2.0 METHODS

Where there is interaction between people and natural hazards there is risk. We used a quantitative approach through two modes of analysis, Hazus-MH loss estimation and exposure, to assess the level of risk to buildings and people from natural hazards.

2.1 Hazus-MH Loss Estimation

Key Terms:

- *Loss estimation:* Damage in terms of value that occurs to a building in an earthquake or flood scenario, as modeled with Hazus-MH methodology. This is measured as the cost to repair or replace the damaged building in US dollars.
- *Loss ratio:* Percentage of estimated loss relative to the total value.

We used Hazus-MH version 5.0 (FEMA, 2021), which was the latest version available when we began this risk assessment. According to FEMA (FEMA, 2012a, p. 1-1), "Hazus provides nationally applicable, standardized methodologies for estimating potential wind, flood, and earthquake losses on a regional basis. Hazus can be used to conduct loss estimation for floods and earthquakes […]. The multi-hazard Hazus is intended for use by local, state, and regional officials and consultants to assist mitigation planning and emergency response and recovery preparedness. For some hazards, Hazus can also be used to prepare real-time estimates of damages during or following a disaster."

Hazus-MH can be used in different modes depending on the level of detail required. Given the high spatial precision of the building inventory data and quality of the natural hazard data available for this study, we chose the user-defined facility (UDF) mode. This mode makes loss estimations for individual buildings relative to their "cost," which we then aggregate to the community level to report loss ratios. Costs used in this mode are associated with rebuilding using new materials, also known as replacement cost. Replacement cost is determined using a method called RSMeans valuation (Charest, 2017) and is calculated by multiplying the building area (in square feet) by a standard cost per square foot. These standard rates per square foot are in tables within the default Hazus-MH database.

Damage functions are at the core of Hazus-MH. The damage functions stored within the Hazus-MH data model were developed and calibrated from the observed results of past disasters. We estimated damage and loss by intersecting building locations with natural hazard layers and applying damage functions based on the hazard severity (e.g., depth of flooding) and building characteristics (e.g., first floor height). **Figure 2-1** illustrates the range of building loss estimates from a Hazus-MH flood analysis. In this example, most buildings within the 100-year flood zone are estimated to experience losses ranging from >0 to >15%. Buildings with a first-floor height above the level of flooding and those outside the flood zone are expected to experience no losses.

Figure 2-1. 100-year flood zone and building loss estimates example in city of Philomath, Oregon.

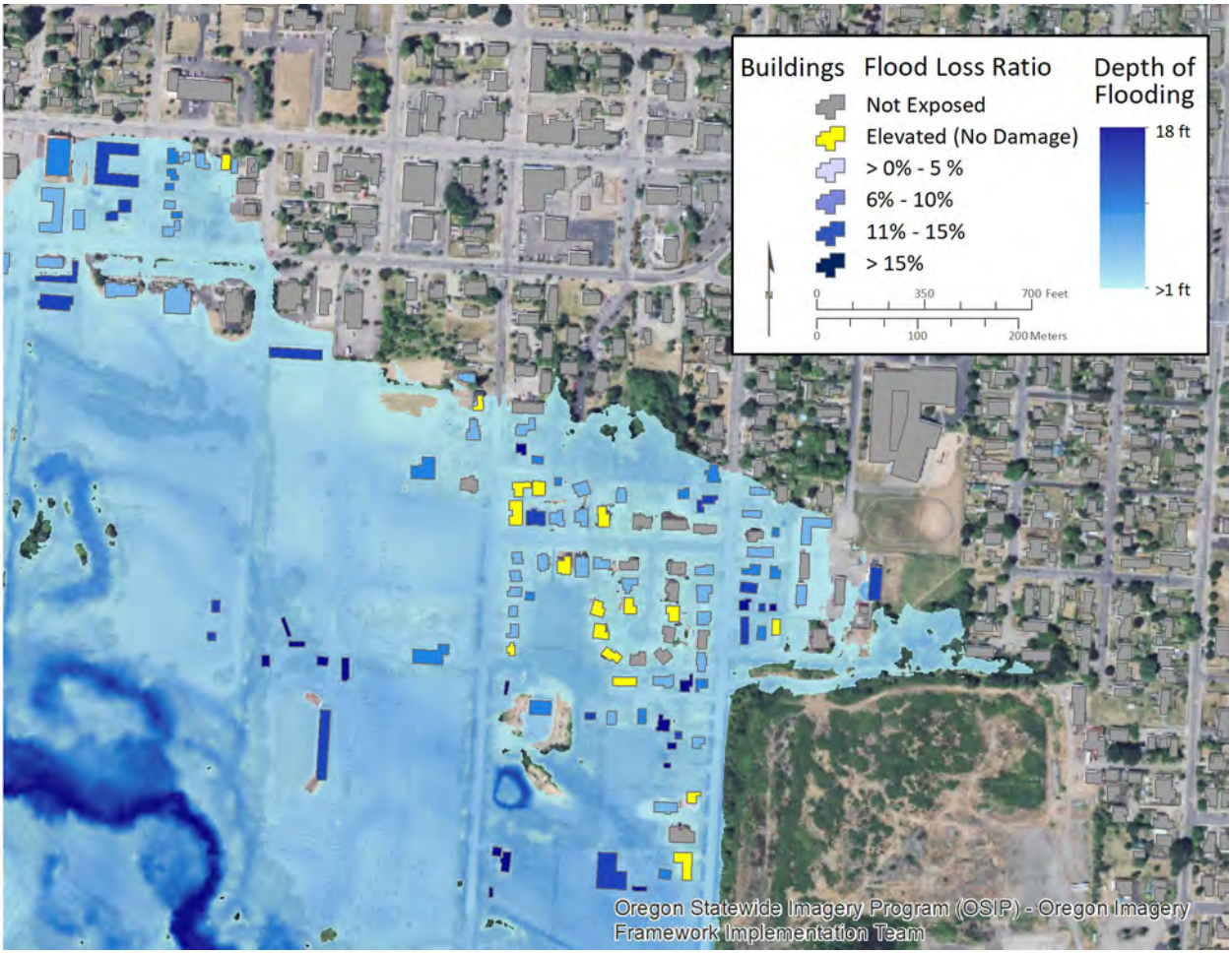


Image source: Oregon Statewide Imagery Program, 2018

Depth grid: Derived from the effective FEMA Flood Insurance Rate Map data for Benton County, 2016

2.2 Exposure

Key Terms:

- *Exposure:* Determination of whether a building is within or outside of a hazard zone. No loss estimation is modeled.
- *Building value:* Total monetary value of a building. This term is used in the context of exposure.

Since loss estimation using Hazus-MH is not available for all types of hazards, we used exposure analysis to assess landslide, channel migration, and wildfire risk. Exposure methodology identifies the buildings and population that are within a particular natural hazard zone. This is an alternative to the more detailed loss estimation method for those natural hazards that do not have available damage models like in Hazus. It provides a way to easily quantify what is and is not threatened. Exposure results are communicated in terms of total building value exposed, rather than a loss estimate. For example, **Figure 2-2** shows buildings that are exposed to different levels of landslide susceptibility with building footprints colored based on what susceptibility zone the center of the building is within.

Exposure is used for landslide, wildfire, and channel migration hazards. For comparison with loss estimates, exposure is also used for the 1% annual chance flood (100-year flood).

Figure 2-2. Landslide susceptibility areas and building exposure example in Benton County, Oregon.

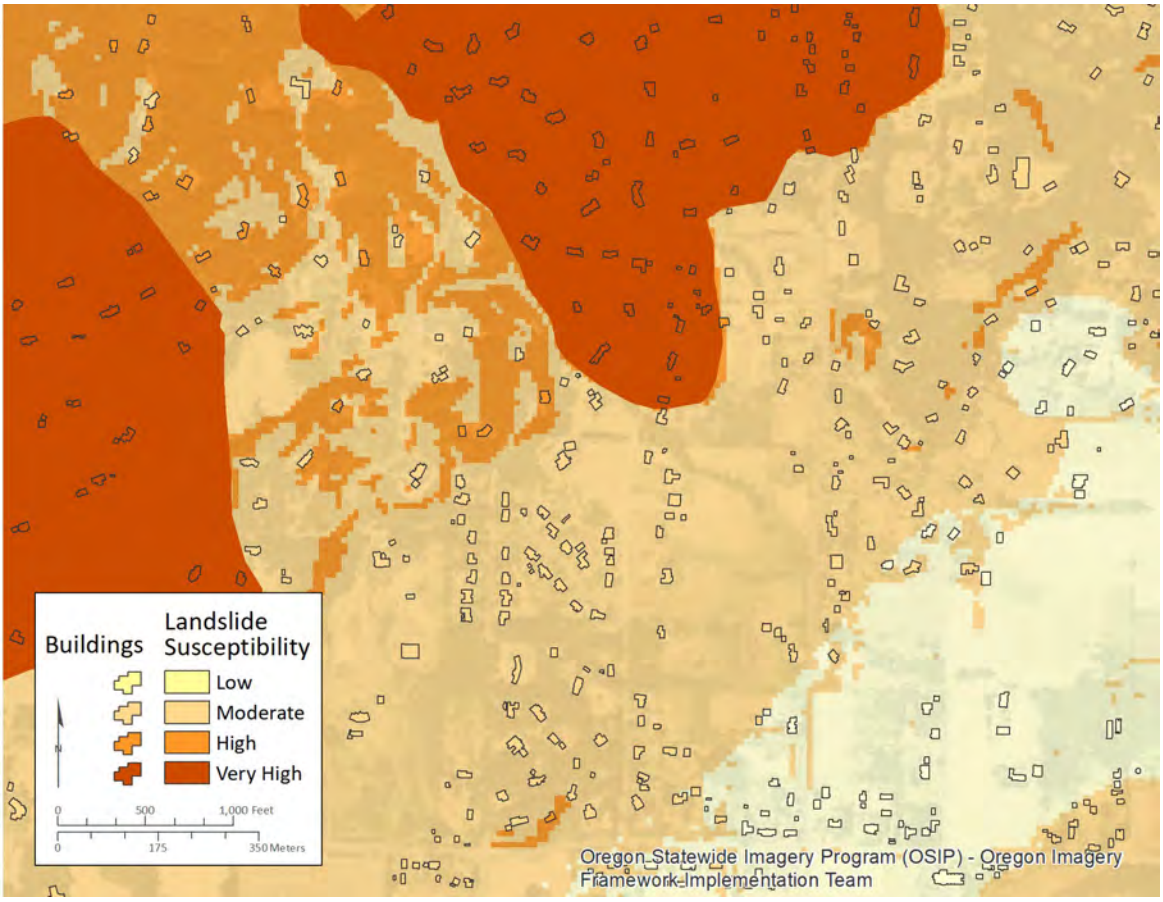


Image source: Oregon Statewide Imagery Program, 2018

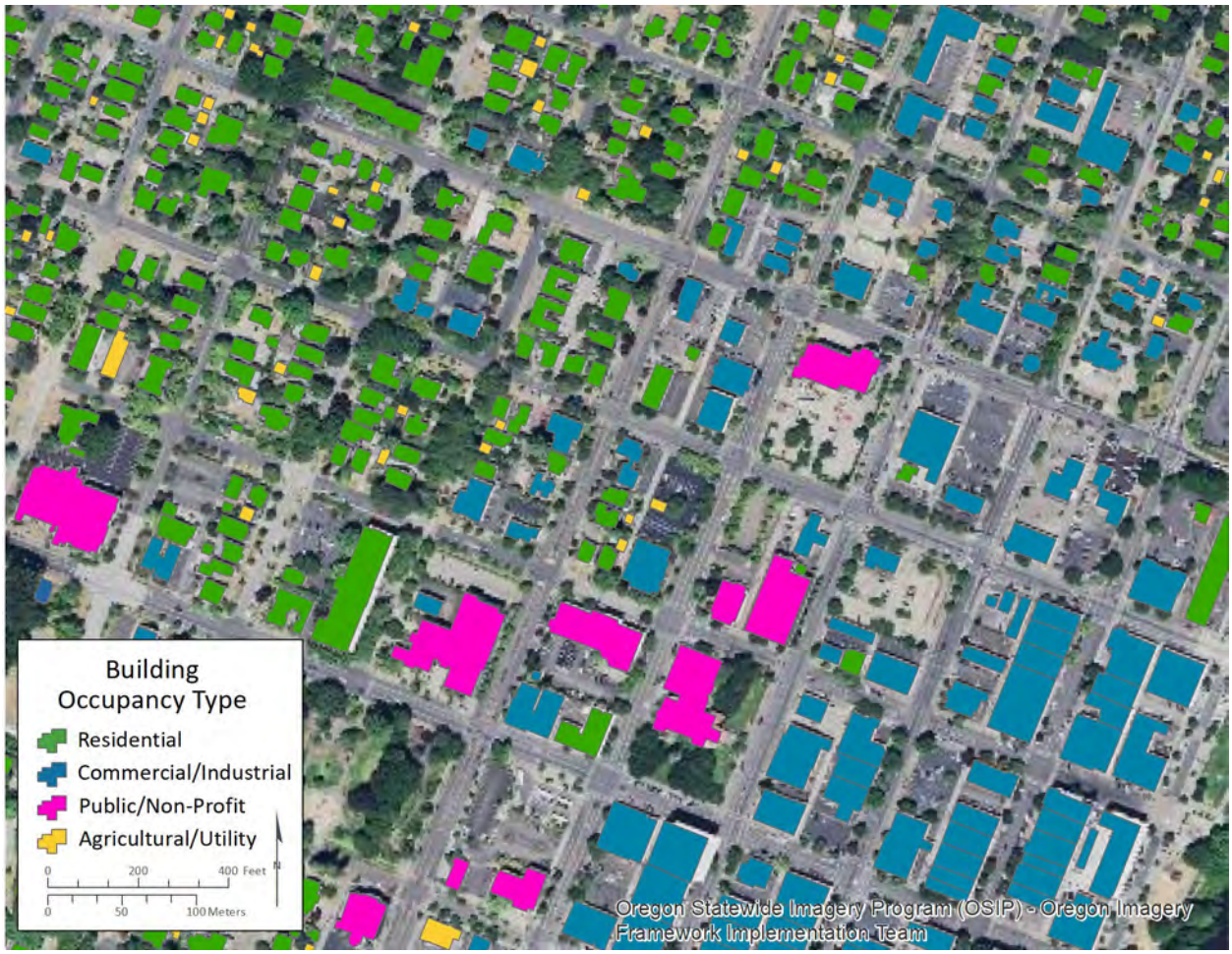
Landslide data source: Landslide susceptibility overview map of Oregon, (Burns and others, 2016) and Benton County landslide deposits, (Hairston-Porter and others, 2021)

2.3 Building Inventory

A key piece of the risk assessment is the countywide building inventory. This inventory consists of all buildings larger than 9.3 square meters (100 square feet), as determined from existing building footprints (Williams, 2021). **Figure 2-3** shows an example of building inventory occupancy types used in the Hazus-MH and exposure analyses in Benton County. See also Appendix B: **Table B-1.**

To use the building inventory within Hazus-MH, we converted the building footprint polygons to points and migrated them into a UDF database with standardized field names and attribute domains. The UDF database formatting allows for the correct damage function to be applied to each building. Hazus-MH version 2.1 technical manuals (FEMA, 2012a, 2012b, 2012c) provide references for acceptable field names, field types, and attributes. The fields and attributes used in the UDF database (including building seismic codes) are discussed in more detail in Appendix **C.2.2**.

Figure 2-3. Building occupancy types, city of Corvallis, Oregon.



The number of buildings and total building value per community varies significantly in Benton County, with 53 buildings and $11 million for Blodgett to 17,509 buildings and $7.1 billion for Corvallis (**Table 2-1).** A table detailing the occupancy class distribution by community is included in **Appendix B: Detailed Risk Assessment Tables**.

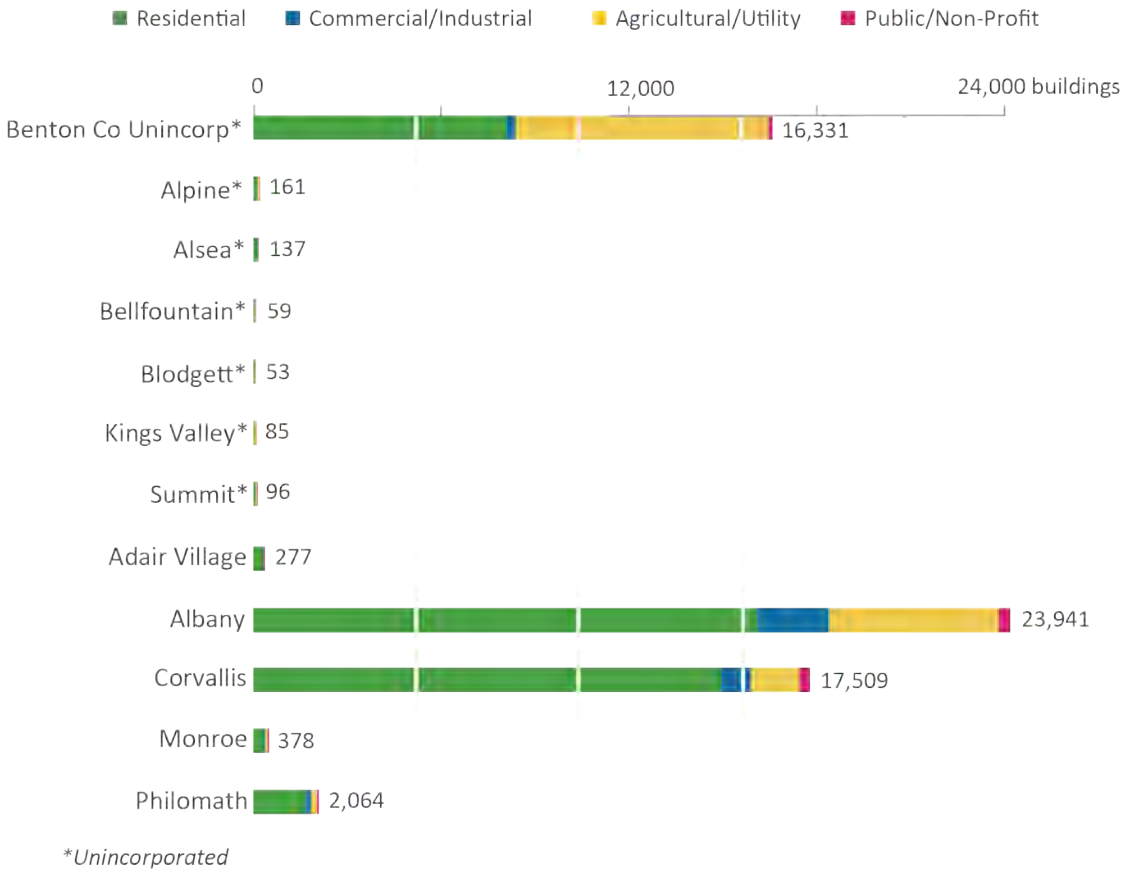
Table 2-1. Benton County building inventory.

Community	Total Number of Buildings	Percentage of Total Buildings	Estimated Total Building Value ($)	Percentage of Total Building Value
Unincorp. Benton Co (rural)	16,331	27%	3,934,253,000	21%
Alpine	161	0.3%	26,781,000	0.1%
Alsea	137	0.2%	30,315,000	0.2%
Bellfountain	59	0.1%	14,814,000	0.1%
Blodgett	53	0.1%	11,186,000	0.1%
Kings Valley	85	0.1%	17,918,000	0.1%
Summit	96	0.2%	20,026,000	0.1%
Total Unincorporated County	16,922	28%	4,055,292,000	22%
Adair Village	277	0.5%	107,166,000	0.6%
Albany	23,941	39%	7,033,549,000	37%
Corvallis	17,509	29%	7,132,168,000	38%
Monroe	378	0.6%	109,046,000	0.6%
Philomath	2,064	3.4%	581,805,000	3.1%
Total Study Area	61,091	100%	19,019,027,000	100%

The building inventory was developed from a building footprints dataset developed in 2021 called the Statewide Building Footprints for Oregon, release 1 (SBFO-1) (Williams, 2021). The SBFO-1 data of Benton County was modified from a building footprints dataset maintained by Benton County, obtained June 2020. The building footprints provide a location and 2D outline of each structure. There are a total of 61,091 buildings within the study area. We define buildings to be permanent structures with walls and a roof that can be occupied by people (Williams, 2021). Other structures, such as dams, water tanks/towers, sewage and water treatment tanks, tents, small garden sheds, hoop-houses or other plastic-covered greenhouses, and grain silos, were not considered buildings and were not included in this analysis.

The Benton County Assessment Office supplied assessor data and we formatted it for use in the risk assessment. The assessor data contains an array of information about each improvement (i.e., building). Tax lot data, which contains property boundaries and other information regarding the property, was obtained from the county assessor and was used to link the buildings with assessor data. The linkage between the two datasets resulted in a database of UDF points that contain attributes for each building. These points are used in the risk assessment for both loss estimation and analyses. Corvallis and Albany are the communities with the highest total number of buildings and residential use is the most common countywide (**Figure 2-4**).

Figure 2-4. Community building value in Benton County by occupancy class.



Critical facilities are important to note because these facilities play a crucial role in emergency response efforts. We embedded identifying characteristics into the critical facilities in the UDF database so they could be highlighted in the results. Critical facilities data came from the DOGAMI Statewide Seismic Needs Assessment (SSNA; Lewis, 2007). We updated the SSNA data by reviewing Google Maps™ data. The critical facilities we identified include hospitals, schools, fire stations, police stations, emergency operations, and military facilities. In addition, we included other buildings based on specific community input and structures that would be essential during a natural hazard event, such as public works and water treatment facilities. 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. Critical facilities are present throughout the county with most in Albany and Corvallis (**Table 2-2**). Critical facilities are listed for each community in **Appendix A**.

Table 2-2. Benton County critical facilities inventory.

Community	Hospital & Clinic		School		Police/Fire		Emergency Services		Military		Other*		Total	
	Count	Value ($)	Count	Value ($)	Count	Value ($)	Count	Value ($)	Count	Value ($)	Count	Value ($)	Count	Value ($)
						(all dollar amounts in thousands)								
Unincorp. Benton Co (rural)	0	0	5	75,619	5	6,108	0	0	1	4,844	5	20,472	16	107,042
Alpine	0	0	1	1,729	1	676	0	0	0	0	1	15	3	2,420
Alsea	1	468	1	9,253	1	1,220	0	0	0	0	0	0	3	10,941
Bellfountain	0	0	1	2,253	1	610	0	0	0	0	0	0	2	2,864
Blodgett	0	0	1	1,874	1	101	0	0	0	0	0	0	2	1,975
Kings Valley	0	0	1	4,591	0	0	0	0	0	0	0	0	1	4,591
Summit	0	0	0	0	1	337	0	0	0	0	0	0	1	337
Total Unincorp. County	1	468	10	95,319	10	9,053	0	0	1	4,844	6	20,487	28	130,170
Adair Village	0	0	1	15,505	1	2,655	0	0	0	0	1	498	2	18,160
Albany	9	14,969	23	73,955	5	9,193	0	0	1	2,828	4	11,407	34	27,538
Corvallis	5	171,755	15	221,554	7	40,745	1	2,920	1	3,107	4	21,868	29	453,015
Monroe	1	559	2	20,510	1	2,237	0	0	0	0	3	1,653	4	24,060
Philomath	0	0	4	53,321	2	5,892	0	0	0	0	3	2,721	7	61,020
Total Study Area	16	187,751	55	480,164	26	69,775	1	2,920	3	10,779	21	58,634	104	713,963

Note: Facilities with multiple buildings were consolidated into one building.

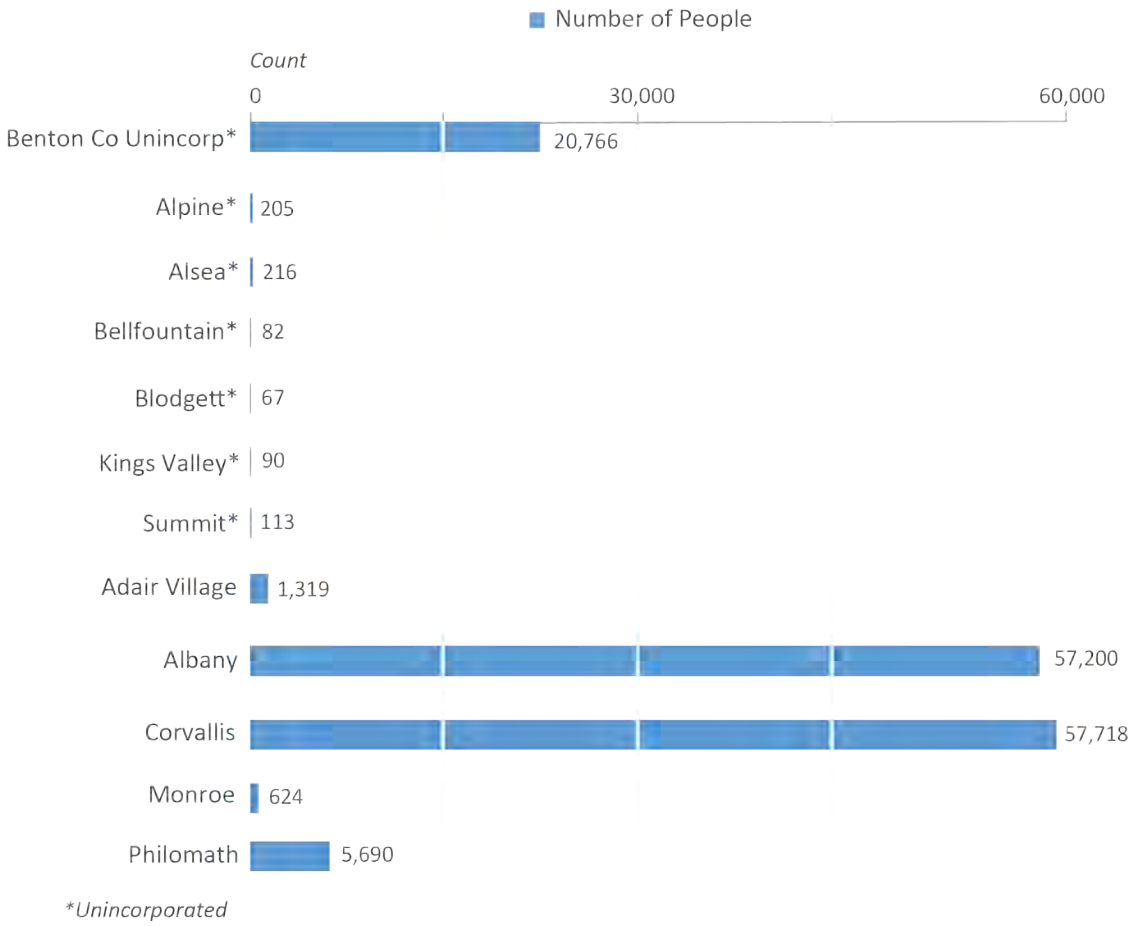
* Category includes buildings that are not traditional (emergency response) critical facilities but considered critical during an emergency based on input from local stakeholders (e.g., water treatment facilities or airports).

2.4 Population

One purpose of the UDF database design was so that we could estimate the number of people at risk from natural hazards. Within the UDF database, the 2020 U.S. Census population of permanent residents per census block was distributed proportionally among residential buildings based on building area. This census block-based distribution was further adjusted with the PSU Population Research Center estimates for 2021 (**Figure 2-5**). We did not examine the impacts of natural hazards on non-permanent populations (e.g., tourists), whose total numbers fluctuate seasonally. Due to lack of information within the assessor and census databases, we cannot distinguish between vacation homes and primary residences. Therefore, our method distributes some of the permanent residents into vacation homes, however they make up a small portion of the residential building stock in most communities (U.S. Census Bureau, 2020b).

From the Census and PSU Population Research Center data, we assessed the risk of the 144,091 residents within the study area that could be affected by a natural hazard scenario. For each natural hazard, with the exception of the earthquake scenario, a simple exposure analysis was used to find the number of potentially displaced residents within a hazard zone. For the earthquake scenario the number of potentially displaced residents was based on residents in buildings estimated to be significantly damaged by the earthquake.

Figure 2-5. Population by Benton County community.



3.0 ASSESSMENT OVERVIEW AND RESULTS

In this risk assessment, we considered five natural hazards (earthquake, flood, landslide, channel migration, and wildfire) that pose a risk to Benton County. The assessment describes both localized vulnerabilities and the widespread challenges that impact all communities. While results of this risk assessment do not typically represent singular hazard events, they do quantify the potential overall level of risk present for assets and residents. The loss estimation and exposure results, as well as the rich dataset included with this report, can lead to greater understanding of the potential impact of natural disasters. Communities can become more resilient to future disasters by utilizing the results in plan updates and developing future action items for risk reduction.

In this section, results are presented for the entire study area. The study area includes all unincorporated areas and cities within Benton County. Individual community results are in **Appendix A: Community Risk Profiles.**

3.1 Earthquake

An earthquake is a sudden movement of rock along a fault in the earth's crust, which abruptly releases strain that has accumulated over time. This movement produces waves of shaking that spread in all directions. If an earthquake occurs near populated areas, it may cause casualties, economic disruption, and extensive property damage (Madin and Burns, 2013).

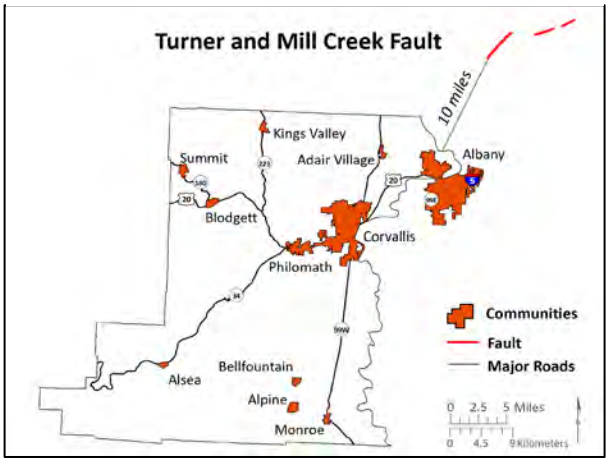
Two earthquake-induced hazards are liquefaction and landslides. Liquefaction occurs when saturated soils substantially lose bearing capacity due to ground shaking, causing the soil to behave like a liquid; this action can be a source of tremendous damage. Coseismic landslides are mass movement of rock, debris, or soil induced by ground shaking. Both of these hazards are site specific and will only occur in locations where conditions permit. All earthquake losses in this report include damages derived from shaking, as well as liquefaction and landslide factors.

3.1.1 Scenarios: CSZ and Turner and Mill Creek Fault

Just off Oregon's coast, the Juan de Fuca tectonic plate slides under the North American plate. Oregon (along with the rest of the Pacific Northwest and the nation) sits on the North American plate. This area of interaction between the two plates is known as the Cascadia subduction zone (CSZ). The pressure and friction created by this convergent motion builds potential energy at the plate boundary until the overriding plate (North American) suddenly slips, releasing energy that manifests as strong shaking spread over a wide area. Earthquakes as large as Mw-8 to 9 occur along the CSZ on average every 230-540 years and scientists estimate a 16-22% chance of one happening in the next 50 years (Goldfinger and others, 2012, 2017).

The other earthquake scenario examined for this report is the Turner and Mill Creek Fault, located approximately 10 miles northeast of Albany and oriented east to west (**Figure 3-1**). This is an ~11 mile (18 km) Quaternary fault estimated to slip less than 0.2mm/yr. Unlike CSZ, which is a very large and deep fault between two tectonics plates, the Turner and Mill Creek Fault is crustal, meaning it is a crack within the North American plate. Despite their comparatively small size, crustal earthquakes can cause significant damage due to their proximity to the surface and the built environment. The estimated maximum fault displacement for the Turner and Mill Creek Fault could produce relatively large (Mw-6.6) earthquakes, enough to pose a significant hazard (Personius, 2002). Although the damage produced from this fault would be far more localized than a CSZ event, it poses a serious seismic threat to the communities in the vicinity of the northeastern portion of Benton County. The current understanding of this fault and various aspects of its frequency and magnitude are limited.

Figure 3-1. Turner and Mill Creek fault location



We examined earthquake shaking and ground failure (coseismic liquefaction and landslides) hazards produced from both earthquake scenarios. These two earthquake scenarios were analyzed in Hazus-MH because we observed, from the initial Hazus-MH analyses for this study, that areas around the northeast corner of Benton County were similarly at risk from the Turner and Mill Creek Fault Mw-6.6 as from the

far more widespread damaging CSZ Mw-9.0. The effects from either earthquake scenario present a challenge for planners preparing for hazard impacts.

3.1.2 Data sources: CSZ

Most of the earthquake hazard data come from the Oregon Seismic Hazard Database, release 1.0 (OSHD-1), which includes ground shaking and site-specific earthquake data for a CSZ Mw-9.0 event (Madin and others, 2021). In recently published work, the USGS (Wirth and others, 2021) ran 30 CSZ Mw-9.0 simulations that represented the variability of shaking that Madin and others (2021) used to develop the ground shaking datasets in the OSHD-1.

Hazus-MH offers two scenario methods for estimating loss from earthquake: probabilistic and deterministic (FEMA, 2012b). A probabilistic scenario uses U.S. Geological Survey (USGS) National Seismic Hazard Maps, which are derived from seismic hazard curves calculated on a grid of sites across the United States that describe the annual frequency of exceeding a set of ground motions as a result of all possible earthquake sources (USGS, 2019). A deterministic scenario is based on a specific seismic event, which in this case is a CSZ Mw-9.0 event. We selected the deterministic scenario method because the CSZ event is the most likely large earthquake to impact this area (Goldfinger and others, 2012, 2017). We used the deterministic method along with the UDF database so that loss estimates could be calculated on a building-by-building basis.

The following hazard layers used for the loss estimation analysis come from OSHD-1: National Earthquake Hazard Reduction Program (NEHRP) soil classification, peak ground acceleration (PGA), peak ground velocity (PGV), spectral acceleration at 1.0 second period and 0.3 second period (SA10 and SA03), and liquefaction and landslide susceptibility. The liquefaction and landslide susceptibility layers together with PGA were used by the Hazus-MH tool to calculate probability and magnitude of permanent ground deformation.

3.1.3 Countywide results: CSZ

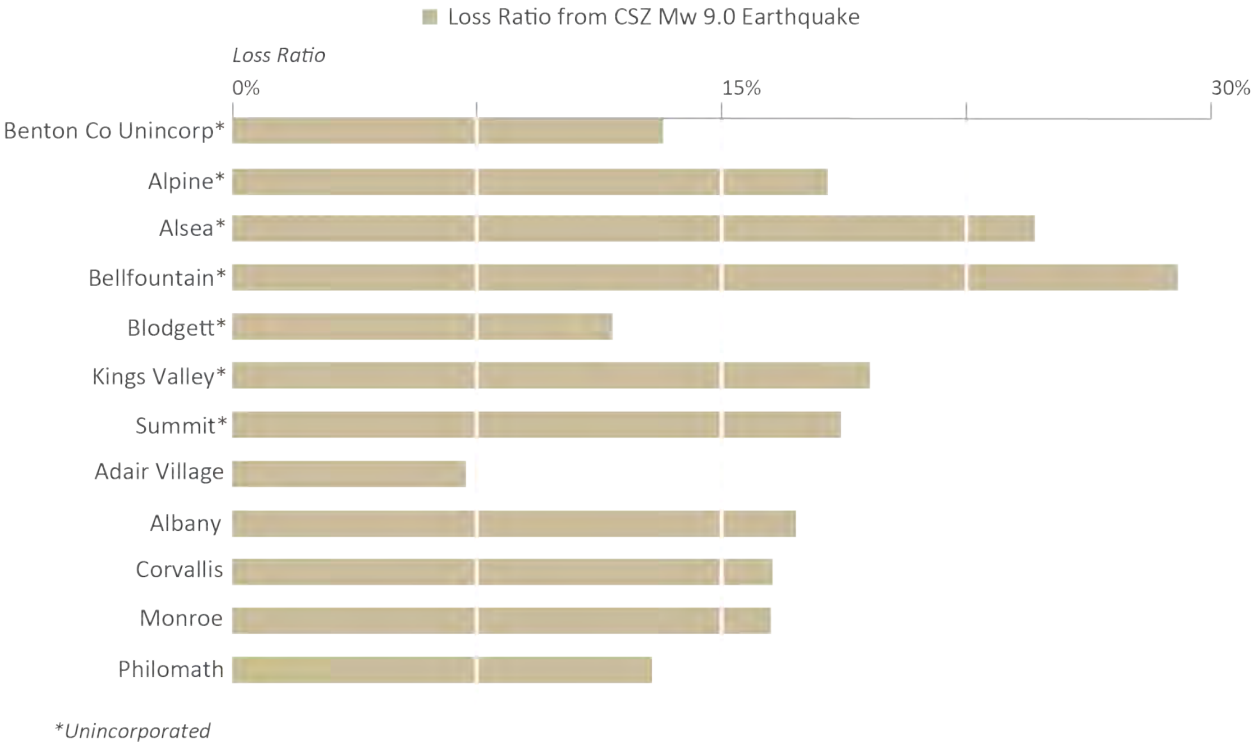
Because an earthquake can affect a wide area, every building in Benton County will be shaken by a CSZ Mw-9.0 earthquake. Hazus-MH loss estimates (see **Table B-2)** for each building are based on a formula where coefficients are multiplied by each of the five damage state percentages (none, low, moderate, extensive, and complete). These damage states are correlated to loss ratios that are then multiplied by the total building replacement value to obtain a loss estimate (FEMA, 2012b). Loss estimates from a CSZ earthquake scenario are presented in **Figure 3-2**.

In keeping with earthquake damage reporting conventions, we used the Applied Technology Council (ATC)-20 post-earthquake building safety evaluation color-tagging system to represent damage states (Applied Technology Council, 2015). Red-tagged buildings correspond to a Hazus-MH damage state of "complete," which means the building is uninhabitable. Yellow-tagged buildings are in the "extensive" damage state, indicating limited habitability. The number of red or yellow-tagged buildings we report for each community is based on an aggregation of the probabilities for individual buildings (FEMA, 2012b).

Critical facilities were considered non-functioning if the Hazus-MH earthquake analysis showed that a building or complex of buildings had a greater than 50-percent chance of being at least moderately damaged (FEMA, 2012b). Because building specific information is more readily available for critical facilities and their importance after a disaster, we chose to report the results of these buildings individually.

The number of potentially displaced residents from our CSZ earthquake scenario was based on the formula: ([Number of Occupants] * [Probability of Complete Damage]) + (0.9 * [Number of Occupants] * [Probability of Extensive Damage]) (FEMA, 2012b).

Figure 3-2. CSZ Mw 9.0 earthquake loss ratio by Benton County community.



The results indicate that Benton County could incur moderate to significant losses (15%) due to a CSZ Mw-9.0 earthquake. Much of the damage is due to soils that amplify seismic shaking. The Willamette River and Marys River floodplains are composed of seismically reactive soils where the majority of the buildings in Benton County are located. Since these soils amplify ground shaking, the probability of earthquake damage is greater for structures built in these areas.

Benton County CSZ Mw-9.0 earthquake results:

- Number of red-tagged buildings: 2,553
- Number of yellow-tagged buildings: 8,936
- Loss estimate: $2,919,744,000
- Loss ratio: 15%
- Non-functioning critical facilities: 79
- Potentially displaced population: 9,505

Although damage caused by coseismic landslides was not specifically looked at in this report, it likely contributes a small amount of the estimated damage from the earthquake hazard in Benton County. Landslide exposure (not to be confused with coseismic landslide analysis) results show that 2.6% of

buildings in Benton County are within a very high or high susceptibility zone. We infer that a similar percentage of the total earthquake losses estimated in this study may be due to coseismic landslide.

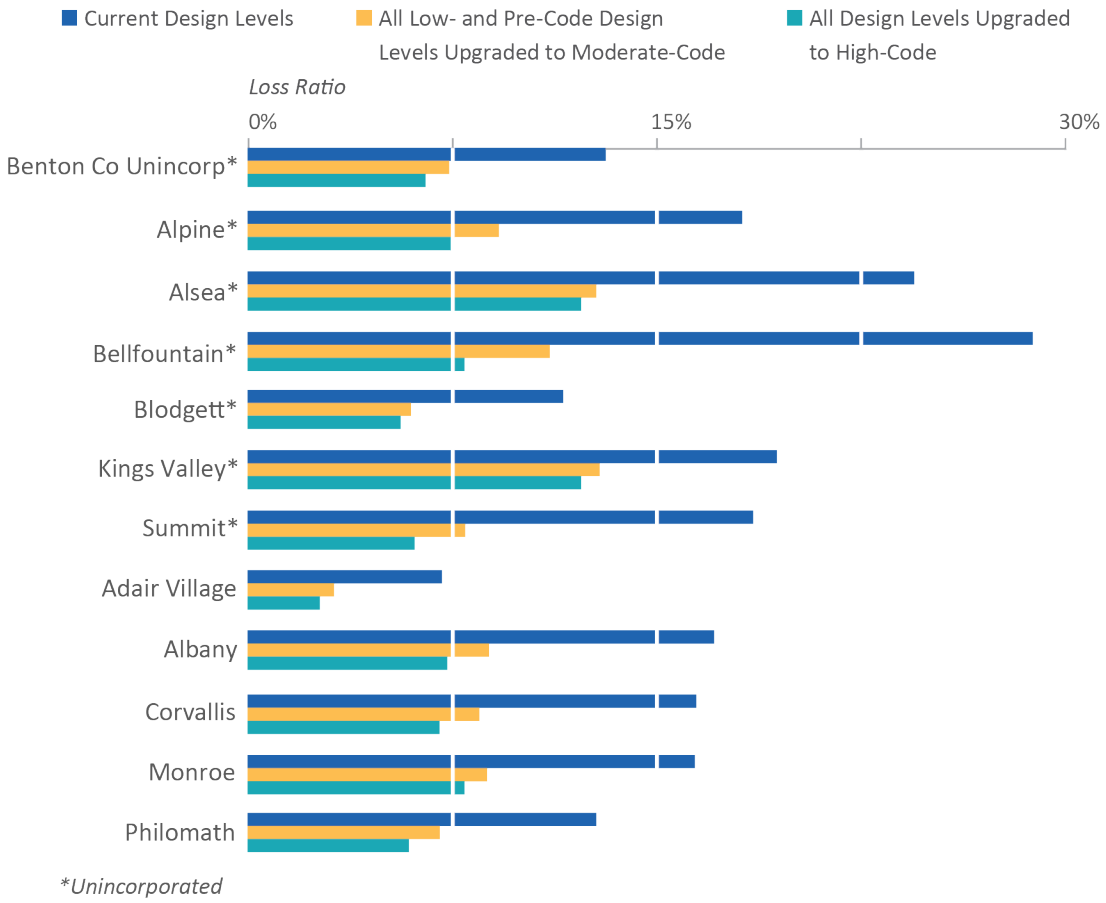
Building vulnerabilities such as the age of the building stock and occupancy type are also contributing factors in loss estimates. The first seismic buildings codes were implemented in Oregon in the 1970's (Judson, 2012) and by the 1990's modern seismic building codes were being enforced. Nearly 75% of Benton County's buildings were built before the 1990's. In Hazus-MH, manufactured homes are one occupancy type that performs poorly in earthquake damage modeling. Communities that are composed of an older building stock and more vulnerable occupancy types are expected to experience more damage from earthquake than communities with fewer of these vulnerabilities.

If buildings could be seismically retrofitted to higher code standards, earthquake risk would be greatly reduced. In this study, a simulation in Hazus-MH earthquake analysis shows that loss ratios drop from 15% to 8%, when all buildings are upgraded to at least moderate code level. While retrofits can decrease earthquake vulnerability, for areas of high landslide or liquefaction susceptibility, additional geotechnical mitigation may be necessary to have an effect on losses. Two simulations of a CSZ Mw-9.0 earthquake where all buildings are upgraded to moderate code standards or to high code standards show significant reductions in loss estimates (**Figure 3-3**).

Key Terms:

- *Seismic retrofit:* Structural modification to a building that improves its resilience to earthquake.
- *Design level:* Hazus-MH terminology referring to the quality of a building's seismic building code (i. e. pre, low, moderate, and high). Refer to **Appendix C.2.3** for more information.

Figure 3-3. CSZ Mw-9.0 earthquake loss ratio in Benton County, with simulated seismic building code upgrades.



3.1.4 Data sources: Turner and Mill Creek Fault scenario

The Mw-6.6 Turner and Mill Creek Fault deterministic scenario was selected as the most appropriate for communicating an alternative earthquake risk for Benton County. The default Hazus-MH earthquake scenario database contained the location and orientation of the fault and provided a recommended maximum magnitude for use in a simulated earthquake event. The epicenter was manually selected and was located at the closest proximity to buildings within the study area.

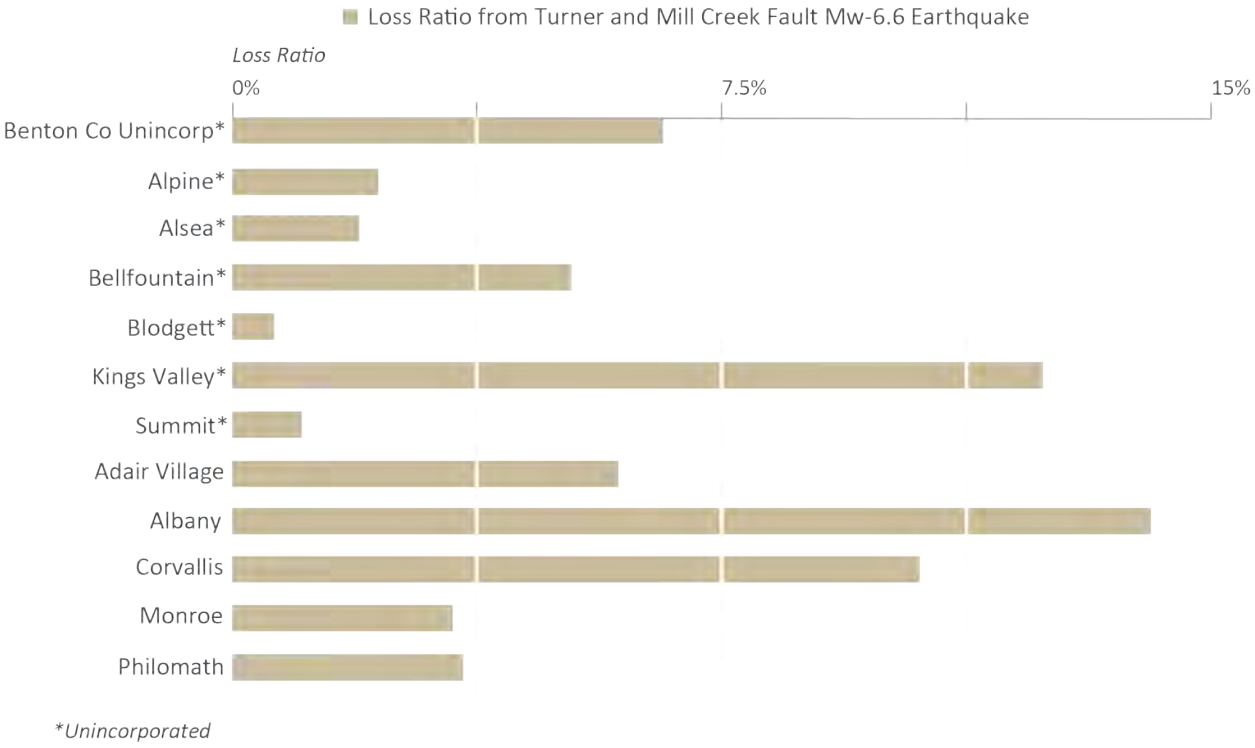
The following hazard layers used for our loss estimation are derived from work conducted by Madin and others (2021): National Earthquake Hazard Reduction Program (NEHRP) soil classification, landslide susceptibility (wet), and liquefaction susceptibility. The liquefaction and landslide susceptibility layers were used by the Hazus-MH tool to calculate the probability and magnitude of permanent ground deformation caused by these factors. Hazus-MH uses a characteristic magnitude value to calculate the impacts of liquefaction and landslides. For this study, we followed the details provided in the default Hazus-MH database and used Mw-6.6 as the characteristic event.

3.1.5 Countywide results: Turner and Mill Creek Fault scenario

While a CSZ event will cause substantial widespread damage throughout the entire study area, our results indicate a Turner and Mill Creek Fault Mw-6.6 earthquake will cause significant damage (10% - 15% in losses) in the communities in the northeastern portion of the county. Because an earthquake can affect a

wide area, it will also cause damage in the other communities in Benton County, but to a lesser degree. **Figure 3-4** shows loss ratios from this earthquake scenario for the communities of Benton County.

Figure 3-4. Earthquake loss ratio from Turner and Mill Creek Fault Mw-6.6 by Benton County community.



The results indicate that Benton County could incur losses near $2 billion or 10% of their total building assets from a Turner and Mill Creek Fault Mw-6.6 earthquake. These results are strongly influenced by the proximity of buildings to the epicenter of the simulated earthquake. Communities in the northeastern portion of the county are not only close to the epicenter, but also are in areas of highly liquefiable soils. In addition to proximity, liquefaction would exacerbate the level of risk from this earthquake scenario for the communities in this part of the county. We reviewed the results in ArcMap and observed several residential buildings north of Corvallis and west of Highway 99W that have a high risk of damage from this earthquake due to coseismic landslide hazard.

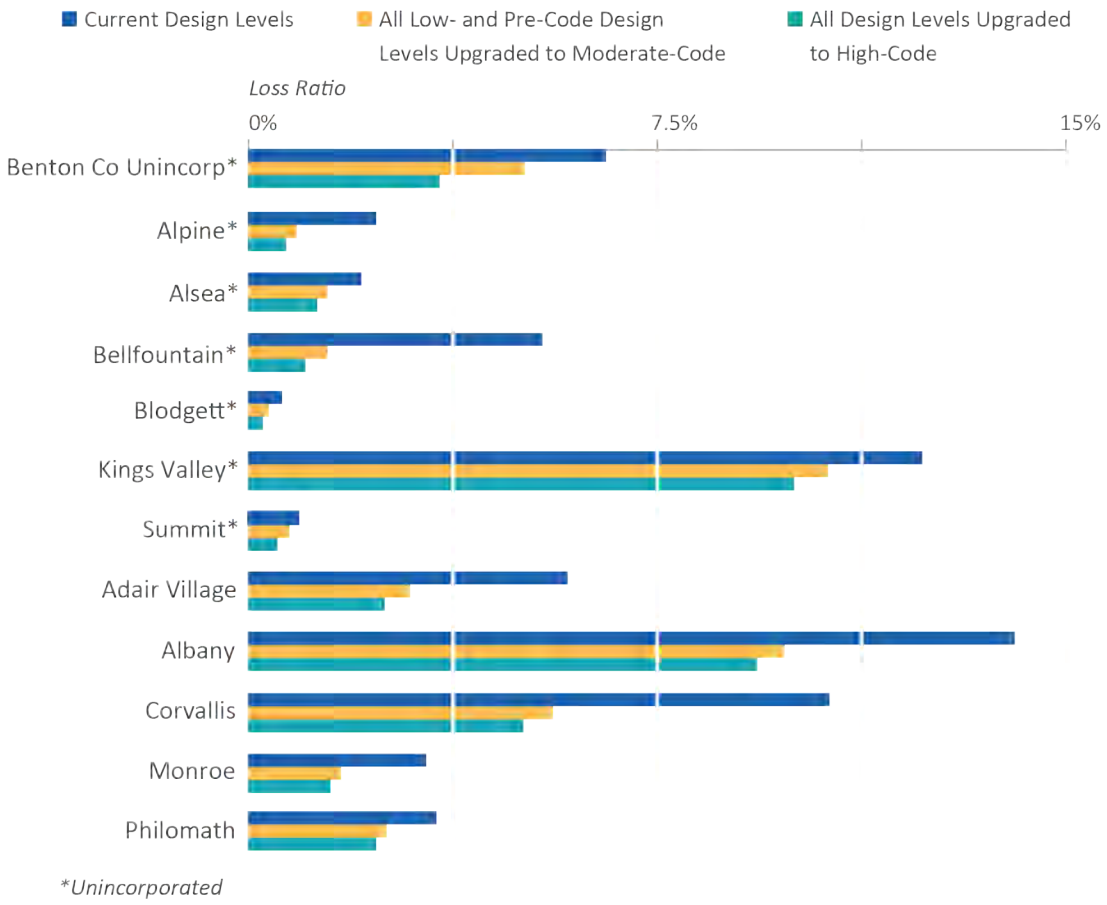
Benton County Turner and Mill Creek Fault Mw-6.6 earthquake results:

- Number of red-tagged buildings: 1,898
- Number of yellow-tagged buildings: 5,956
- Loss estimate: $1,960,037,000
- Loss ratio: 10%
- Non-functioning critical facilities: 37
- Potentially displaced population: 6,774

As with the CSZ earthquake hazard, if buildings could be seismically retrofitted to moderate- or high-code standards, the impact of this event would be greatly reduced. In a simulation by DOGAMI, Hazus-MH earthquake analysis shows that loss estimates drop from 10% to 6.3% when all buildings are brought up

to at least moderate-code level. Although these upgrades can decrease earthquake vulnerability, the benefits are minimized in landslide and liquefaction areas, where buildings would need additional geotechnical mitigation to have an effect on losses. **Figure 3-5** illustrates the reduction in loss estimates from a Turner and Mill Creek Fault Mw-6.6 earthquake through two simulations where all buildings are upgraded to at least moderate-code standards and then all buildings to high-code standards.

Figure 3-5. Turner and Mill Creek Mw-6.6 earthquake loss ratio in Benton County, with simulated seismic building code upgrades



3.1.6 Areas of significant risk

We identified locations within the study area that are comparatively at greater risk to earthquake hazard:

- Areas near the epicenter of a Turner and Mill Creek Fault earthquake scenario are likely to incur a significant amount of damage. The communities of Albany, Corvallis, and Kings Valley have the potential for significant losses if this scenario were to occur.
- Buildings along the Willamette River and Marys River are at higher risk from earthquake damage due to significantly higher liquefaction susceptibility.
- An area of residential buildings north of Corvallis and west of the Highway 99W are at risk from earthquake due to coseismic landslide hazard.

- Unreinforced masonry buildings in the older downtown portions of Corvallis and the Oregon State University campus are more vulnerable to substantial damage during an earthquake compared to other nearby structures built to modern standards.
- 70 of the 96 critical facilities in the study area are estimated to be non-functioning due to a CSZ earthquake like the one simulated in this study and 44 are estimated to be non-functioning due to a Turner and Mill Creek Fault earthquake.

3.2 Flooding

The frequency and severity of flooding may change over time due to changes in climate and precipitation patterns, land use, and how we manage our waterways. This study represents our current understanding of flood hazards and flood risk, but we recognize that flood models and risk assessments will need to be updated with time and changing conditions.

In its most basic form, a flood is an accumulation of water over normally dry areas, typically due to excessive rain or snowmelt. Floods become hazardous to people and property when they inundate an area where development has occurred, causing losses. Floods are a commonly occurring natural hazard in Benton County and have the potential to create public health hazards and public safety concerns, close and damage major highways, destroy railways, damage structures, and cause major economic disruption. More rare flood issues such as flash flooding, ice jams, post-wildfire floods, and dam safety were not examined in this report.

A typical method for determining flood risk is to identify the probability and impact of flooding. The annual probabilities calculated for flood hazard used in this report are 10%, 2%, 1%, and 0.2%, henceforth referred to as 10-year, 50-year, 100-year, and 500-year scenarios, respectively. The ability to assess the probability of a flood, and the level of accuracy of that assessment is influenced by modeling advancements, better understanding of hydrologic factors, and longer periods of record for the stream or water body in question.

The major rivers and creeks within the county are the Long Tom, Marys, North Fork Alsea, and Willamette rivers and Dixon, Frazier, Evergreen, Greasy, Oak, Muddy, and Soap creeks. In addition, there are several tributaries to these major streams that have mapped flood zones. All the mapped streams are subject to flooding and could cause damage to buildings in the floodplain.

The impacts of flooding are determined by adverse effects to human activities within the natural and built environment. These adverse impacts can be reduced through mitigation efforts, such as elevating structures above the expected level of flooding or removing structures through FEMA's property acquisition ("buyout") program.

3.2.1 Data sources

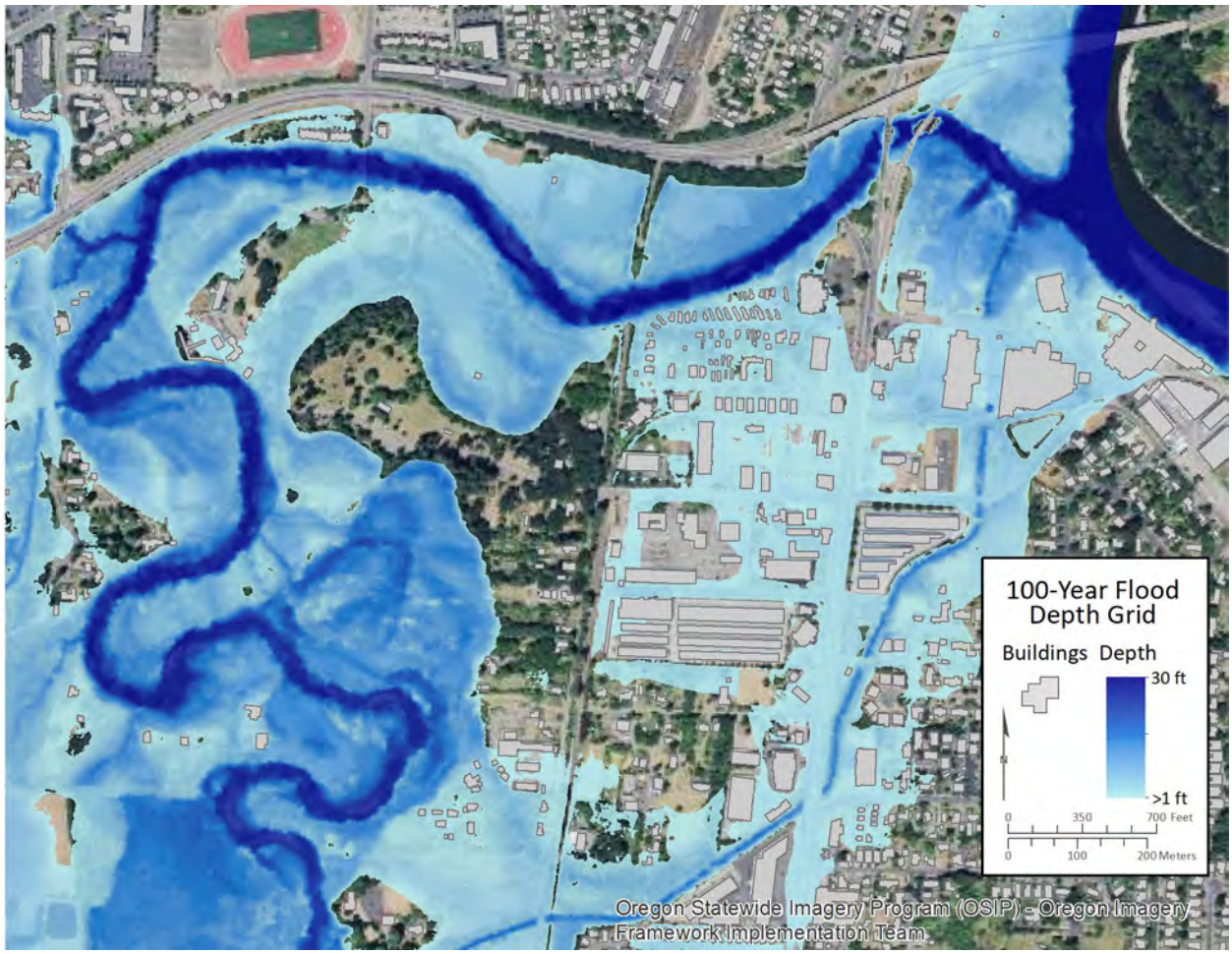
The most recent Flood Insurance Study (FIS) and Flood Insurance Rate Maps (FIRMs) (FEMA, 2016) were used to assess flood risk in this study. Flooding inevitably occurs in areas outside of the detailed mapped areas, however due to limited data availability and variable data resolutions, no other data sources were used in this study. Further information regarding the National Flood Insurance Program (NFIP) related statistics can be found at FEMA's website: https://www.fema.gov/policy-claim-statistics-flood-insurance.

DOGAMI developed the 10-, 50-, 100-, and 500-year depth grids from detailed stream information and high-resolution lidar collected in 2009 and 2012 (Appleby and others, 2021; Willamette Valley 2009 project and Central Coast 2012 project - Oregon Lidar Consortium; see

http://www.oregongeology.org/lidar/collectinglidar.htm). The set of depth grids were used in this risk assessment to determine the level to which buildings are impacted by flooding.

Depth grids are raster GIS datasets in which each digital pixel value represents the depth of flooding at that location within the flood zone (**Figure 3-6**). Depth grids for four riverine flooding scenarios (10-, 50-, 100-, and 500-year) were used for loss estimations and, for comparative purposes, exposure analysis.

Figure 3-6. Flood depth grid example in the city of Corvallis, Oregon.



Building loss estimates are determined in Hazus-MH by overlaying building data on a depth grid. Hazus-MH uses individual building information, specifically the first-floor height above ground and the presence of a basement, to calculate the loss ratio from a particular depth of flood.

For Benton County, occupancy type and basement presence attributes were available from the assessor database for most buildings. Where individual building information was not available from assessor data, we used oblique imagery and street-level imagery to estimate these important building attributes. Only buildings in a flood zone or within 152 meters (500 feet) of a flood zone were examined closely in this manner for more accurate information on first-floor height and basement presence. Because our analysis accounted for building first-floor height, buildings that have been elevated above the flood level were not given a loss estimate—but we did count residents in those structures as displaced. We did

not look at the duration that residents would be displaced from their homes due to flooding. For information about structures exposed to flooding but not damaged, see the **Exposure analysis** section.

3.2.2 Countywide results

For this risk assessment, we imported the countywide UDF data and depth grids into Hazus-MH and ran a flood analysis for four flood scenarios (10-, 50-, 100-, and 500-year). We used the 100-year flood scenario as the primary scenario for reporting flood results (also see Appendix E: **Plate 7**). The 100-year flood has traditionally been used as a reference level for flooding and is the standard probability that FEMA uses for regulatory purposes. See **Table B-4** for multi-scenario cumulative results.

Benton Countywide 100-year flood loss:

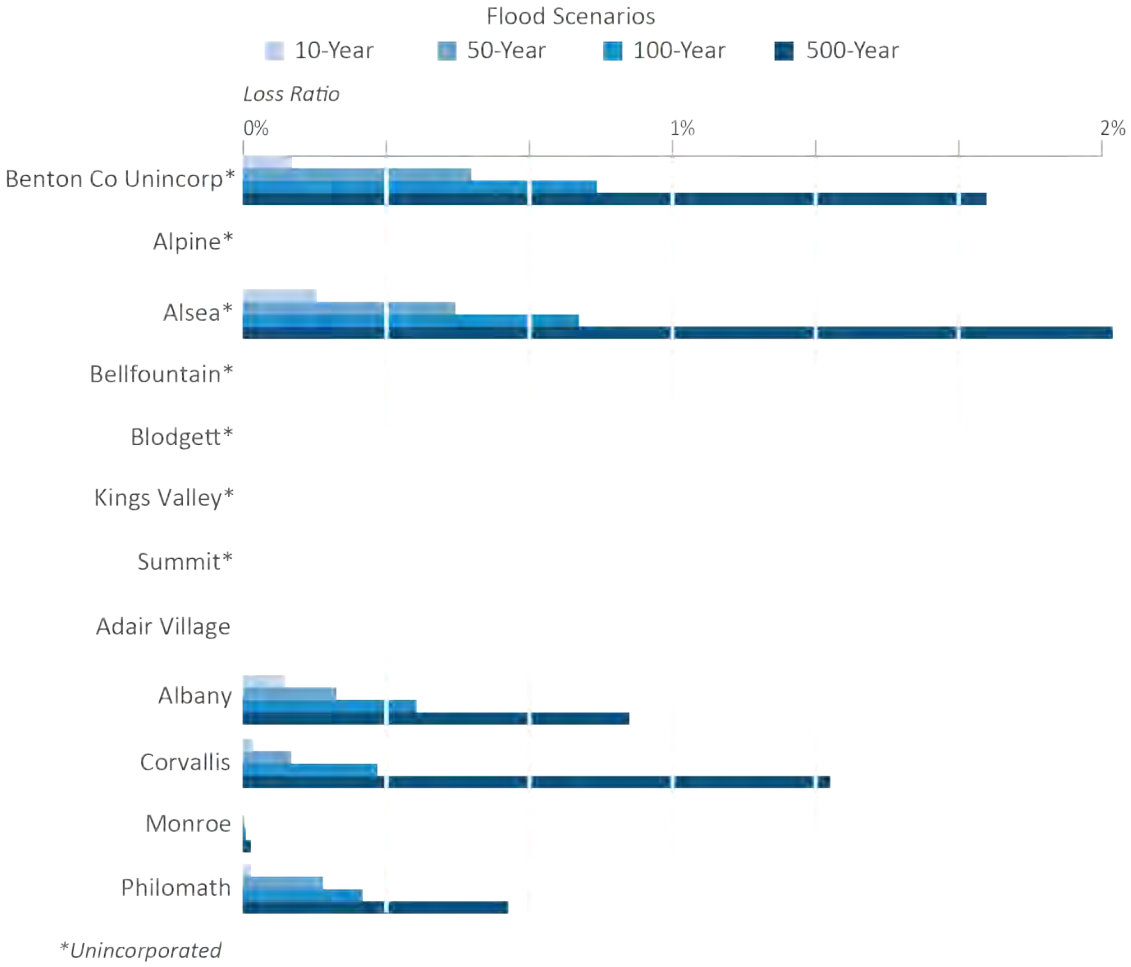
- Number of buildings damaged: 2,067
- Loss estimate: $88,484,000
- Loss ratio: 0.5%
- Damaged critical facilities: 12
- Potentially displaced population: 4,089

3.2.3 Hazus-MH analysis

The Hazus-MH loss estimate for the 100-year flood scenario for the entire county is over $88 million. While the loss ratio of flood damage for the entirety of Benton County is 0.5%, the impact to areas of development near flood-prone streams is significant (**Figure 3-7**). In communities where most residents are not within flood designated zones, the loss ratio may not be as helpful as the actual replacement cost and number of residents displaced to assess the level of risk and impact from flooding. The Hazus-MH analysis also provides useful information for individual communities so that planners can identify problems and consider which mitigating activities will provide the greatest resilience to flooding.

The main flooding problems within Benton County are primarily in the areas of Albany, Alsea, and portions of Corvallis. The unincorporated county also has a high level of estimated damage from the major streams and their tributaries that flow through the county (**Figure 3-7**). There are few areas of concentrated flood damage in the study area. The small amount of damage that is estimated is scattered across the county at various places along the mapped streams.

Figure 3-7. Ratio of flood loss estimates by Benton County community.



3.2.4 Exposure analysis

Separate from the Hazus-MH flood analysis, we did an exposure analysis by overlaying building locations on the 100-year flood extent. We did this to estimate the number of buildings that are elevated above the level of flooding and the number of displaced residents. This was done by comparing the number of non-damaged buildings from Hazus-MH with the number of exposed buildings in the flood zone. A small proportion (3.7%) of Benton County's buildings were found to be within designated flood zones. Of the 2,298 buildings that are exposed to flooding, we estimate that 301 are above the height of the 100-year flood. This evaluation also estimates that 4,089 residents might have mobility or access issues due to surrounding water. See Appendix B: **Table B-5**for community-based results of flood exposure.

While DFIRM 100-year flood hazard areas include all the studied streams in Benton County and Albany from which the depth grids were derived, the flood hazard zones also include approximate areas of 100-year flooding. These approximate 100-year flood hazard areas are designated as Zone A's on the FEMA DFIRM maps. Since depth grids cannot be created from Zone A information, these areas were excluded from the Hazus flood risk assessment. We included **Table 3-1** to show the exposure of buildings and people to the study area's approximate 100-year flood hazard areas.

Table 3-1. Benton County Zone A exposure.

Community	Total Number of Exposed Buildings	Estimated Exposed Building Value ($)	Total Number of People
Unincorp. Benton Co (rural)	651	142,845,000	615
Alpine	2	105,000	4
Alsea	2	431,000	2
Bellfountain	0	0	0
Blodgett	0	0	0
Kings Valley	31	7,956,000	41
Summit	0	0	0
Total Unincorporated County	686	151,336,000	661
Adair Village	0	0	0
Albany	86	39,393,000	239
Corvallis	95	41,371,000	373
Monroe	16	1,960,000	20
Philomath	23	4,545,000	64
Total Study Area	906	238,605,000	1,357

3.2.5 Areas of significant risk

We identified locations within the study area that are comparatively at greater risk of flood hazard:

- Many buildings are built within the large floodplain of the Willamette River and are at risk from flood hazard.
- Significant exposure to flooding along the Marys River in the southern portion of Philomath.
- Many buildings in the Thornton Lakes Overflow area of Albany are at risk from flood hazard.
- Many buildings in two areas within Corvallis where Frazier Creek and Marys River confluence with the Willamette River are at high risk from flood hazard.

3.3 Landslide Susceptibility

Landslides are mass movements of rock, debris, or soil most commonly downhill. Landslides can occur in many sizes, at different depths, and with varying rates of movement. Generally, they are large, deep, and slow moving or small, shallow, and rapid. Factors that influence landslide type include slope steepness, water content, and geology. Many triggers can cause a landslide: intense rainfall, earthquakes, or human-induced factors like water concentration, excavation along a landslide toe or loading at the top. Landslides can cause severe damage to buildings and infrastructure. Fast-moving landslides may pose life safety risks and can occur throughout Oregon (Burns and others, 2016). The most common landslide types in Benton County are debris flows and shallow- and deep-seated landslides.

Because landslides are a site-specific hazard that occur over much smaller spatial extents than most other natural hazards, measuring the risk associated with future landslides for a large area can be difficult. Landslide susceptibility measures the likelihood that a given location will experience a landslide in the

future based on a variety of factors including slope, surficial geology, soil type, and the presence of pre-existing landslides.

This study represents our current understanding of landslide susceptibility to measure the risk of landsliding in Benton County. However, changing climate, precipitation patterns, land use, wildfire events, and land and forest management strategies may increase or decrease the susceptibility to landslides.

3.3.1 Data sources

We used the data from the statewide landslide susceptibility map (Burns and others, 2016) and recent landslide inventory mapping in Benton County (Hairston-Porter and others, 2021) (**Figure 3-8**) based on lidar using methods outlined in DOGAMI Special Paper Special Paper 42 (SP-42: Burns and Madin, 2009) for the landslide analysis. The statewide susceptibility layer is an analysis of multiple landslide datasets.

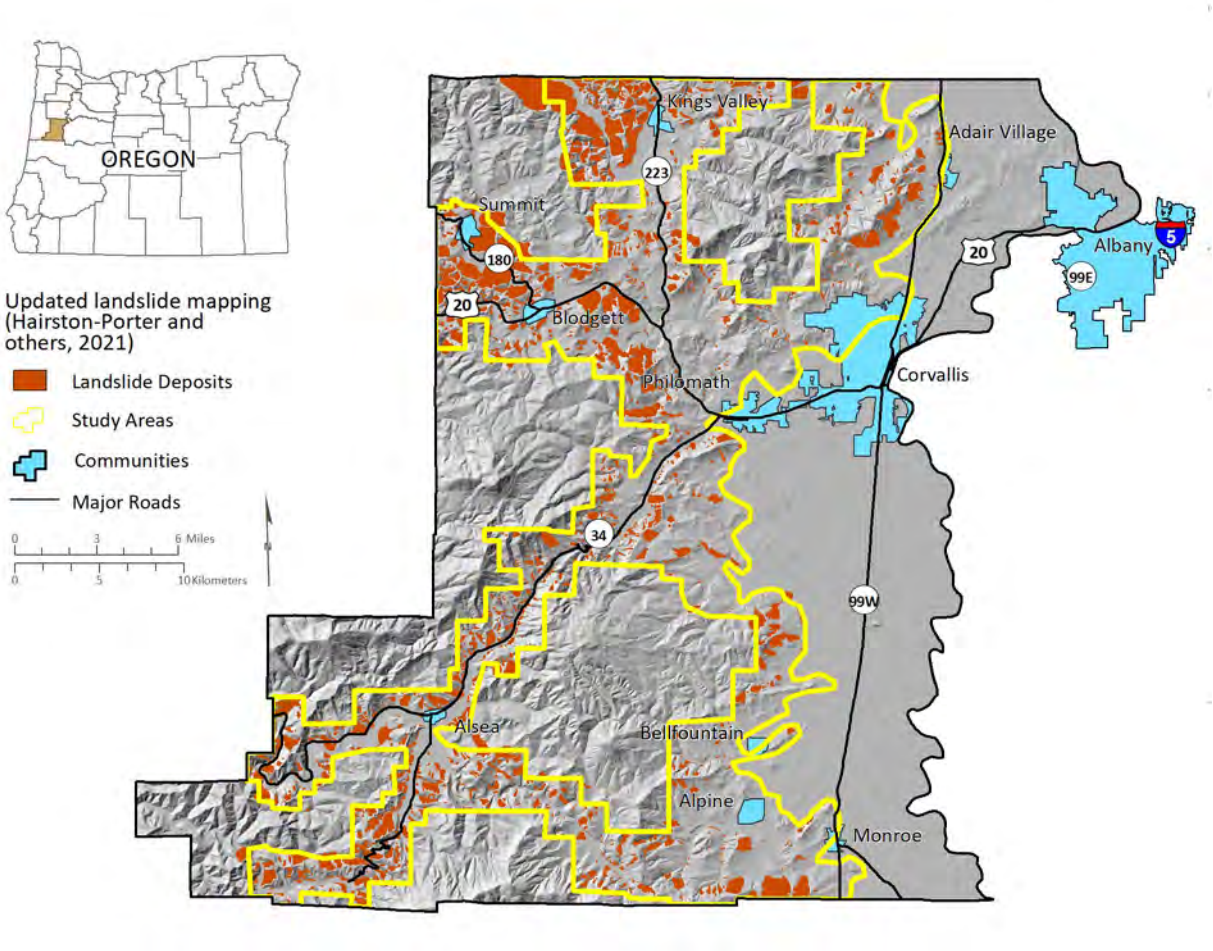
Burns and others (2016) used SLIDO inventory data along with maps of generalized geology and slope to create a landslide susceptibility overview map of Oregon that shows zones of relative susceptibility: Very High, High, Moderate, and Low. Mapped landslides from SLIDO data directly define the Very High landslide susceptibility zone, while SLIDO data coupled with statistical results from generalized geology and slope maps define the other relative susceptibility zones (Burns and others, 2016).

SLIDO, release 3.2 (Burns and Watzig, 2014) was used in the Burns and others (2016) statewide susceptibility analysis, which preceded the new lidar-based inventory mapping of Hairston-Porter and others (2021) and thus this newer mapping was not incorporated into the Statewide Landslide Susceptibility Map.

SLIDO is a compilation of past studies; some studies were completed very recently using new technologies, like lidar-derived topography, and some studies were performed more than 50 years ago. Consequently, SLIDO data vary greatly in scale, scope, and focus and thus in accuracy and resolution across the state. Statewide landslide susceptibility map data have the inherent limitations of SLIDO and of the generalized geology and slope maps used to create the map. Therefore, the statewide landslide susceptibility map varies significantly in quality across the state, depending on the quality of the input datasets. Another limitation is that susceptibility mapping does not include some aspects of landslide hazard, such as runout, where the momentum of the landslide can carry debris beyond the zone deemed to be a high hazard area.

We used the data from the combined Statewide Landslide Susceptibility Map (Burns and others, 2016) and new landslide mapping (Hairston-Porter and others, 2021) in this report to identify the general level of susceptibility of given area to landslide hazards, primarily shallow and deep landslides. We overlaid building and critical facilities data on landslide susceptibility zones to assess the exposure for each community (see **Table B-6**)The total dollar value of exposed buildings was summed for the study area and is reported below. We also estimated the number of people threatened by landslides. Land value losses due to landslides and potentially hazardous unmapped areas that may pose real risk to communities were not examined for this report.

Figure 3-8. Recent landslide mapping in Benton County.



3.3.2 Countywide results

We found that areas along Highway 20 and Route 34 west of Philomath have a high level of exposure to landslide hazard. Communities in terrain with moderate to steep slopes or at the base of steep hillsides may be exposed to landslides. The percentage of building value exposed to very high and high landslide susceptibility is approximately 2.7% for the entire study area.

We combined high and very high susceptibility zones as the primary scenario to provide a general sense of community risk for planning purposes (see Appendix E, **Plate 8**). These susceptibility zones represent areas most susceptible to landslides with the highest impact to the community.

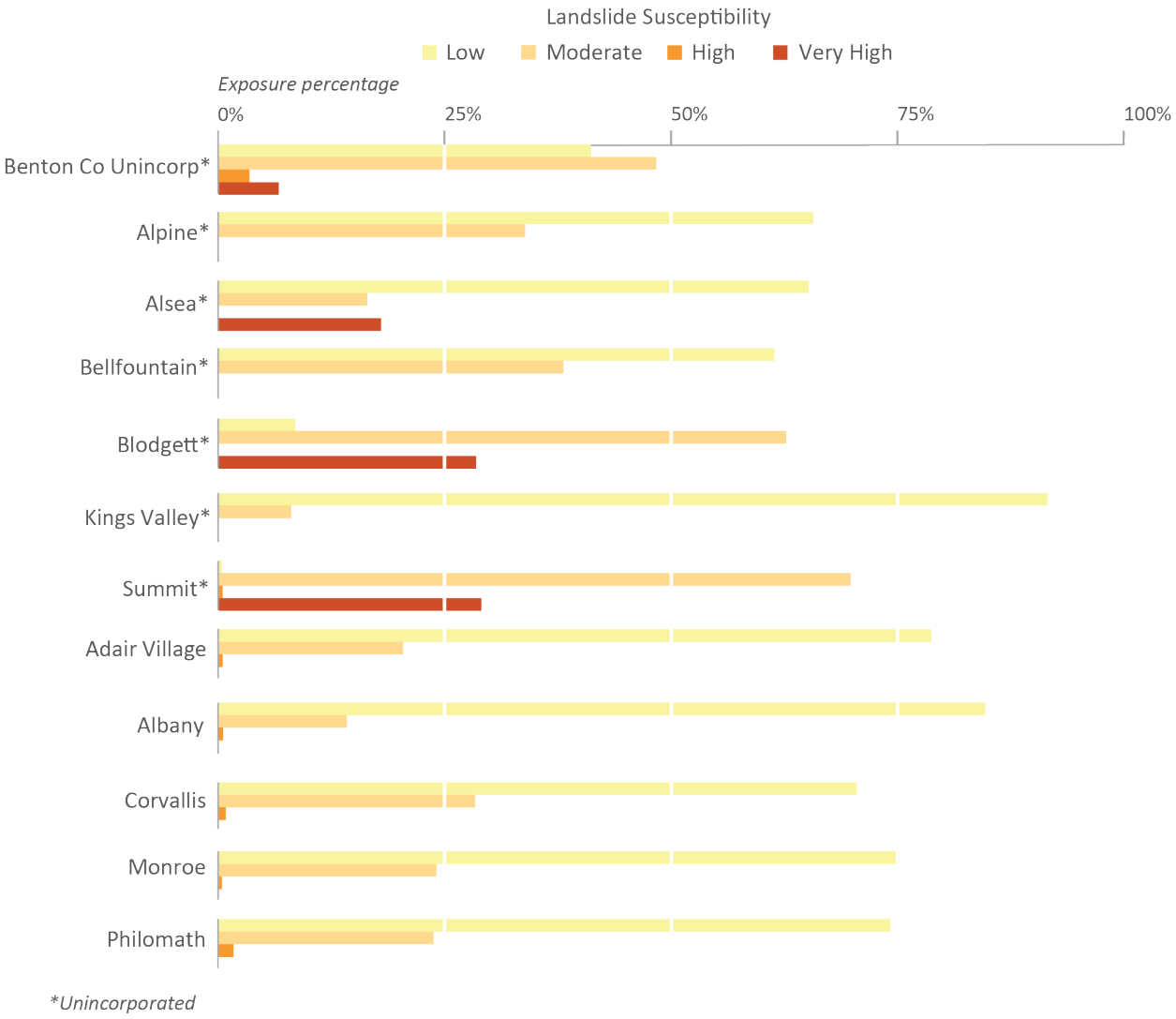
For this risk assessment we compared building locations to geographic extents of the landslide susceptibility zones (**Figure 3-9**). The exposure results shown below are for the high and very high susceptibility zones. See **Appendix B: Detailed Risk Assessment Tables** for exposure analysis results of all susceptibility categories.

Benton Countywide landslide exposure (High and Very High susceptibility):

- Number of buildings: 2,078
- Value of exposed buildings: $496,739,000
- Percentage of total county value exposed: 2.7%
- Critical facilities exposed: 2
- Potentially displaced population: 3,473

Most of the developed land in Benton County is located on the gentle terrain found in the Willamette River Valley, which is predominantly classified as having a low landslide susceptibility. However, there are developed areas just north and west of Corvallis that are highly susceptible to landslide hazard. Landslide hazard is also ubiquitous in the western portion of Benton County which may present challenges for planning and mitigation efforts. Awareness of nearby areas of landslide hazard is beneficial to reducing risk for every community and rural area of Benton County.

Figure 3-9. Landslide susceptibility exposure by Benton County community.



3.3.3 Areas of significant risk

We identified locations within the study area that are comparatively at greater risk to landslide hazard:

- Buildings in the unincorporated county along Highway 20 and Route 34 are within very high and high risk landslide zones.
- The communities of Alsea, Blodgett, and Summit, in the mountainous western part of the county, have a significant amount of exposure to High and Very High landslide hazard.
- Several residential buildings north of Corvallis and west of Highway 99W are within very high and high risk landslide zones.

3.4 Channel Migration

Channel migration is a dynamic process by which a stream's location changes over time. This process includes channel bed and bank erosion, sediment deposition, and channel avulsion, a process in which the stream abruptly moves to a new location on the floodplain. Many factors influence channel movement, including the local geology, size, and quantity of sediment within the river, discharge of water, vegetation, channel shape, and slope. Human changes to the channel, such as the construction of dams and levees, also have a major impact on how a channel changes its course. In combination, these factors affect how a river's energy and erosive power is dispersed. Straight, steep streams have highly concentrated erosive power; by contrast, curving channels that flow across wide and flat floodplains allow a river to dissipate its energy and deposit sediment over a wider area (Rapp and Abbe, 2003).

The area in which a stream channel moves laterally over a given time is known as a channel migration zone (CMZ). In places where development has occurred within the CMZ, structures are at risk for severe damage to foundations and infrastructure through erosion and flooding. The CMZ typically extends beyond the limits of the regulatory floodplain, but little consideration is given to this potential hazard. This factor contributes greatly to the level of risk that exists for many developed areas along streams (Rapp and Abbe, 2003).

The frequency and severity of channel migration may change over time due to changes in climate and precipitation patterns, land use, and how we manage our waterways. This study represents our current understanding of channel migration hazards and risk, but we recognize that channel migration mapping and risk assessments will need to be updated with time and changing conditions.

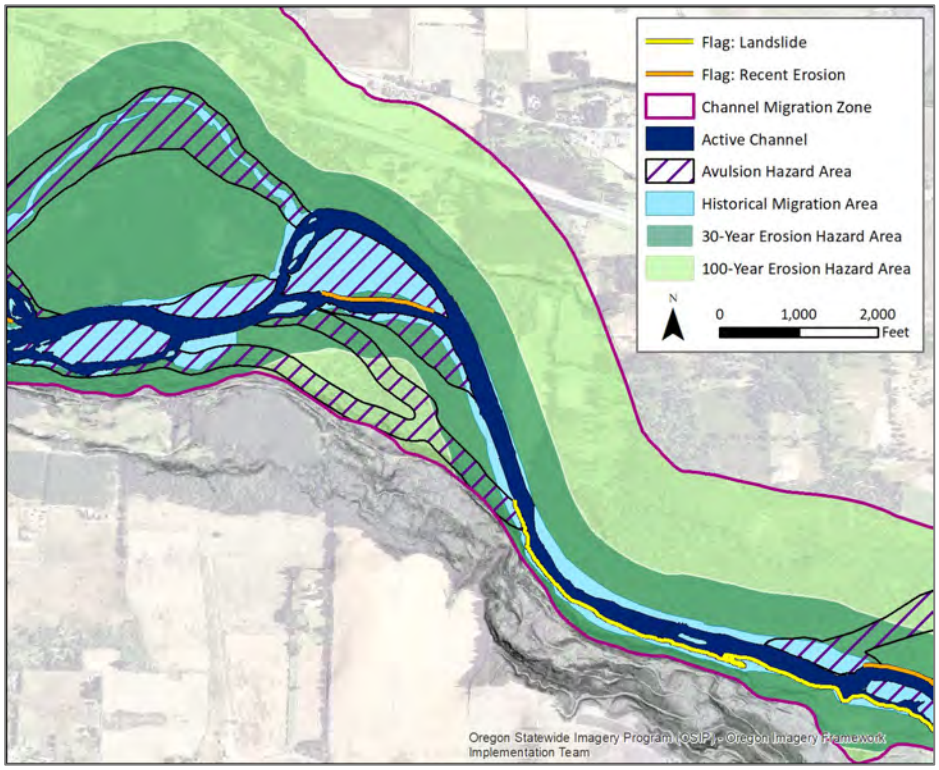
3.4.1 Data sources

The channel migration zones used for this report were developed by Appleby and others (2021) for the North Fork Alsea River and Marys River. DOGAMI's CMZ mapping considers areas of historical channel migration as well as, potential future erosion, and channel avulsion; these areas are mapped based on geology, historical aerial imagery, lidar topography, limited field work, and measured rates of historical channel migration. The CMZ is subdivided into seven components: the active channel, historical migration area, 30-year and 100-year erosion hazard areas, the avulsion hazard area, and flagged section of streambank that are actively eroding or adjacent to landslides (**Figure 3-10**). The methodology for calculating each component and how they are combined are described in Appleby and others (2021).

It is important to note that the total study area in Benton County for channel migration hazard is limited to the North Fork Alsea River and Marys River. These study areas do not encompass the totality of the channel migration hazard that could be present within the county. Structures built in proximity to waterways are potentially at risk to channel migration hazard even if not within a studied hazard area.

To assess the exposure within each community, we overlaid buildings and critical facilities on the 30-year erosion hazard area within the CMZ. While there is risk throughout the CMZ, we chose to examine the structures within the 30-year erosion hazard area, because it represents the area of greatest probability of being at risk from channel migration during the next 30 years. The following section presents the estimated total dollar value of exposed buildings and the number of people potentially displaced from the 30-year CMZ. Land value losses due to CMZ were not examined for this report.

Figure 3-10.Example diagram of the components of a CMZ map in Oregon, including the active channel (AC) in dark blue, historical migration area (HMA) in light blue, avulsion hazard area (AHA) with hatched lines, 30-year and 100-year erosion hazard areas (EHA) in dark and light green, flagged streambanks with yellow and orange lines, and channel migration zone (CMZ) boundary outlined in magenta (from Appleby and others, 2021).



3.4.2 Countywide results

Mapped channel migration areas along the North Fork Alsea River and Marys River show a very high level of risk from this hazard for many communities along either watercourse. To quantify risk, the exposure analysis was conducted by determining which buildings were within or outside of the CMZ (see Appendix E: **Plate 9**). Due to the frequency of shifting channel patterns in streams, channel migration can be a serious hazard in areas close to stream regardless of if they have been mapped as a hazard or not.

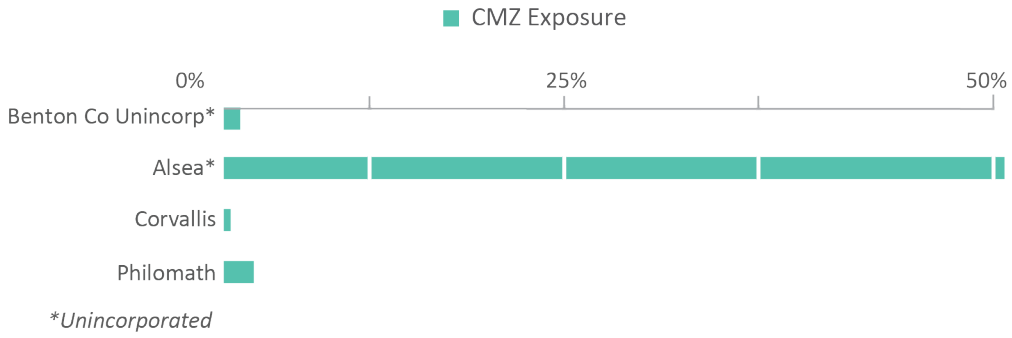
Benton County channel migration exposure (100-year Erosion Hazard Area):

- Number of buildings: 402
- Value of exposed buildings: $96,427,000
- Percentage of total county value exposed: 0.8%
- Critical facilities exposed: 3
- Potentially displaced population: 454

A significant number of buildings in Alsea and the southern portion of Philomath are within areas where channel migration is likely to occur. Nearly half of the buildings in Alsea are within the 30-year erosion hazard zone. **Figure 3-11** presents the estimated total building value at risk from channel

migration for the communities of Alsea, Corvallis and Philomath. See **Appendix B: Detailed Risk Assessment Tables** for complete analysis results.

Figure 3-11. 30-year erosion hazard exposure by Benton County community within the study area of Appleby and others (2021).



Note: Communities in figure limited to communities within the study area of Appleby and others (2021).

3.4.3 Areas of significant risk

We identified locations within the study area that are comparatively at greater risk to channel migration hazard:

- A significant portion (>50%) of the buildings in Alsea are at risk from channel migration hazard from the North Fork Alsea River.
- The southern part of Philomath is within the 100-year channel migration zone from the Marys River.

3.5 Wildfire

Wildfires are a natural part of the ecosystem in Oregon. However, wildfires can present a substantial hazard to life and property in growing communities. The most common wildfire conditions include hot, dry, and windy weather; the inability of fire protection forces to contain or suppress the fire; the occurrence of multiple fires that overwhelm committed resources; and a large fuel load (dense vegetation). Once a fire has started, its behavior is influenced by numerous conditions, including fuel, topography, weather, drought, and development (Gilbertson-Day and others, 2018). Post-wildfire natural hazards can also present risk. These usually include flood, debris flows, and landslides. Post-wildfire geologic hazards were not evaluated in this project.

The 2016 Benton County Community Wildfire Protection Plan (BCCWPP) recommended that the county develop policies addressing fire restriction enforcement, wildland urban interface standards, and building code enforcement related to emergency access. Forests cover large portions of the study area and play an important role in the local economy, but also surround homes and businesses (BCCWPP, 2016). Contact the Benton County Planning Department for specific requirements related to the county's comprehensive plan.

The frequency, intensity, and severity of wildfires may change over time due to changes in climate, drought conditions, urbanization, and how we manage our forested lands. This study represents our

current understanding of wildfire hazards and wildfire risk, but we recognize that wildfire models and risk assessments will need to be updated with time and changing conditions.

3.5.1 Data sources

The Pacific Northwest Quantitative Wildfire Risk Assessment (PNRA): Methods and Results (Gilbertson-Day and others, 2018) is a comprehensive report that includes a database of spatial information related to wildfire hazard developed by the United States Forest Service (USFS) for the states of Oregon and Washington. The steward of this database in Oregon is the Oregon Department of Forestry (ODF). The database was created to assess the level of risk residents and structures have to wildfire. For this project, the burn probability dataset, a dataset included in the PNRA database, was used to measure the risk to communities in Benton County.

Using guidance from ODF, we categorized the Overall Wildfire Risk dataset into low, moderate, and high-hazard zones for the wildfire exposure analysis. Overall Wildfire Risk was developed as a combination of burn probability and the presence of infrastructure and assets. The range of values in the risk dataset describe the level of potential impact and are characterized by negative values that indicate very high risk to zero which indicates low risk. The risk dataset also includes positive values that represent uninhabited areas that benefit from wildfire, but these were combined into the low-risk category (Gilbertson-Day and others, 2018). In many areas with moderate to dense development there are no pixel values, which indicates an Overall Wildfire Risk of none.

Overall Wildfire Risk values were grouped into three hazard categories:

- Low wildfire hazard (-0.000011 to 0.005)
- Moderate wildfire hazard (-0.000119 to -0.000011)
- High wildfire hazard (-0.203 to -0.000119)

We overlaid the buildings layer and critical facilities on each of the wildfire hazard zones to determine exposure. In certain areas no wildfire data is present which indicates areas that have minimal risk to wildfire hazard (see Appendix B: **Table B-8**). The total dollar value of exposed buildings in the study area is reported in the following section. We also estimated the number of people threatened by wildfire. Land value losses, infrastructure, and environmental impacts due to wildfire were not examined for this project.

3.5.2 Countywide results

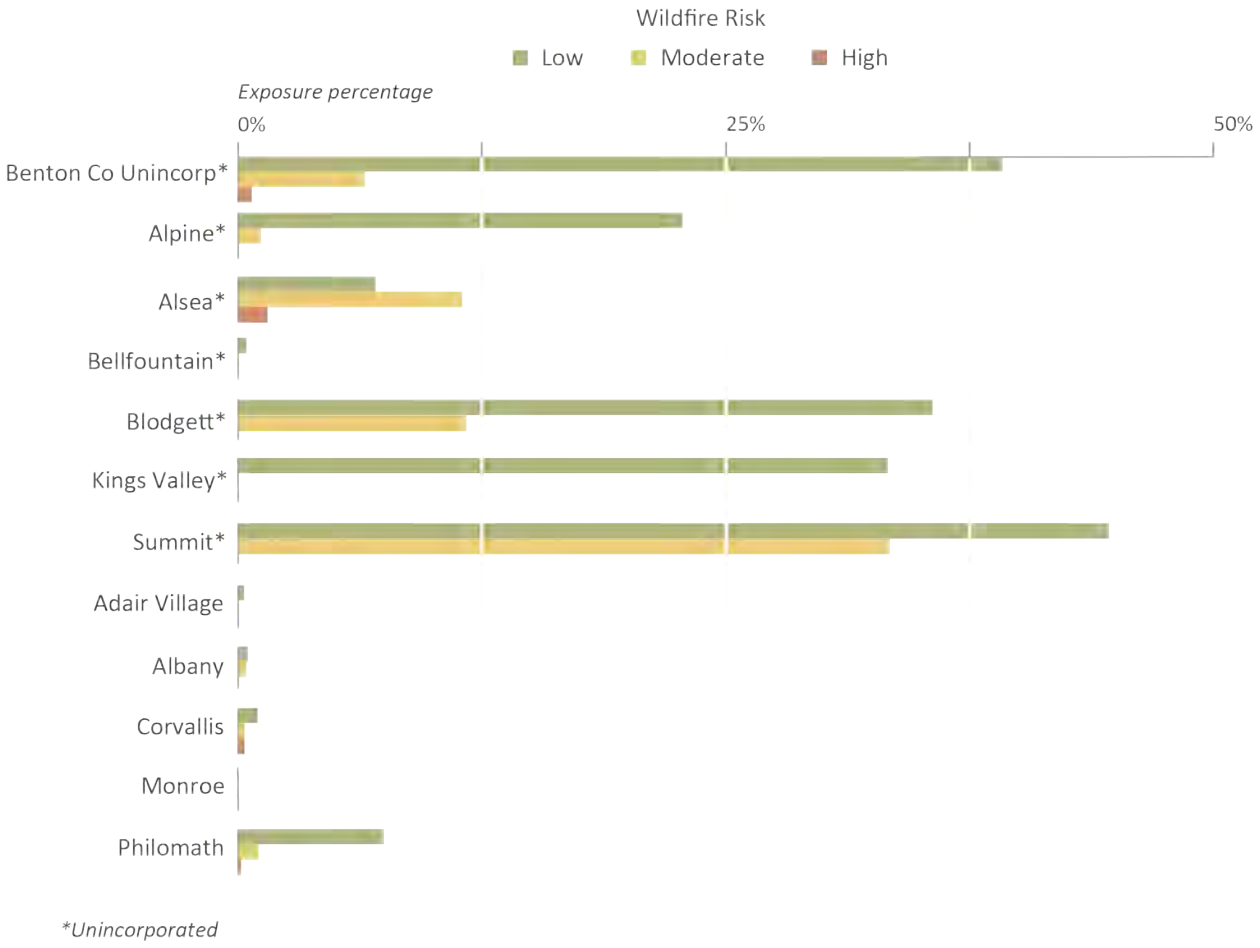
The High risk category was chosen as the primary scenario for this report because it represents areas that have the highest potential for losses. However, Low risk is not the same as no hazard. Moderate wildfire risk is included with High risk in the assessment of exposure, because under certain conditions moderate risk zones can be very susceptible to burn. In combining the High and Moderate risk categories within Benton County, we can emphasize areas where lives and property are most at risk.

Benton Countywide wildfire exposure (High or Moderate Risk):

- Number of buildings: 1,777
- Value of exposed buildings: $481,260,000
- Percentage of total county value exposed: 2.5%
- Critical facilities exposed: 2
- Potentially displaced population: 3,369

For this risk assessment, the building locations were compared to the geographic extent of the wildfire risk categories. One hundred buildings in the heavily forested unincorporated parts of western Benton County are exposed to High or Moderate wildfire hazard (see Appendix E: **Plate 10**). Portions of heavily forested areas in western Benton County, where the communities of Alsea, Blodgett, and Summit are located, have the highest percentage of exposure to High and Moderate wildfire hazard within the study area. **Figure 3-12** illustrates the level of risk from wildfire for the different communities of Benton County. See **Appendix B: Detailed Risk Assessment Tables** for multi-scenario analysis results.

Figure 3-12. Wildfire Risk exposure by Benton County community



3.5.3 Areas of significant risk

We identified locations within the study area that are comparatively at greater risk to wildfire hazard:

- While the overall probability of wildfire hazard in Benton County is low, it is still a possibility, especially in the heavily forested unincorporated parts of the county. Nearby wildfire prone areas also pose a risk related to evacuation routes and hazardous smoke.
- The communities of Alsea, Blodgett, and Summit have a higher risk to wildfire than other communities in the county.
- In Albany, Corvallis, and Philomath, structures built in the WUI are at elevated risk from wildfire relative to structures in areas more densely developed.
- Moderate to high risk of wildfire exists for the forested northern parts of the unincorporated county.

4.0 CONCLUSIONS

The purpose of this study is to provide a better understanding of potential impacts from multiple natural hazards at the community scale. We accomplished this by using the latest natural hazard mapping and loss estimation tools or exposure analysis to quantify risk to buildings and potential displacement of permanent residents. This detailed approach provides new context for the county's risk reduction efforts. We note several important findings based on the results of this study:

- **Extensive damage and losses for some areas in Benton County can occur from a CSZ Mw-9.0 earthquake**—Based on the results of the CSZ Mw-9.0 earthquake, every community in Benton County will experience significant impact and disruption from such an event. Results show that this earthquake could cause building value losses ranging from 10% to 30% across all communities. Many buildings along the Willamette River and Marys River floodplains could see earthquake damage due to ground deformation related to liquefaction. High vulnerability within the building inventory (primarily unreinforced masonry) also contributed to losses expected in the county.
- **Significant damage and losses for some areas in Benton County can occur from a Turner and Mill Creek Fault earthquake** — Based on the results of a Turner and Mill Creek Fault Mw-6.6 earthquake, some communities in Benton County will experience significant impact and disruption. Results show that an earthquake can cause building losses ranging from 10% to 15% for buildings in the northeastern part of Benton County. Some communities like Corvallis, Kings Valley, and Albany can expect earthquake damage due to proximity to the epicenter (i.e., severe shaking) and ground deformation related to liquefaction. High vulnerability within the building inventory (primarily unreinforced masonry) also contributed to losses expected in the county.
- **Retrofitting buildings to modern seismic building codes can reduce damages and losses from earthquake shaking**—Seismic building codes have a major influence on earthquake shaking damage estimated in this study. We found that retrofitting to at least moderate code was the most efficient mitigation strategy because the additional benefit from retrofitting to high code was minimal. In our simulation of upgrading buildings to at least moderate code, the estimated loss for the entire study area was reduced from 15% to 8% for a CSZ event and 10% to 6.3% for a Turner and Mill Creek Fault event. Communities with older buildings, that were constructed below the moderate seismic code standards, are both the most vulnerable and have the greatest potential for risk reduction. For example, the city of Corvallis could reduce losses from 16% to 8% for a CSZ event and 9.2% to 5.4% for a Turner and Mill Creek Fault event by retrofitting all

buildings to at least moderate code. While seismic retrofits are an effective strategy for reducing earthquake shaking damage, it should be noted that earthquake-induced liquefaction hazards will also be present in areas along the Willamette River and Marys River and these hazards require different geotechnical mitigation strategies.

- **Some communities in the study area are at moderate risk from flooding**—Many buildings within the floodplain are vulnerable to significant damage from flooding. At first glance, Hazus-MH flood loss estimates may give a false impression of lower risk because they show lower damages within individual communities relative to other hazards we examined. This is likely due to the difference between the type of results from loss estimation and exposure analysis, as well as the limited area impacted by flooding. Flooding is one of the most frequently occurring natural hazards and thus commonly has repetitive losses which occur with recurrence intervals of 10s to 100s of years versus earthquake hazards with recurrence intervals of 100s to thousands of years. We estimate that an average of 12% building value loss occurs for buildings within the 100-year flood zone. The areas most vulnerable to flood hazard within the study are buildings along the Willamette River, the Thornton Lakes Overflow near Albany, and where the Frazier Creek and Marys River confluences with the Willamette River in Corvallis.
- **Elevating structures in the flood zone reduces vulnerability**—We used flood exposure analysis in addition to Hazus-MH loss estimation to identify buildings that were not damaged but were within the area expected to experience a 100-year flood. By using both analyses in this way, the number of elevated structures within the flood zone could be quantified. This showed possible mitigation needs in flood loss prevention and the effectiveness of past activities. For example, in the city of Corvallis an estimated 171 buildings exposed to flooding are elevated above the base flood elevation (BFE). Based on the number of buildings exposed to flooding throughout the county, many would benefit from elevating above the level of flooding.
- **Landslide risk is significant for steeper areas in the county**—The recent landslide mapping used in this study was created using lidar and modern mapping methods to develop very accurate landslide hazard maps. We used exposure analysis to assess the threat from landslide hazards. The developed areas along highway 20 and route 34, a residential area north of Corvallis, and communities in the mountainous western part of the county (Alsea, Blodgett, and Summit) are highly susceptible to landslide hazards. Nearly 30% of the buildings in Blodgett and Summit are exposed to very high or high landslide hazard.
- **Exposure analysis show that buildings in the riverine valleys of the study area are at risk to channel migration hazard**—Exposure analysis shows that channel migration hazard is a threat to communities and buildings along the Marys River and North Fork Alsea River. The community of Alsea has very high risk from channel migration hazard, with approximately half of the buildings exposed to the hazard.
- **Wildfire risk is higher in the wildland-urban interface portions of the county**—Exposure analysis shows that buildings in rural northern portions of the county are at higher risk from wildfire than other areas in the county. The forested and less populated northern and western portions of the county correspond to high and moderate wildfire hazard. The communities of Alsea, Blodgett, and Summit have the highest risk from wildfire compared to other communities in the county. Over 6% of the buildings in the unincorporated county are within areas of high or moderate wildfire hazard.
- **Most of the study area's critical facilities are at greatest risk from a CSZ event hazard relative to other hazards in the study area**— Because of their importance during and after a

natural disaster, we identified and examined critical facilities. We have estimated that 73% (70 of 96) of Benton County's critical facilities will be non-functioning after a CSZ Mw-9.0 earthquake and 38% (36 of 96) will be non-functioning after a Turner and Mill Creek Fault Mw-6.6 earthquake. We found that 10 critical facilities are exposed to flood hazard.

- **The biggest causes of displacement to population are earthquake, flood, and landslide hazards**—Potential displacement of permanent residents from natural hazards was estimated within this report. We estimated that there is risk to 16% of the population in the county from a CSZ Mw-9.0 earthquake and 11% from a Turner and Mill Creek earthquake. Flood hazard is a potential threat to 6.7% of permanent residents and are vulnerable to displacement. Landslide hazard is a potential threat to 5.7% of permanent residents and are vulnerable to displacement. A small percentage of residents are vulnerable to displacement from channel migration and wildfire hazards.
- **The results allow communities the ability to compare across hazards and prioritize their needs**—Each community within the study area was assessed for natural hazard exposure and loss. This allowed for comparison of risk for a specific hazard between communities. It also allows for a comparison between different hazards, though care must be taken to distinguish loss estimates and exposure results. The loss estimates and exposure analyses can assist in developing plans that address the concerns of those individual communities.

5.0 LIMITATIONS

There are several limitations to keep in mind when interpreting the results of this risk assessment.

- **Spatial and temporal variability of natural hazard occurrence** – With the exception of earthquakes, other hazards like flood, landslide, channel migration, and wildfire are extremely unlikely to occur across the fully mapped extent of the hazard zones. For example, areas mapped in the 100-year flood zone will be prone to flooding on occasion in certain watersheds during specific events, but not all at once throughout the entire county or even an entire community. While we report the overall impacts of a given hazard scenario, the losses from a single hazard event probably will not be as severe and widespread.
- **Loss estimation for individual buildings** – Hazus-MH is a model, not reality, which is an important factor when considering the loss ratio of an individual building. On-the-ground mitigation, such as elevation of buildings to avoid flood loss, has been only minimally captured. Also, due to a lack of building material information, assumptions were made about the distribution of wood, steel, and un-reinforced masonry buildings. Loss estimation is most insightful when individual building results are aggregated to the community level because it reduces the impact of data outliers.
- **Loss estimation versus exposure** – We recommend careful interpretation of exposure results. This is due to the spatial and temporal variability of natural hazards (described above) and the inability to perform loss estimations due to the lack of Hazus-MH damage functions. Exposure is reported in terms of total building value, which could imply a total loss of the buildings in a particular hazard zone, but this is not the case. Exposure is simply a calculation of the number of buildings and their value and does not make estimates about the level to which an individual building could be damaged.

- **Population variability** – Some of the communities in Benton County have vacation homes and rentals, which are typically occupied during the summer. Our estimates of potentially displaced people rely on permanent populations published in the 2020 U.S. Census (United States Census Bureau, 2020b) and adjusted for population growth based on PSU Population Research Center data. As a result, we are slightly underestimating the number of people that may be in harm's way on a summer weekend.
- **Data accuracy and completeness** – Some datasets in our risk assessment had incomplete coverage or lacked high-resolution data within the study area. We used lower-resolution data where there was incomplete coverage or where high-resolution data was not available. We made assumptions to amend areas of incomplete data coverage based on reasonable methods described within this report. Data layers in which assumptions were made to fill gaps are building footprints, population, some building specific attributes, and landslide susceptibility. Many of the datasets included known or suspected artifacts, omissions, and errors, however repairing these problems was beyond the scope of the project and are areas needing additional research. We are aware that some uncertainty has been introduced from these data amendments at an individual building scale, but at community-wide scales the effects of the uncertainties are slight.
- **Changing Conditions** – This assessment did not account for potential changes in climate, land use, or population; it is a snapshot of Benton County's current risk from natural hazards. Human-induced climate change poses a significant and widespread risk to people around the world. In Oregon, climate change is expected to impact the frequency and intensity of floods, wildfires, and landslides, but quantifying this impact was beyond the scope of this study.

6.0 RECOMMENDATIONS

The following actions are needed to better understand hazards and reduce risk to natural hazard through mitigation planning. These implementation areas, while not comprehensive, touch on all phases of risk management and focus on awareness and preparation, planning, emergency response, mitigation funding opportunities, and hazard-specific risk reduction activities.

6.1 Awareness and Preparation

Natural hazard awareness is crucial to lowering risk and lessening the impacts of natural hazards. When community members understand their risk and know the role that they play in preparedness, the community will become a much safer place to live. Awareness and preparation not only reduce the initial impact from natural hazards, but they also reduce the time a community needs to recover from a disaster, commonly referred to as "resilience."

This report is intended to provide local officials with a comprehensive and authoritative profile of natural hazard risk to underpin their public outreach efforts.

Messaging can be tailored to stakeholder groups. For example, outreach to homeowners could focus on actions they can take to reduce risk to their property. The DOGAMI Homeowners Guide to Landslides (https://www.oregongeology.org/Landslide/ger_homeowners_guide_landslides.pdf) provides a variety of risk reduction options for homeowners who live in high landslide susceptibility areas. This guide is one of many existing resources. Agencies partnering with local officials in the development of additional effective resources could help reach a broader community and user groups.

6.2 Planning

This report can help local decision-makers develop their local plans by identifying geohazards and associated risks to the community. The primary framework for accomplishing this is through the comprehensive planning process. The comprehensive plan sets the long-term trajectory of capital improvements, zoning, and urban growth boundary expansion, all of which are planning tools that can be used to reduce natural hazard risk.

Another framework is the natural hazard mitigation plan (NHMP) process. NHMP plans focus on characterizing natural hazard risk and identifying actions to reduce risk. Additionally, the information presented here can be a resource when updating the mitigation actions and inform the vulnerability assessment section of the NHMP plan.

While there are many similarities between this report and an NHMP, the primary difference is that the risk assessment is not a planning document. Additional differences can be the hazards or critical facilities examined in each report. Differences between the reports may be due to data availability or limited methodologies for specific hazards. The critical facilities considered in this report may not be identical to those listed in a typical NHMP due to the lack of damage functions in Hazus-MH for non-building structures and to different considerations about emergency response during and after a disaster.

6.3 Emergency Response

Critical facilities will play a major role during and immediately after a natural disaster. This study can help emergency managers identify vulnerable critical facilities and develop contingency plans. Additionally, detailed mapping of potentially displaced residents can be used to re-evaluate evacuation routes and identify vulnerable populations to target for early warning.

The building database that accompanies this report presents many opportunities for future pre-disaster mitigation, emergency response, and community resilience improvements. Vulnerable areas can be identified and targeted for awareness campaigns. These campaigns can be aimed at pre-disaster mitigation through, for example, improvements of the structural connection of a building's frame to its foundation. Emergency response entities can benefit from the use of the building dataset through identification of potential hazards and populated buildings before and during a disaster. Both reduction of the magnitude of the disaster and a decrease in the response time contribute to a community's overall resilience.

6.4 Mitigation Funding Opportunities

Several state and federal funding options are available to communities that are susceptible to natural hazards and have specific cost-effective mitigation projects they wish to accomplish. The Oregon Office of Emergency Management (OEM) State Hazard Mitigation Officer (SHMO) can provide communities assistance in determining eligibility, finding mitigation grants, and navigating the mitigation grant application process. OEM has produced a document that can assist local officials in applying for mitigation funds
(https://www.oregon.gov/OEM/Documents/Oregon_Hazard_Mitigation_Grant_Program_Handbook.pdf
).

At the time of writing this report, FEMA has five programs that assist with mitigation funding for natural hazards: Hazard Mitigation Grant Program (HMGP), HMGP Post-Fire Assistance, Pre-Disaster

Mitigation (PDM) Grant Program, Building Resilient Infrastructure and Communities (BRIC) grant program, and Flood Mitigation Assistance (FMA) (https://www.fema.gov/grants/mitigation). The SHMO can help with finding further opportunities for earthquake and tsunami assistance and funding.

6.5 Hazard-Specific Risk Reduction Actions

6.5.1 Earthquake

- Evaluate critical facilities for seismic preparedness by identifying structural deficiencies and vulnerabilities to dependent systems (e.g., water, fuel, power).
- Evaluate vulnerabilities of critical facilities. We estimate that 73% of critical facilities (**Appendix A: Community Risk Profiles**) will be damaged by a CSZ earthquake scenario described in this report, which will have many direct and indirect negative effects on first-response and recovery efforts.
- Identify communities and buildings that would benefit from seismic upgrades.

6.5.2 Flood

- Map areas of potential flood water storage areas.
- Identify structures that have repeatedly flooded in the past and would be eligible for FEMA's "buyout" program.
- Additional risk reduction strategies may be found on FEMA's website at https://www.ready.gov/floods.

6.5.3 Landslide

- Create modern landslide inventory and susceptibility maps.
- Monitor ground movement in high susceptibility areas.
- Evaluate risks to transportation networks and land value losses due to landslides in future risk assessments.
- Study the risk from landslides that are experience channel erosion at the toe of the landslide.
- Additional risk reduction strategies may be found on FEMA's website at https://www.ready.gov/landslides-debris-flow.

6.5.4 Wildfire-related geologic hazards

- Evaluate post-wildfire geologic hazards including flood, debris flows, and landslides.
- Additional risk reduction strategies may be found on FEMA's website at https://www.ready.gov/wildfires.

6.5.5 Channel migration

- Future development in areas with the largest CMZs, particularly Marys River and North Fork Alsea River, could incorporate CMZ mitigation strategies into plans and designs.
- Evaluate the losses in land value or productivity due to channel migration.
- Evaluate risks to transportation networks and bridges due to channel migration.
- Identify areas suitable for conservation corridors along rivers that are at risk from channel migration. These can be multi-purpose including areas that provide or improve flood water storage, riparian and aquatic habitat restoration, climate change resilience, and water quality.

7.0 ACKNOWLEDGMENTS

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Many people contributed to this report at different points during the analysis phase and during the writing phase and at various levels. We are grateful to everyone who contributed, especially the following from DOGAMI: William Burns, Christina Appleby, and Robert Hairston-Porter.

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9.0 APPENDICES

APPENDIX A. COMMUNITY RISK PROFILES

A risk analysis summary for each community is provided in this section to encourage ideas for natural hazard risk reduction. Increasing disaster preparedness, public hazards communication, and education, ensuring functionality of emergency services, and ensuring access to evacuation routes are actions that every community can take to reduce their risk. This appendix contains community specific data to provide an overview of the community and the level of risk from each natural hazard analyzed. In addition, for each community, we provide a list of critical facilities (**in bold**) and other community lifelines with each of their risk to hazard examined in this study indicated by an "X".

A.1 Unincorporated Benton County (Rural)

Table A-1. Unincorporated Benton County (rural) hazard profile.

Community Overview							
Community Name		Population	Number of Buildings		Critical Facilities[1]	Total Building Value ($)	
Unincorporated Benton County (rural)		20,766	16,331		15	3,934,253,000	
Hazus-MH Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	828	4.0%	842	2	34,480,000	0.9%
Earthquake	CSZ Mw-9.0 Deterministic	806	3.9%	2,982	10	506,585,000	13%
Earthquake	Turner and Mill Creek Fault Mw-6.6 Deterministic	338	1.6%	1343	0	264,564,000	6.7%
Exposure Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Exposure Ratio
Landslide	High and Very High Susceptibility	2,516	12.1%	1,729	0	398,676,000	10%
Channel Migration	Channel Migration Zone	258	1.2%	254	0	53,663,000	1.4%
Wildfire	High and Moderate Risk	1,740	8.4%	1,172	0	250,624,000	6.4%

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with “First floor height” above the level of flooding (base flood elevation).

Table A-2. Unincorporated Benton County (rural) critical facilities and other lifelines.

Critical Facilities and Lifelines by Community	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Turner and Mill Creek 6.6 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Channel Migration Zone	Wildfire High or Moderate Risk
	Exposed	>50% Prob.	>50% Prob.	Exposed	Exposed	Exposed
Adair Village STP	-	X	-	-	-	-
Alsea Food Bank	-	X	-	X	-	-
Alsea Gleaners	-	X	-	-	-	-
Camp Adair	-	X	-	-	-	-
Corvallis Locke Fire Station	-	-	-	-	-	-
Corvallis Municipal Airport	-	X	-	-	-	-
Corvallis Waldorf School	-	X	-	-	-	-
Crescent Valley High School	X	X	-	-	-	-
Fir Grove Primary School	-	X	-	-	-	-
Flying Tom Landing Strip	-	-	-	-	-	-
Hoskins - Kings Valley RFPD	-	-	-	-	-	-
Lobster Valley Church of Christ	-	-	-	X	-	-
Mountain View Elementary School	-	X	-	-	-	-
Muddy Creek Charter School	-	X	-	-	-	-
ODF Fire Station	-	X	-	-	-	-
Philomath Fire and Rescue Station 202	-	-	-	-	-	-
Philomath Fire and Rescue Station 203	-	-	-	-	-	-
Philomath Wastewater Treatment Plant	X	X	-	-	-	-
Rock Creek Water Treatment	-	-	-	-	-	-
The Alsea Fellowship Church	-	-	-	-	-	-
The Alsea Hope Grange	-	X	-	-	-	-
Wren substation	-	-	-	-	-	-

A.2 Unincorporated Community of Alpine

Table A-3. Unincorporated community of Alpine hazard profile.

Community Overview							
Community Name		Population	Number of Buildings		Critical Facilities[1]	Total Building Value ($)	
Alpine		205	161		3	26,781,000	
Hazus-MH Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	0	0.0%	0	0	0	0.0%
Earthquake	CSZ Mw-9.0 Deterministic	22	10.7%	49	2	4,763,000	18%
Earthquake	Turner and Mill Creek Fault Mw-6.6 Deterministic	1	0.6%	3	0	522,000	1.9%
Exposure Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Exposure Ratio
Landslide	High and Very High Susceptibility	0	0%	0	0	0	0%
Wildfire	High and Moderate Risk	4	2.0%	2	0	291,000	1.1%

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Table A-4. Unincorporated community of Alpine critical facilities and other lifelines.

	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Turner and Mill Creek 6.6 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Wildfire High or Moderate Risk
Critical Facilities and Lifelines by Community	**Exposed**	**>50% Prob.**	**>50% Prob.**	**Exposed**	**Exposed**
Alpine School	-	X	-	-	-
Alpine Wastewater	-	-	-	-	-
Monroe Fire Department Station 1	-	X	-	-	-

A.3 Unincorporated Community of Alsea

Table A-5. Unincorporated community of Alsea hazard profile.

Community Overview							
Community Name		Population	Number of Buildings		Critical Facilities[1]	Total Building Value ($)	
Alsea		216	137		3	30,315,000	
Hazus-MH Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	17	7.7%	17	1	252,000	0.8%
Earthquake	CSZ Mw-9.0 Deterministic	45	21.0%	62	1	7,268,000	24%
Earthquake	Turner and Mill Creek Fault Mw-6.6 Deterministic	1	0.4%	4	0	531,000	1.8%
Exposure Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Exposure Ratio
Landslide	High and Very High Susceptibility	66	30.5%	32	1	5,466,000	18%
Channel Migration	Channel Migration Zone	79	37%	50	3	16,937	56%
Wildfire	High and Moderate Risk	28	13%	18	1	3,683,000	12%

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Table A-6. Unincorporated community of Alsea critical facilities and other lifelines.

	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Turner and Mill Creek 6.6 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Channel Migration Zone	Wildfire High or Moderate Risk
Critical Facilities and Lifelines by Community	**Exposed**	**>50% Prob.**	**>50% Prob.**	**Exposed**	**Exposed**	**Exposed**
Alsea Community School	X	X	-	-	X	X
Alsea Health Center	-	-	-	-	-	-
Alsea Public Library	-	-	-	X	-	-
Alsea substation	-	-	-	-	X	-
Alsea RFPD	-	-	-	-	X	-

A.4 Unincorporated Community of Bellfountain

Table A-7. Unincorporated community of Bellfountain hazard profile.

Community Overview							
Community Name		Population	Number of Buildings		Critical Facilities[1]	Total Building Value ($)	
Bellfountain		82	59		2	14,814,000	
Hazus-MH Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	0	0.0%	0	0	0	0.0%
Earthquake	CSZ Mw-9.0 Deterministic	3	3.9%	17	2	4,184,000	28%
Earthquake	Turner and Mill Creek Fault Mw-6.6 Deterministic	0	0%	2	0	674,000	4.6%
Exposure Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Exposure Ratio
Landslide	High and Very High Susceptibility	0	0%	0	0	0	0%
Wildfire	High and Moderate Risk	0	0%	0	0	0	0%

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Table A-8. Unincorporated community of Bellfountain critical facilities and other lifelines.

	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Turner and Mill Creek 6.6 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Wildfire High or Moderate Risk
Critical Facilities and Lifelines by Community	**Exposed**	**>50% Prob.**	**>50% Prob.**	**Exposed**	**Exposed**
Bellfountain Cornerstone Christian School	-	X	-	-	-
Monroe Fire Station 3	-	X	-	-	-

A.5 Unincorporated Community of Blodgett

Table A-9. Unincorporated community of Blodgett hazard profile.

Community Overview							
Community Name		Population	Number of Buildings		Critical Facilities[1]	Total Building Value ($)	
Blodgett		67	53		2	11,186,000	
Hazus-MH Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	0	0.0%	0	0	0	0.0%
Earthquake	CSZ Mw-9.0 Deterministic	8	12.0%	16	0	1,271,000	11%
Earthquake	Turner and Mill Creek Fault Mw-6.6 Deterministic	0	0%	0	0	58,000	0.5%
Exposure Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Exposure Ratio
Landslide	High and Very High Susceptibility	36	53.7%	22	1	3,195,000	29%
Wildfire	High and Moderate Risk	4	6.0%	3	0	1,282,000	11%

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Table A-10. Unincorporated community of Blodgett critical facilities and other lifelines.

	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Turner and Mill Creek 6.6 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Wildfire High or Moderate Risk
Critical Facilities and Lifelines by Community	**Exposed**	**>50% Prob.**	**>50% Prob.**	**Exposed**	**Exposed**
Blodgett Elementary	-	-	-	X	-
Blodgett Summit FD Station 600	-	-	-	-	-

A.6 Unincorporated Community of Kings Valley

Table A-11. Unincorporated community of Kings Valley hazard profile.

Community Overview							
Community Name		Population	Number of Buildings		Critical Facilities[1]	Total Building Value ($)	
Kings Valley		90	85		1	17,918,000	
Hazus-MH Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	0	0.0%	0	0	0	0.0%
Earthquake	CSZ Mw-9.0 Deterministic	12	13.3%	28	1	3,412,000	19%
Earthquake	Turner and Mill Creek Fault Mw-6.6 Deterministic	4	4.6%	18	0	2,214,000	12%
Exposure Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Exposure Ratio
Landslide	High and Very High Susceptibility	0	0%	0	0	0	0%
Wildfire	High and Moderate Risk	0	0%	0	0	0	0%

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Table A-12. Unincorporated community of Kings Valley critical facilities and other lifelines.

	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Turner and Mill Creek 6.6 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Wildfire High or Moderate Risk
Critical Facilities and Lifelines by Community	**Exposed**	**>50% Prob.**	**>50% Prob.**	**Exposed**	**Exposed**
Kings Valley Charter School	-	X	-	-	-

A.7 Unincorporated Community of Summit

Table A-13. Unincorporated community of Summit hazard profile and other lifelines.

Community Overview							
Community Name		Population	Number of Buildings		Critical Facilities[1]	Total Building Value ($)	
Summit		113	96		1	20,026,000	
Hazus-MH Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	0	0.0%	0	0	0	0.0%
Earthquake	CSZ Mw-9.0 Deterministic	12	10.7%	18	1	3,641,000	18%
Earthquake	Turner and Mill Creek Fault Mw-6.6 Deterministic	0	0%	1	0	177,000	0.9%
Exposure Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Exposure Ratio
Landslide	High and Very High Susceptibility	40	35.7%	38	0	5,921,000	30%
Wildfire	High and Moderate Risk	26	23%	20	1	6,884,000	34%

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Table A-14. Unincorporated community of Summit critical facilities.

Critical Facilities and Lifelines by Community	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Turner and Mill Creek 6.6 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Wildfire High or Moderate Risk
	Exposed	>50% Prob.	>50% Prob.	Exposed	Exposed
Blodgett-Summit RFPD Station 2	-	X	-	-	X

A.8 City of Adair Village

Table A-15. City of Adair Village hazard profile.

Community Overview							
Community Name		Population	Number of Buildings		Critical Facilities[1]	Total Building Value ($)	
Adair Village		1,319	277		3	107,166,000	
Hazus-MH Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	0	0.0%	0	0	0	0.0%
Earthquake	CSZ Mw-9.0 Deterministic	12	0.9%	18	3	7,486,000	7.0%
Earthquake	Turner and Mill Creek Fault Mw-6.6 Deterministic	14	1%	18	0	5,822,000	5.4%
Exposure Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Exposure Ratio
Landslide	High and Very High Susceptibility	12	0.9%	2	0	497,000	0.5%
Wildfire	High and Moderate Risk	0	0%	0	0	0	0%

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Table A-16. City of Adair Village critical facilities and other lifelines.

Critical Facilities and Lifelines by Community	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Turner and Mill Creek 6.6 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Wildfire High or Moderate Risk
	Exposed	>50% Prob.	>50% Prob.	Exposed	Exposed
Adair City Hall	-	X	-	-	-
Adair Rural Fire and Rescue	-	X	-	-	-
Santiam Christian School	-	X	-	-	-
Village Christian Church	-	X	-	-	-

A.9 City of Albany

Table A-17. City of Albany hazard profile.

Community Overview							
Community Name		Population	Number of Buildings		Critical Facilities[1]	Total Building Value ($)	
Albany		57,200	23,941		34	7,033,549,000	
Hazus-MH Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	964	1.7%	509	1	28,271,000	0.4%
Earthquake	CSZ Mw-9.0 Deterministic	2,457	4.3%	4,512	21	1,159,096,000	17%
Earthquake	Turner and Mill Creek Fault Mw-6.6 Deterministic	2,900	5.1%	4,309	19	1,011,785,000	14%
Exposure Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Exposure Ratio
Landslide	High and Very High Susceptibility	151	0.3%	75	0	17,700,000	0.3%
Wildfire	High and Moderate Risk	0	0%	0	0	0	0%

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with “First floor height” above the level of flooding (base flood elevation).

Table A-18. City of Albany critical facilities.

Critical Facilities and Lifelines by Community	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Turner and Mill Creek 6.6 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Wildfire High or Moderate Risk
	Exposed	>50% Prob.	>50% Prob.	Exposed	Exposed
Albany-Millersburg WRF	X	X	X	-	-
Albany Armory	-	X	X	-	-
Albany Christian School	-	-	-	-	-
Albany Fire Dept. Station 11	-	-	-	-	-
Albany Fire Dept. Station 12	-	X	-	-	-
Albany Fire Dept. Station 13	-	-	-	-	-
Albany Fire Dept. Station 14	-	-	-	-	-
Albany Maintenance Station	-	X	X	-	-
Albany Options School	-	-	-	-	-
Albany Police Department	-	X	-	-	-
Albany Public Works	-	X	X	-	-
Central Elementary	-	X	X	-	-
Circle of Friends Learning Center	-	X	X	-	-
First United Methodist Early Learning Center	-	-	-	-	-
Good Shepherd Lutheran School	-	-	-	-	-
Lafayette Elementary	-	X	X	-	-
Liberty Elementary	-	X	X	-	-
Linn County Road Department	-	X	-	-	-
Memorial Middle School	-	X	X	-	-
North Albany Elementary School	-	X	X	-	-
North Albany Middle School	-	X	X	-	-
Oak Elementary	-	X	X	-	-
Periwinkle Elementary	-	X	X	-	-
Samaritan Albany General Hospital	-	X	X	-	-
South Albany High School	-	-	-	-	-
South Shore Elementary	-	X	X	-	-
St Marys Catholic School	-	-	-	-	-
Standard Christian School	-	-	-	-	-
Sundborn Montessori School	-	-	-	-	-
Sunrise Elementary	-	-	-	-	-
Takena Elementary	-	X	X	-	-
Timber Ridge School	-	-	X	-	-
Waverly Elementary	-	X	X	-	-
West Albany High School	-	X	X	-	-

A.10 City of Corvallis

Table A-19. City of Corvallis hazard profile.

Community Overview							
Community Name		Population	Number of Buildings		Critical Facilities[1]	Total Building Value ($)	
Corvallis		57,718	17,509		33	7,132,168,000	
Hazus-MH Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	2,036	3.5%	603	3	23,743,000	0.3%
Earthquake	CSZ Mw-9.0 Deterministic	5,881	10.2%	3,295	26	1,131,548,000	16%
Earthquake	Turner and Mill Creek Fault Mw-6.6 Deterministic	3464	6%	2040	15	649,732,000	9.1%
Exposure Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Exposure Ratio
Landslide	High and Very High Susceptibility	538	0.9%	146	0	55,189,000	0.8%
Channel Migration	Channel Migration Zone	100	0.2%	61	0	11,280,000	0.2%
Wildfire	High and Moderate Risk	1,270	2.2%	376	0	174,380,000	2.4%

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Table A-20. City of Corvallis critical facilities and other lifelines.

Critical Facilities and Lifelines by Community	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Turner and Mill Creek 6.6 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Channel Migration Zone	Wildfire High or Moderate Risk
	Exposed	>50% Prob.	>50% Prob.	Exposed	Exposed	Exposed
Adams Elementary School	-	X	X	-	-	-
Ashbrook Independent School	-	-	-	-	-	-
Benton Center	-	X	-	-	-	-
Benton County Circuit Court	-	X	X	-	-	-
Benton County Health Services	-	X	-	-	-	-
Benton County Public Works	X	X	X	-	-	-
Boyter's Golden Horizon, Inc.	-	X	-	-	-	-
Cheldelin Middle School	-	X	X	-	-	-
City Hall Annex and Law Library	-	X	X	-	-	-
College Hill Alternative High School	-	X	-	-	-	-
Conifer House Nursing Home	X	X	X	-	-	-
Corvallis-Benton County Public Library	-	-	-	-	-	-
Corvallis Armory-Smith Hall	-	X	-	-	-	-
Corvallis Care Center	-	X	-	-	-	-

Critical Facilities and Lifelines by Community	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Turner and Mill Creek 6.6 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Channel Migration Zone	Wildfire High or Moderate Risk
	Exposed	>50% Prob.	>50% Prob.	Exposed	Exposed	Exposed
Corvallis City Hall	-	X	X	-	-	-
Corvallis Community Center		X	X	-	-	-
Corvallis Fire Station No 1	-	-	-	-	-	-
Corvallis Fire Station No 2	-	X	-	-	-	-
Corvallis Fire Station No 3	-	X	-	-	-	-
Corvallis Fire Station No 4	-	-	-	-	-	-
Corvallis Fire Station No 5	-	-	-	-	-	-
Corvallis High School	X	X	X	-	-	-
Corvallis Manor	X	X	X	-	-	-
Corvallis Montessori School	-	X	X	-	-	-
Corvallis Municipal Court		X	X	-	-	-
Corvallis Police Department	-	X	X	-	-	-
Corvallis Public Works	-	X	X	-	-	-
Corvallis Wastewater Reclamation	X	X	X	-	-	-
Franklin School	-	X	-	-	-	-
Garfield Elementary School	-	X	X	-	-	-
Good Samaritan - The Corvallis Clinic	-	-	-	-	-	-
Good Samaritan Corvallis Medical Center	-	-	-	-	-	-
Good Samaritan School	-	X	-	-	-	-
Good Samaritan Wellness Center	-	X	-	-	-	-
Hoover Elementary School	-	X	X	-	-	-
Jefferson Elementary School	-	X	X	-	-	-
Lincoln Elementary School	-	X	X	-	-	-
Linus Pauling Middle School	-	X	-	-	-	-
Madison Building	-	X	X	-	-	-
OSP - OSU Campus	-	X	-	-	-	-
OSU Health Center	-	X	X	-	-	-
Parks and Recreation Admin	-	-	X	-	X	-
Parks and Recreation Maintenance	X	-	X	-	X	-
Prestige Senior Living West Hills	-	-	-	-	-	-
Regent Retirement Center	-	-	-	-	-	-
Samaritan Heart of the Valley	-	X	-	-	-	-
Stoneybrook Senior Living	-	-	-	-	-	-
Wilson Elementary School	-	X	X	-	-	-

A.11 City of Monroe

Table A-21. City of Monroe hazard profile.

Community Overview							
Community Name		Population	Number of Buildings	Critical Facilities[1]		Total Building Value ($)	
Monroe		624	378	7		109,046,000	
Hazus-MH Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	0	0.0%	1	1	10,000	0.0%
Earthquake*	CSZ Mw-9.0 Deterministic	51	8.2%	126	5	17,540,000	16%
Earthquake*	Turner and Mill Creek Fault Mw-6.6 Deterministic	3	0.5%	17	1	3,555,000	3.3%
Exposure Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Exposure Ratio
Landslide	High and Very High Susceptibility	1	0.2%	3	0	377,000	0.3%
Wildfire	High and Moderate Risk	0	0%	0	0	0	0%

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Table A-22. City of Monroe critical facilities and other lifelines.

Critical Facilities and Lifelines by Community	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Turner and Mill Creek 6.6 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Wildfire High or Moderate Risk
	Exposed	>50% Prob.	>50% Prob.	Exposed	Exposed
Monroe Area Community Center	-	X	-	-	-
Monroe City Hall	-	X	-	-	-
Monroe Community Library	-	-	-	-	-
Monroe Grade School	-	X	-	-	-
Monroe Health Center	-	-	-	-	-
Monroe High School	-	-	-	-	-
Monroe RFPD - Station 2	-	X	-	-	-
Monroe STP	X	X	X	-	-
Monroe Water Treatment Facility	-	X	-	-	-
Old Mill Center Relief Nursery	-	-	-	-	-
South Benton Community Museum	-	X	-	-	-
South Benton Food Pantry	-	X	-	-	-

A.12 City of Philomath

Table A-23. City of Philomath hazard profile.

Community Overview							
Community Name		Population	Number of Buildings		Critical Facilities[1]	Total Building Value ($)	
Philomath		5,690	2,064		9	581,805,000	
Hazus-MH Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	244	4.3%	95	4	1,728,000	0.3%
Earthquake*	CSZ Mw-9.0 Deterministic	195	3.4%	366	3	72,950,000	13%
Earthquake*	Turner and Mill Creek Fault Mw-6.6 Deterministic	48	0.8%	99	2	20,401,000	3.5%
Exposure Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Exposure Ratio
Landslide	High and Very High Susceptibility	112	2.0%	31	0	9,718,000	1.7%
Channel Migration	Channel Migration Zone	17	0.3%	37	0	14,547,000	2.5%
Wildfire	High and Moderate Risk	132	2.3%	56	0	11,146,000	1.9%

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Table A-24. City of Philomath critical facilities and other lifelines.

Critical Facilities and Lifelines by Community	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Turner and Mill Creek 6.6 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Channel Migration Zone	Wildfire High or Moderate Risk
	Exposed	>50% Prob.	>50% Prob.	Exposed	Exposed	Exposed
Benton County Historical Museum	-	X	-	-	-	-
Clemens Primary School	-	X	X	-	-	-
Philomath City Hall	X	-	-	-	-	-
Philomath Community Library	-	-	-	-	-	-
Philomath Elementary School*	-	-	-	-	-	-
Philomath High School*	-	-	-	-	-	-
Philomath Middle School*	-	-	-	-	-	-
Philomath Police Department	X	-	-	-	-	-
Philomath Public Works	X	X	X	-	-	-
Philomath RFPD*	-	-	-	-	-	-
Philomath Water Treatment Plant	X	X	-	-	-	-

*Critical facility has been mitigated for seismic risk.

APPENDIX B. DETAILED RISK ASSESSMENT TABLES

Table B-1. Benton County building inventory.

(all dollar amounts in thousands)

	Residential			Commercial and Industrial			Agricultural			Public and Non-Profit			All Buildings			
Community	Number of Buildings	Building Value ($)	Building Value per Community Total	Number of Buildings	Building Value ($)	Building Value per Community Total	Number of Buildings	Building Value ($)	Building Value per Community Total	Number of Buildings	Building Value ($)	Building Value per Community Total	Number of Buildings	Number of Buildings per Study Area Total	Building Value ($)	Value of Buildings per Study Area Total
Unincorp. Benton Co (rural)	7,960	1,934,898	49%	284	270,784	6.9%	7,962	1,560,801	40%	125	167,770	4.3%	16,331	27%	3,934,253	21%
Alpine	82	9,279	35%	4	2,842	10.6%	72	13,410	50%	3	1,249	4.7%	161	0.3%	26,781	0.1%
Alsea	89	12,249	40%	17	3,567	11.8%	22	2,983	9.8%	9	11,516	38.0%	137	0.2%	30,315	0.2%
Bellfountain	30	4,877	33%	3	782	5.3%	23	6,183	41.7%	3	2,972	20.1%	59	0.1%	14,814	0.1%
Blodgett	28	4,381	39%	1	441	4%	21	3,675	32.9%	3	2,689	24.0%	53	0.1%	11,186	0.1%
Kings Valley	28	4,314	24%	2	323	1.8%	48	8,301	46.3%	7	4,981	27.8%	85	0.1%	17,918	0.1%
Summit	47	8,698	43%	1	4,242	21.2%	47	6,748	33.7%	1	337	2%	96	0.2%	20,026	0.1%
Total Unincorp. County	8,264	1,978,696	49%	312	282,981	7%	8,195	1,602,101	40%	151	191,514	5%	16,922	28%	4,055,292	21%
Adair Village	236	58,252	54%	20	26,154	24%	9	1,276	1.2%	12	21,484	20%	277	0.5%	107,166	0.6%
Albany	18,316	4,669,707	66%	1,282	1,604,927	23%	3,890	248,367	3.5%	453	510,549	7.3%	23,941	39%	7,033,549	37%
Corvallis	14,709	4,511,844	63%	932	1,514,056	21%	1,531	151,737	2%	337	954,530	13%	17,509	29%	7,132,168	38%
Monroe	266	54,610	50%	20	7,684	7%	63	7,484	7%	29	39,268	36.0%	378	0.6%	109,046	0.6%
Philomath	1,644	373,240	64%	169	106,094	18%	197	18,852	3.2%	54	83,619	14%	2,064	3.4%	581,805	3.1%
Total Study Area	43,435	11,646,349	61%	2,735	3,541,896	19%	13,885	2,029,817	11%	1,036	1,800,964	9%	61,091	100%	19,019,026	100%

Table B-2. CSZ Mw-9.0 Earthquake loss estimates.

(all dollar amounts in thousands)

			Total Earthquake Damage							
			Buildings Damaged				All Buildings Changed to At Least Moderate Code			
	Total Number of Buildings	Total Estimated Building Value ($)	Yellow-Tagged Buildings	Red-Tagged Buildings	Sum of Economic Loss	Loss Ratio	Yellow-Tagged Buildings	Red-Tagged Buildings	Sum of Economic Loss	Loss Ratio
Unincorp. Benton Co (rural)	16,331	3,934,253	2,275	707	506,585	13%	1,421	301	285,111	7%
Alpine	161	26,781	38	11	4,763	18%	19	3	2,420	9%
Alsea	137	30,315	37	25	7,268	24%	26	6	3,800	13%
Bellfountain	59	14,814	13	4	4,184	28%	6	1	1,609	11%
Blodgett	53	11,186	11	5	1,271	11%	5	1	658	6%
Kings Valley	85	17,918	19	8	3,412	19%	15	4	2,269	13%
Summit	96	20,026	14	4	3,641	18%	9	2	1,567	8%
Total Unincorp. County	16,922	4,055,292	2,406	765	531,124	13%	1,500	318	297,434	7%
Adair Village	277	107,166	15	3	7,486	7%	10	2	3,334	3%
Albany	23941	7,033,549	3,600	912	1,159,096	17%	2,112	448	586,768	8%
Corvallis	17,509	7,132,168	2,526	769	1,131,548	16%	1,576	334	594,868	8%
Monroe	378	109,046	100	26	17,540	16%	48	8	9,389	9%
Philomath	2,064	581,805	289	77	72,950	13%	155	31	40,197	7%
Total Study Area	61,091	19,019,026	8,936	2,552	2,919,744	15%	5,401	1,141	1,531,990	8%

Table B-3. Turner and Mill Creek Fault Mw-6.6 Earthquake loss estimates.

(all dollar amounts in thousands)

			Total Earthquake Damage							
			Buildings Damaged				All Buildings Changed to At Least Moderate Code			
	Total Number of Buildings	Total Estimated Building Value ($)	Yellow-Tagged Buildings	Red-Tagged Buildings	Sum of Economic Loss	Loss Ratio	Yellow-Tagged Buildings	Red-Tagged Buildings	Sum of Economic Loss	Loss Ratio
Unincorp. Benton Co (rural)	16,331	3,934,253	1032	311	264,564	6.7%	752	172	166,172	4.2%
Alpine	161	26,781	3	0	522	1.9%	1	0	210	0.8%
Alsea	137	30,315	3	1	531	1.8%	2	0	382	1.3%
Bellfountain	59	14,814	2	0	674	4.6%	0	0	183	1.2%
Blodgett	53	11,186	0	0	58	0.5%	0	0	24	0.2%
Kings Valley	85	17,918	15	3	2,214	12%	13	3	1,912	11%
Summit	96	20,026	1	0	177	0.9%	0	0	88	0.4%
Total Unincorp. County	16,922	4,055,292	1,056	315	268,740	6.6%	768	175	168,971	7%
Adair Village	277	107,166	15	3	5,822	5.4%	11	3	3,155	2.9%
Albany	23,941	7,033,549	3,178	1,131	1,011,785	14%	2,389	599	627,239	8.9%
Corvallis	17,509	7,132,168	1610	430	649,732	9.1%	1,053	238	385,541	5.4%
Monroe	378	109,046	15	2	3,555	3.3%	5	1	1,814	1.7%
Philomath	2,064	581,805	82	17	20,401	3.5%	51	12	12,880	2.2%
Total Study Area	61,091	19,019,026	5,956	1,898	1,685,473	10%	4,277	1,028	1,199,600	6.3%

Table B-4. Flood loss estimates.

			(all dollar amounts in thousands)											
			10% (10-yr)			**2% (50-yr)**			**1% (100-yr)**			**0.2% (500-yr)**		
Community	**Total Number of Buildings**	**Total Estimated Building Value ($)**	**Number of Buildings**	**Loss Estimate**	**Loss Ratio**	**Number of Buildings**	**Loss Estimate**	**Loss Ratio**	**Number of Buildings**	**Loss Estimate**	**Loss Ratio**	**Number of Buildings**	**Loss Estimate**	**Loss Ratio**
Unincorp. Benton Co (rural)	16,331	3,934,253	216	4,805	0.1%	627	22,246	0.6%	842	34,480	0.9%	1,176	72,299	1.8%
Alpine	161	26,781	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%
Alsea	137	30,315	3	56	0.2%	13	159	0.5%	17	252	0.8%	25	652	2.1%
Bellfountain	59	14,814	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%
Blodgett	53	11,186	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%
Kings Valley	85	17,918	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%
Summit	96	20,026	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%
Total Unincorp. County	16,922	4,055,292	219	4,861	0.1%	640	22,405	0.6%	859	34,733	0.9%	1,201	72,950	1.8%
Adair Village	277	107,166	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%
Albany	23,941	7,033,549	94	4,451	0.1%	250	14,794	0.2%	509	28,271	0.4%	1,038	74,980	1.0%
Corvallis	17,509	7,132,168	51	1,965	0.0%	226	8,648	0.1%	603	23,743	0.3%	1,590	103,599	1.5%
Monroe	378	109,046	0	0	0.0%	1	6	0.0%	1	10	0.0%	2	23	0.0%
Philomath	2,064	581,805	21	126	0.0%	76	1,162	0.2%	95	1,728	0.3%	144	3,818	0.7%
Total Study Area	61,091	19,019,026	385	11,403	0.1%	1,193	47,015	0.3%	2,067	88,485	0.5%	3,975	255,370	1.3%

Table B-5. Flood exposure.

Community	Total Number of Buildings	Total Population	1% (100-yr) Potentially Displaced Residents from Flood Exposure	1% (100-yr) % Potentially Displaced Residents from flood Exposure	1% (100-yr) Number of Flood Exposed Buildings	1% (100-yr) % of Flood Exposed Buildings	1% (100-yr) Number of Flood Exposed Buildings Without Damage
Unincorp. Benton Co (rural)	16,331	20,766	828	4.0%	884	5.4%	42
Alpine	161	205	0	0.0%	0	0.0%	0
Alsea	137	216	17	7.7%	19	13.9%	2
Bellfountain	59	82	0	0.0%	0	0.0%	0
Blodgett	53	67	0	0.0%	0	0.0%	0
Kings Valley	85	90	0	0.0%	0	0.0%	0
Summit	96	113	0	0.0%	0	0.0%	0
Total Unincorp. County	16,922	21,540	845	3.9%	903	5.3%	44
Adair Village	277	1,319	0	0%	0	0%	0
Albany	23,941	57,200	964	1.7%	509	2.1%	70
Corvallis	17,509	57,718	2,036	4%	774	4%	171
Monroe	378	624	0	0%	1	0%	0
Philomath	2,064	5,690	244	4%	111	5%	16
Total Study Area	61,091	144,091	4,089	2.8%	2,298	3.7%	301

Table B-6. Landslide exposure.

			(all dollar amounts in thousands)								
			Very High Susceptibility			**High Susceptibility**			**Moderate Susceptibility**		
Community	**Total Number of Buildings**	**Total Estimated Building Value ($)**	**Number of Buildings**	**Building Value ($)**	**Percent of Building Value Exposed**	**Number of Buildings**	**Building Value ($)**	**Percent of Building Value Exposed**	**Number of Buildings**	**Building Value ($)**	**Percent of Building Value Exposed**
Unincorp. Benton Co (rural)	16,331	3,934,253	1,153	263,280	6.7%	576	135,396	3.4%	8,511	1,910,337	49%
Alpine	161	26,781	0	0	0.0%	0	0	0.0%	64	9,112	34%
Alsea	137	30,315	32	5,466	18%	0	0	0.0%	27	5,001	16%
Bellfountain	59	14,814	0	0	0.0%	0	0	0.0%	21	5,673	38%
Blodgett	53	11,186	22	3,195	28.6%	0	0	0.0%	27	7,043	63%
Kings Valley	85	17,918	0	0	0%	0	0	0.0%	12	1,442	8%
Summit	96	20,026	37	5,833	29.1%	1	88	0.4%	57	14,035	70%
Total Unincorp. County	16,922	4,055,292	1,244	277,774	6.8%	577	135,483	3.3%	8,719	1,952,643	48%
Adair Village	277	107,166	0	0	0%	2	497	0.5%	78	21,933	20%
Albany	23,941	7,033,549	0	0	0%	75	17,700	0.3%	3,831	972,522	14%
Corvallis	17,509	7,132,168	0	0	0%	146	55,189	0.8%	5,062	2,029,140	28%
Monroe	378	109,046	0	0	0%	3	377	0.3%	90	26,327	24%
Philomath	2,064	581,805	0	0	0%	31	9,718	1.7%	475	138,661	24%
Total Study Area	61,091	19,019,026	1,244	277,774	1.5%	834	218,964	1.2%	18,255	5,141,226	27%

Table B-7. Channel migration exposure

(all dollar amounts in thousands)

Community*	Total Number of Buildings	Total Population	Total Estimated Building Value ($)	Channel Migration Hazard				
				Potentially Displaced Residents from channel migration Exposure	% Potentially Displaced Residents from channel migration Exposure	Number of Buildings Exposed	Building Value ($)	Ratio of Exposure Value
Unincorp. Benton Co (rural)	16,331	20,766	3,934,253	258	1.2%	254	53,663	1.4%
Alsea	137	216	30,315	79	37%	50	16,937	56%
Total Unincorp. County	16,468	20,982	3,964,568	337	1.6%	304	70,600	1.8%
Corvallis	17,509	57,718	7,132,168	100	0.2%	61	11,280	0.2%
Philomath	2,064	5,690	581,805	17	0.3%	37	14,547	2.5%
Total Study Area	36,041	84,390	11,678,541	454	0.5%	402	96,427	0.8%

*Communities in table limited to communities within the study area of Appleby and others (2021).

Table B-8. Wildfire exposure.

			(all dollar amounts in thousands)								
			High Hazard			**Moderate Hazard**			**Low Hazard**		
Community	**Total Number of Buildings**	**Total Estimated Building Value ($)**	**Number of Buildings**	**Building Value ($)**	**Percent of Building Value Exposed**	**Number of Buildings**	**Building Value ($)**	**Percent of Building Value Exposed**	**Number of Buildings**	**Building Value ($)**	**Percent of Building Value Exposed**
Unincorp. Benton Co (rural)	16,331	3,934,253	66	13,611	0.3%	1,106	237,013	6.0%	7,198	1,558,060	40%
Alpine	161	26,781	0	0	0%	2	291	1.1%	41	6,094	23%
Alsea	137	30,315	2	488	1.6%	16	3,195	11%	16	2,056	6.8%
Bellfountain	59	14,814	0	0	0%	0	0	0%	1	48	0.3%
Blodgett	53	11,186	0	0	0%	3	1,282	11%	28	3,983	36%
Kings Valley	85	17,918	0	0	0%	0	0	0%	38	6,007	34%
Summit	96	20,026	0	0	0%	20	6,884	34%	54	8,952	45%
Total Unincorp. County	16,922	4,055,292	68	14,099	0.3%	1,147	248,666	6.1%	7,376	1,585,200	39%
Adair Village	277	107,166	0	0	0%	0	0	0%	2	622	0.6%
Albany	23,941	7,033,549	0	0	0%	130	32,969	0.5%	315	87,252	1.2%
Corvallis	17,509	7,132,168	38	44,136	0.6%	338	130,244	1.8%	668	219,792	3.1%
Monroe	378	109,046	0	0	0%	0	0	0%	0	0	0%
Philomath	2,064	581,805	2	640	0.1%	54	10,506	1.8%	81	38,064	6.6%
Total Study Area	61,091	19,019,026	108	58,876	0.3%	1,669	422,385	2.2%	8,442	1,930,931	10%

APPENDIX C. HAZUS-MH METHODOLOGY

C.1 Software

We performed all loss estimations using Hazus®-MH 4.2 and ArcGIS® Desktop® 10.2.2.

C.2 User-Defined Facilities (UDF) Database

A UDF database was compiled for all buildings in Benton County for use in both the flood and earthquake modules of Hazus-MH. The Benton County assessor database (acquired in 2021) was used to determine which taxlots had improvements (i.e., buildings) and how many building points should be included in the UDF database.

C.2.1 Locating buildings points

The Oregon Department of Geology and Mineral Industries (DOGAMI) used the SBFO-1 (Williams, 2021) dataset to help precisely locate the centroid of each building. Extra effort was spent to locate building points along the 1% and 0.2% annual chance inundation fringe. When buildings were partially within the inundation zone, the building point was moved to the centroid of the portion of the building within the inundation zone. An iterative approach was used to further refine locations of building points for the flood module by generating results, reviewing the highest value buildings, and moving the building point over a representative elevation on the lidar digital elevation model to ensure an accurate first floor height.

C.2.2 Attributing building points

Populating the required attributes for Hazus-MH was achieved through a variety of approaches. The Benton County assessor database was used whenever possible, but in many cases that database did not provide the necessary information. The following is list of attributes and their sources:

- **Longitude** and **Latitude** – Location information that provides Hazus-MH the x and y-position of the UDF point. This allows for an overlay to occur between the UDF point and the flood or earthquake input data layers. The hazard model uses this spatial overlay to determine the correct hazard risk level that will be applied to the UDF point. The format of the attribute must be in decimal degrees. A simple geometric calculation using GIS software is done on the point to derive this value.
- **Occupancy class** – An alphanumeric attribute that indicates the use of the UDF (e.g. 'RES1' is a single family dwelling). The alphanumeric code is composed of seven broad occupancy types (RES = residential, COM = commercial, IND = industrial, AGR = agricultural, GOV = public, REL = non-profit/religious, EDU = education) and various suffixes that indicate more specific types. This code determines the damage function to be used for flood analysis. It is also used to attribute the Building Type field, discussed below, for the earthquake analysis. The code was interpreted from "Stat Class" or "Description" data found in the Benton County assessor database. When data was not available, the default value of RES1 was applied throughout.
- **Cost** – The replacement cost of an individual UDF. Loss ratio is derived from this value. Replacement cost is based on a method called RSMeans valuation (Charest, 2017) and is calculated by multiplying the building square footage by a standard cost per square foot. These standard rates per square foot are in tables within the default Hazus database.

- **Year built** – The year of construction that is used to attribute the Building Design Level field for the earthquake analysis (see "Building Design" below). The year a UDF was built is obtained from Benton County assessor database. When not available, the year of "1900" was applied.
- **Square feet** – The size of the UDF is used to pro-rate the total improvement value for taxlots with multiple UDFs. The value distribution method will ensure that UDFs with the highest square footage will be the most expensive on a given taxlot. This value is also used to pro-rate the **Number of People** field for Residential UDFs within a census block. The value was obtained from DOGAMI's building footprints; where (RES) footprints were not available, we used the Benton County assessor database.
- **Number of stories** – The number of stories for an individual UDF, along with Occupancy Class, determines the applied damage function for flood analysis. The value was obtained from the Benton County assessor database when available. For UDFs without assessor information for number of stories that are within the flood zone, closer inspection using Google Street View™ or available oblique imagery was used for attribution.
- **Foundation type** – The UDF foundation type correlates with First Floor Height values in feet (see Table 3.11 in the Hazus-MH Technical Manual for the Flood Model [FEMA, 2012a]). It also functions within the flood model by indicating if a basement exists or not. UDFs with a basement have a different damage function from UDFs that do not have one. The value was obtained from the Benton County assessor database when available. For UDFs without assessor information for basements that are within the flood zone, closer inspection using Google Street View™ or available oblique imagery was used to ascertain if one exists or not.
- **First floor height** – The height in feet above grade for the lowest habitable floor. The height is factored during the depth of flooding analysis. The value is used directly by Hazus-MH, where Hazus-MH overlays a UDF location on a depth grid and using the **first floor height** determines the level of flooding occurring to a building. It is derived from the Foundation Type attribute or observation via oblique imagery or Google Street View™ mapping service.
- **Building type** – This attribute determines the construction material and structural integrity of an individual UDF. It is used by Hazus-MH for estimating earthquake losses by determining which damage function will be applied. This information was unavailable from the Benton County assessor data, so instead it was derived from a statistical distribution based on **Occupancy class**.
- **Building design level** – This attribute determines the seismic building code for an individual UDF. It is used by Hazus-MH for estimating earthquake losses by determining which damage function will be applied. This information is derived from the **Year Built** attribute (Benton County Assessor) and state/regional Seismic Building Code benchmark years.
- **Number of people** – The estimated number of permanent residents living within an individual residential structure. It is used in the post-analysis phase to determine the amount of people affected by a given hazard. This attribute is derived from default Hazus database (United States Census Bureau, 2020a) of population per census block and distributed across residential UDFs and adjusted based on population growth estimates from PSU Population Research Center.
- **Community** – The community that a UDF is within. These areas are used in the post-analysis for reporting results. The communities were based on incorporated area boundaries; unincorporated community areas were based on building density.

C.2.3 Seismic building codes

Oregon initially adopted seismic building codes in the mid-1970s (Judson, 2012). The established benchmark years of code enforcement are used in determining a "design level" for individual buildings. The design level attributes (pre code, low code, moderate code, and high code) are used in the Hazus-MH earthquake model to determine what damage functions are applied to a given building (FEMA, 2012b). The year built or the year of the most recent seismic retrofit are the main considerations for an individual design level attribute. Seismic retrofitting information for structures would be ideal for this analysis but was not available for Benton County. **Table C-1** outlines the benchmark years that apply to buildings within Benton County.

Table C-1. Benton County seismic design level benchmark years.

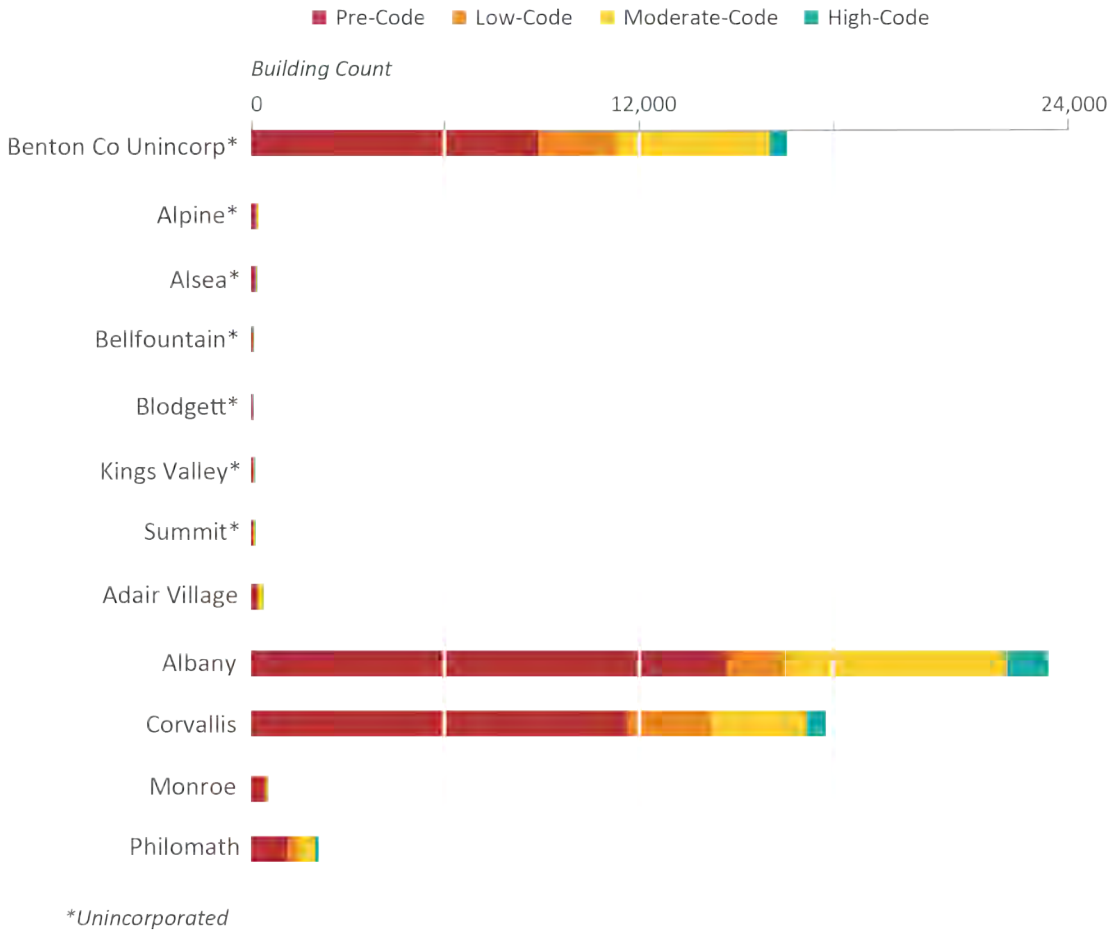
Building Type	Year Built	Design Level	Basis
Single-Family Dwelling (includes Duplexes)	prior to 1976	Pre Code	Interpretation of Judson (Judson, 2012)
	1976–1991	Low Code	
	1992–2003	Moderate Code	
	2004–2016	High Code	
Manufactured Housing	prior to 2003	Pre Code	Interpretation of OR BCD 2002 Manufactured Dwelling Special Codes (Oregon Building Codes Division, 2002)
	2003–2010	Low Code	
	2011–2016	Moderate Code	Interpretation of OR BCD 2010 Manufactured Dwelling Special Codes Update (Oregon Building Codes Division, 2010)
All other buildings	prior to 1976	Pre Code	Business Oregon 2022 Oregon Benefit-Cost Analysis Tool, p. 24 (Business Oregon, 2022)
	1976–1990	Low Code	
	1991–2016	Moderate Code	

Table C-2 and corresponding **Figure C-1** illustrate the current state of seismic building codes for the county.

Table C-2. Seismic design level in Benton County.

		Pre Code		Low Code		Moderate Code		High Code	
Community	**Total Number of Buildings**	**Number of Buildings**	**Percentage of Buildings**	**Number of Buildings**	**Percentage of Buildings**	**Number of Buildings**	**Percentage of Buildings**	**Number of Buildings**	**Percentage of Buildings**
Unincorp. Benton Co (rural)	16,331	8,762	54%	2,392	15%	4,656	29%	521	3.2%
Alpine	161	110	68%	13	8.1%	38	23.6%	0	0.0%
Alsea	137	106	77%	7	5%	22	16%	2	1.5%
Bellfountain	59	42	71%	2	3%	14	24%	1	1.7%
Blodgett	53	35	66%	4	7.5%	12	22.6%	2	3.8%
Kings Valley	85	48	56%	10	12%	26	31%	1	1.2%
Summit	96	52	54%	10	10.4%	31	32.3%	3	3.1%
Total Unincorp. County	16,922	9,155	54%	2,438	14%	4,799	28%	530	3.1%
Adair Village	277	141	51%	4	1%	129	47%	3	1.1%
Albany	23,941	14,604	61%	2,872	12%	4,492	19%	1,973	8%
Corvallis	17,509	11,457	65%	2,543	15%	2,920	17%	589	3%
Monroe	378	300	79%	46	12%	26	6.9%	6	1.6%
Philomath	2,064	1,122	54%	333	16%	505	25%	104	5.0%
Total Study Area	61,091	36,779	60%	8,236	14%	12,871	21%	3,205	5%

Figure C-1. Seismic design level by Benton County community.



C.3 Flood Hazard Data

Depth grids for "Zone A" designated flood zones, or approximate 100-year flood zones, were developed by the Strategic Alliance for Risk Reduction (STARR) in 2015 to revise the Benton County FIRMs (FEMA, 2016). DOGAMI developed depth grids from detailed stream model information within the study area. Both sets of depth grids were used in this risk assessment to determine the level to which buildings are impacted by flooding.

A study area-wide, 2-meter, lidar-based depth grid was developed for each of the 10-, 50-, 100-, and 500-year annual chance flood events. The depth grids were imported into Hazus-MH for determining the depth of flooding for areas within the FEMA flood zones.

Once the UDF database was developed into a Hazus-compliant format, the Hazus-MH methodology was applied using a Python (programming language) script developed by DOGAMI (Bauer, 2018). The analysis was then run for a given flood event, and the script cross-referenced a UDF location with the depth grid to find the depth of flooding. The script then applied a specific damage function, based on a UDF's Occupancy Class [OccCls], which was used to determine the loss ratio for a given amount of flood depth, relative to the UDF's first-floor height.

C.4 Earthquake Hazard Data

The following hazard layers used for our loss estimation are derived from work conducted by Madin and others (2021): National Earthquake Hazard Reduction Program (NEHRP) soil classification, liquefaction susceptibility and wet landslide susceptibility. The liquefaction and landslide susceptibility layers together with NEHRP were used by the Hazus-MH tool to calculate ground motion layers and permanent ground deformation and associated probability. The default value of 5 feet was used for the water table depth value.

During the Hazus-MH earthquake analysis, each UDF was analyzed given its site-specific parameters (ground deformation) and evaluated for loss, expressed as a probability of a damage state. Specific damage functions based on Building type and Building design level were used to calculate the damage states given the site-specific parameters for each UDF. The output provided probabilities of the five damage states (None, Slight, Moderate, Extensive, Complete) from which losses in dollar amounts were derived.

C.5 Post-Analysis Quality Control

Ensuring the quality of the results from Hazus-MH flood and earthquake modules is an essential part of the process. A primary characteristic of the process is that it is iterative. A UDF database without errors is highly unlikely, so this part of the process is intended to limit and reduce the influence these errors have on the final outcome. Before applying the Hazus-MH methodology, closely examining the top 10 largest area UDFs and the top 10 most expensive UDFs is advisable. Special consideration can also be given to critical facilities due to their importance to communities.

Identifying, verifying, and correcting (if needed) the outliers in the results is the most efficient way to improve the UDF database. This can be done by sorting the results based on the loss estimates and closely scrutinizing the top 10 to 15 records. If corrections are made, then subsequent iterations are necessary. We continued checking the “loss leaders” until no more corrections were needed.

Finding anomalies and investigating possible sources of error are crucial in making corrections to the data. A wide range of corrections might be required to produce a better outcome. For example, floating homes may need to have a first-floor height adjustment or a UDF point position might need to be moved due to issues with the depth grid. Incorrect basement or occupancy type attribution could be the cause of a problem. Commonly, inconsistencies between assessor data and taxlot geometry can be the source of an error. These are just a few of the many types of problems addressed in the quality control process.

APPENDIX D. ACRONYMS AND DEFINITIONS

D.1 Acronyms

CRS	Community Rating System
CSZ	Cascadia subduction zone
DLCD	Oregon Department of Land Conservation and Development
DOGAMI	Department of Geology and Mineral Industries (State of Oregon)
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FRI	Fire Risk Index
GIS	Geographic Information System
NFIP	National Flood Insurance Program
NHMP	Natural hazard mitigation plan
NOAA	National Oceanic and Atmospheric Administration
ODF	Oregon Department of Forestry
OEM	Oregon Emergency Management
OFR	Open-File Report
OPDR	Oregon Partnership for Disaster Resilience
PGA	Peak ground acceleration
PGD	Permanent ground deformation
PGV	Peak ground velocity
Risk MAP	Risk Mapping, Assessment, and Planning
SHMO	State Hazard Mitigation Officer
SLIDO	State Landslide Information Layer for Oregon
UDF	User-defined facilities
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
WUI	Wildland-urban interface
WWA	West Wide Wildfire Risk Assessment

D.2 Definitions

1% annual chance flood – The flood elevation that has a 1-percent chance of being equaled or exceeded each year. Sometimes referred to as the 100-year flood.

0.2% annual chance flood – The flood elevation that has a 0.2-percent chance of being equaled or exceeded each year. Sometimes referred to as the 500-year flood.

Base flood elevation (BFE) – Elevation of the 1-percent-annual-chance flood. This elevation is the basis of the insurance and floodplain management requirements of the NFIP.

Critical facilities – Facilities that, if damaged, would present an immediate threat to life, public health, and safety. As categorized in HAZUS-MH, critical facilities include hospitals, emergency operations centers, police stations, fire stations and schools.

Exposure – Determination of whether a building is within or outside of a hazard zone. No loss estimation is modeled.

Flood Insurance Rate Map (FIRM) – An official map of a community, on which FEMA has delineated both the SFHAs and the risk premium zones applicable to the community.

Flood Insurance Study (FIS) – Contains an examination, evaluation, and determination of the flood hazards of a community and, if appropriate, the corresponding water-surface elevations.

Hazus-MH – A GIS-based risk assessment methodology and software application created by FEMA and the National Institute of Building Sciences for analyzing potential losses from floods, hurricane winds, and earthquakes.

Lidar – A remote sensing technology that measures distance by illuminating a target with a laser and analyzing the reflected light. Lidar is popularly used as a technology to make high-resolution maps.

Liquefaction – Describes a phenomenon whereby a saturated soil substantially loses strength and stiffness in response to an applied stress, usually an earthquake, causing it to behave like liquid.

Loss Ratio – The expression of loss as a fraction of the value of the local inventory (total value/loss).

Magnitude – A scale used by seismologists to measure the size of earthquakes in terms of energy released.

Risk – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of a natural hazard. Sometimes referred to as vulnerability.

Risk MAP – The vision of this FEMA strategy is to work collaboratively with State, local, and tribal entities to deliver quality flood data that increases public awareness and leads to action that reduces risk to life and property.

Riverine – Of or produced by a river. Riverine floodplains have readily identifiable channels.

Susceptibility – Degree of proneness to natural hazards that is determined based on physical characteristics that are present.

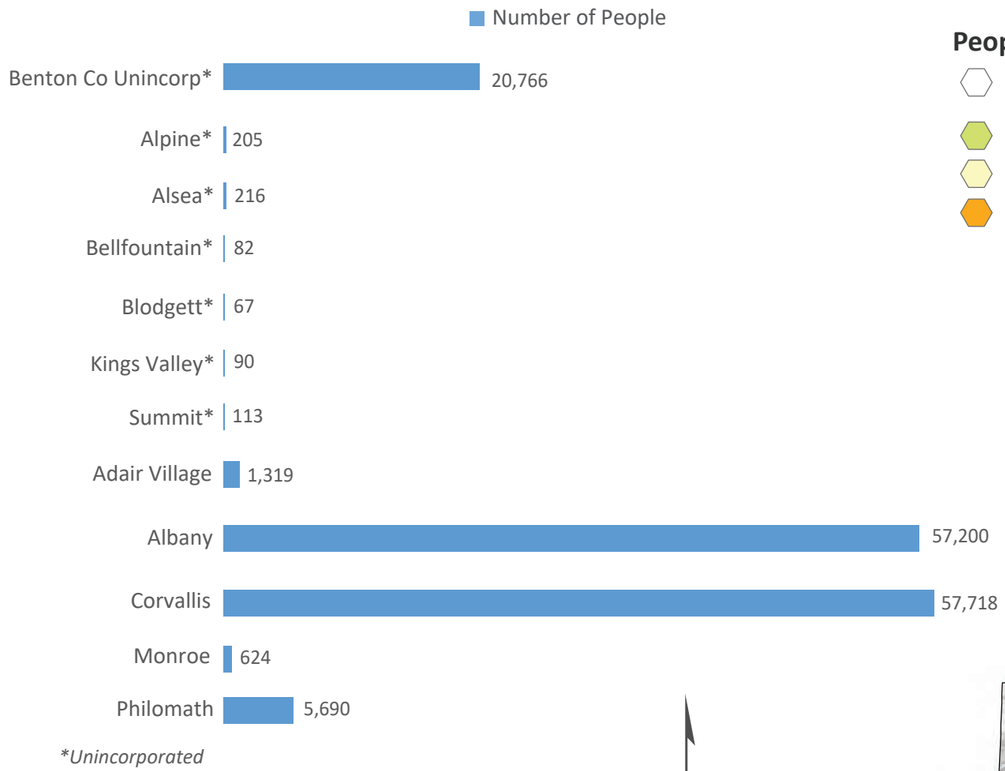
Vulnerability – Characteristics that make people or assets more susceptible to a natural hazard.

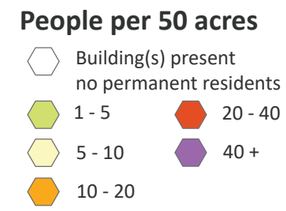
APPENDIX E. MAP PLATES

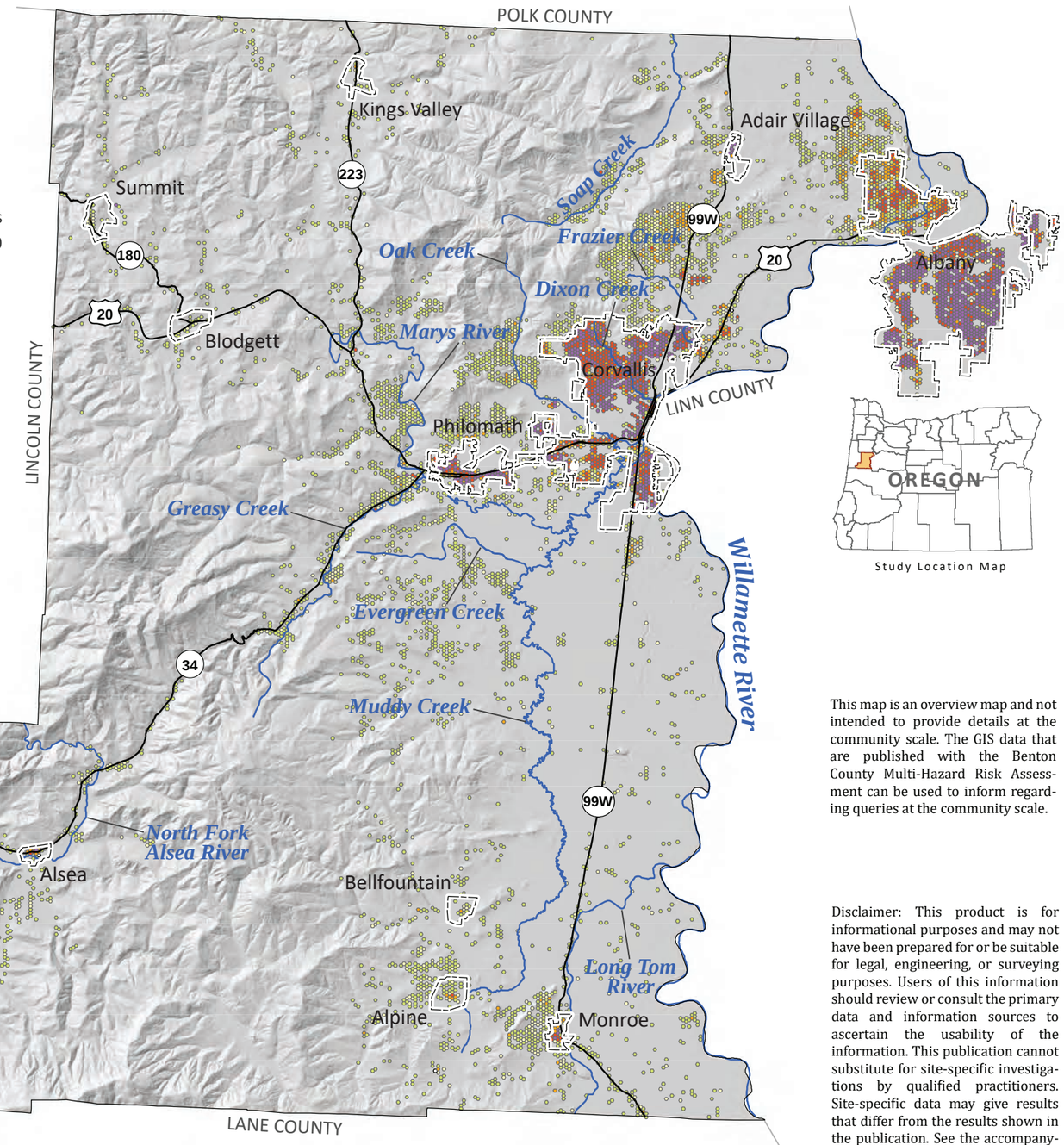
See appendix folder for individual map PDFs.

PLATE 1

Population Density Map of Benton County, Oregon







Data Sources:
Population data: PSU Population Research Center (2021)
Roads: Oregon Department of Transportation Signed Routes (2013)
Place names: U.S. Geological Survey Geographic Names Information System (2015)
City limits: Oregon Department of Transportation (2014)
Basemap: Oregon Lidar Consortium (2014)
Hydrography: U.S. Geological Survey National Hydrography Dataset (2017)

Projection: NAD 1983 UTM Zone 10N
Software: Esri ArcMap 10, Adobe Illustrator CC

Cartography by:Matt C. Williams, 2022

This map is an overview map and not intended to provide details at the community scale. The GIS data that are published with the Benton County Multi-Hazard Risk Assessment can be used to inform regarding queries at the community scale.

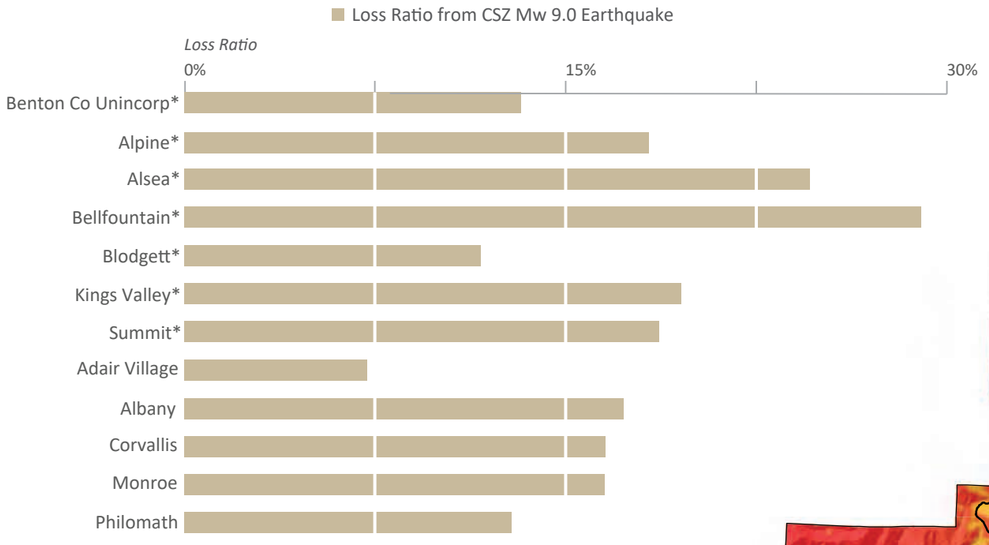
Disclaimer: This product is for informational purposes and may not have been prepared for or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information. This publication cannot substitute for site-specific investigations by qualified practitioners. Site-specific data may give results that differ from the results shown in the publication. See the accompanying text report for more details on the limitations of the methods and data used to prepare this publication.

PLATE 2

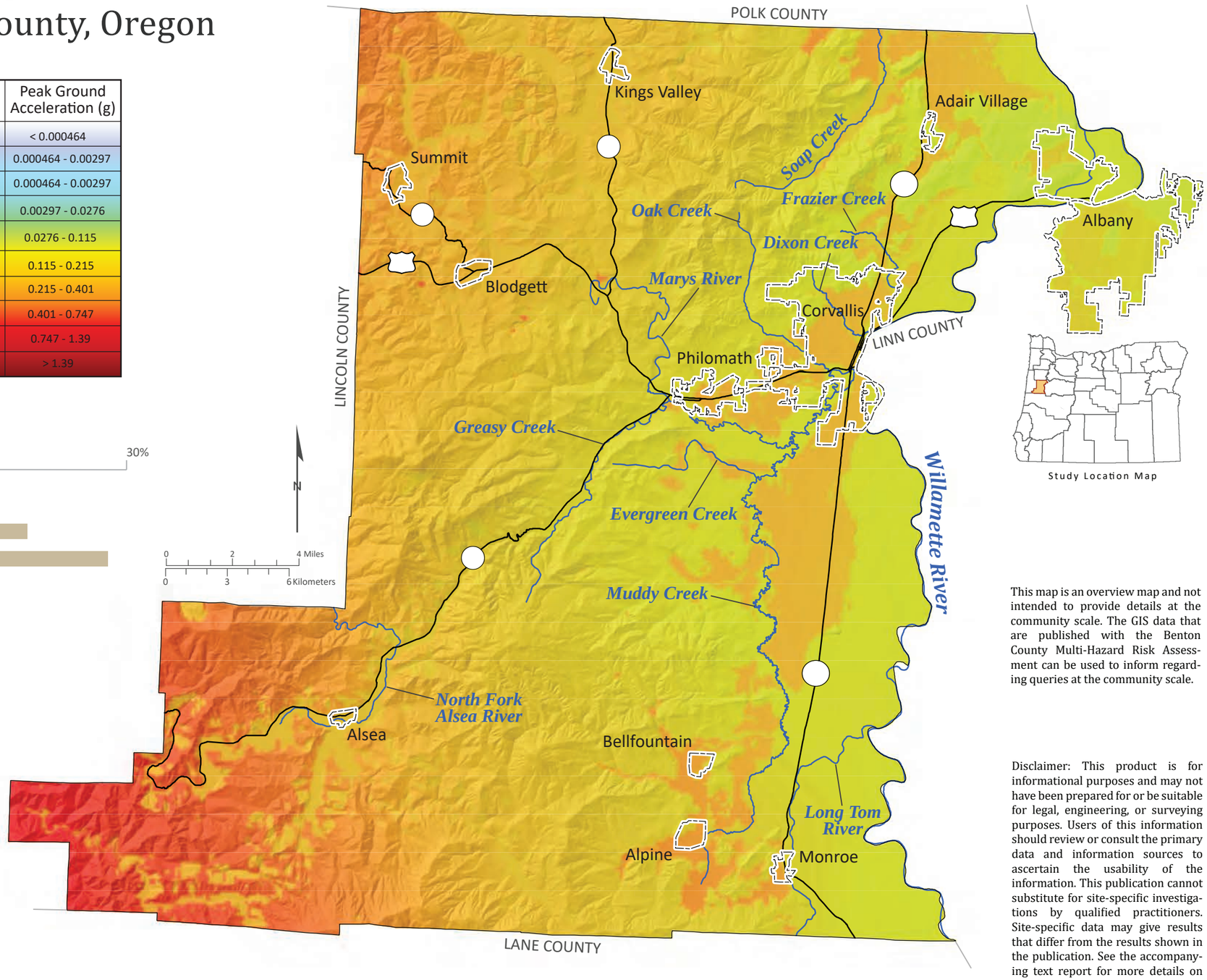
CSZ Magnitude-9.0 Earthquake Shaking Map of Benton County, Oregon

Peak Ground Acceleration (PGA) is the maximum acceleration in a given location or rather how hard the ground is shaking during an earthquake. It is one measurement of ground motion, which is closely associated with the level of damage that occurs from an earthquake.

Modified Mercalli	Perceived Shaking	Potential Damage	Peak Ground Acceleration (g)
I	Not felt	None	< 0.000464
II	Weak	None	0.000464 - 0.00297
III	Weak	None	0.000464 - 0.00297
IV	Light	None	0.00297 - 0.0276
V	Moderate	Very Light	0.0276 - 0.115
VI	Strong	Light	0.115 - 0.215
VII	Very Strong	Moderate	0.215 - 0.401
VIII	Severe	Mod./Heavy	0.401 - 0.747
IX	Violent	Heavy	0.747 - 1.39
X	Extreme	Very Heavy	> 1.39



*Unincorporated



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Data Sources:
Earthquake peak ground acceleration: Oregon Department of Geology and Mineral Industries (2021)
Roads: Oregon Department of Transportation Signed Routes (2013)
Place names: U.S. Geological Survey Geographic Names Information System (2015)
City limits: Oregon Department of Transportation (2014)
Basemap: Oregon Lidar Consortium (2014)
Hydrography: U.S. Geological Survey National Hydrography Dataset (2017)

Projection: NAD 1983 UTM Zone 10N
Software: Esri® ArcMap 10, Adobe® Illustrator CC

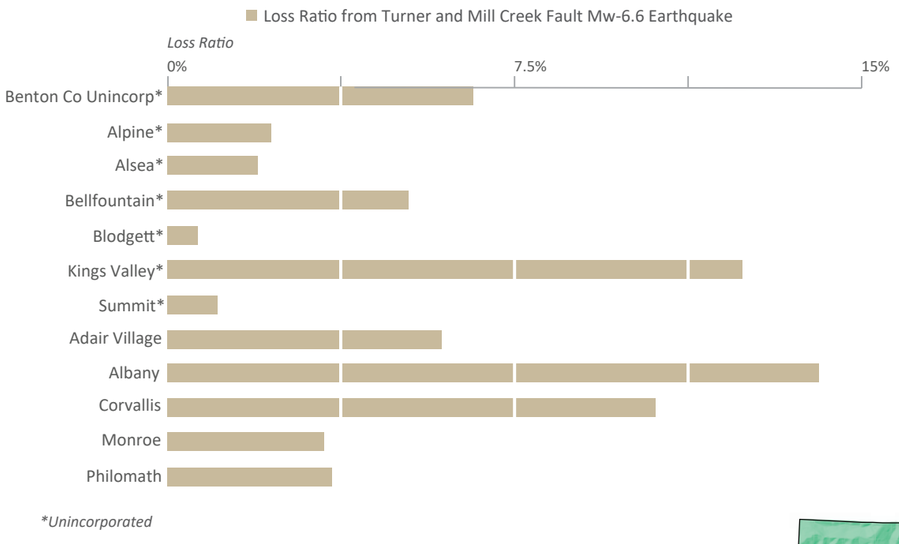
Cartography by:Matt C. Williams, 2022

PLATE 3

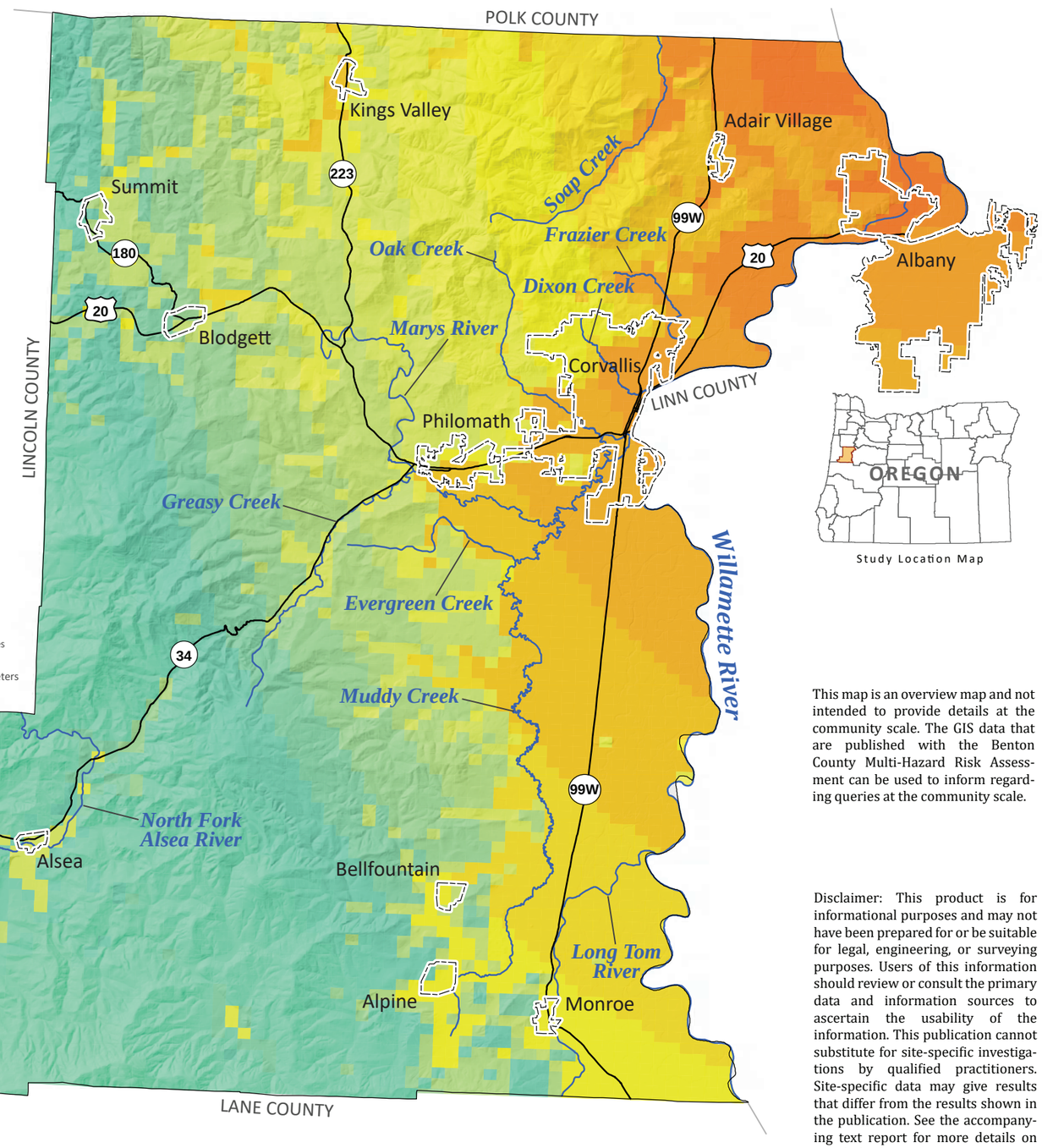
Turner and Mill Creek Fault Magnitude-6.6 Earthquake Shaking Map of Benton County, Oregon

Peak Ground Acceleration (PGA) is the maximum acceleration in a given location or rather how hard the ground is shaking during an earthquake. It is one measurement of ground motion, which is closely associated with the level of damage that occurs from an earthquake.

Modified Mercalli	Perceived Shaking	Potential Damage	Peak Ground Acceleration (g)
I	Not felt	None	< 0.000464
II	Weak	None	0.000464 - 0.00297
III	Weak	None	0.000464 - 0.00297
IV	Light	None	0.00297 - 0.0276
V	Moderate	Very Light	0.0276 - 0.115
VI	Strong	Light	0.115 - 0.215
VII	Very Strong	Moderate	0.215 - 0.401
VIII	Severe	Mod./Heavy	0.401 - 0.747
IX	Violent	Heavy	0.747 - 1.39
X	Extreme	Very Heavy	> 1.39



*Unincorporated



This map is an overview map and not intended to provide details at the community scale. The GIS data that are published with the Benton County Multi-Hazard Risk Assessment can be used to inform regarding queries at the community scale.

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Data Sources:
Earthquake peak ground acceleration: Generated from Hazus 5.0 earthquake analysis (2022)
Roads: Oregon Department of Transportation Signed Routes (2013)
Place names: U.S. Geological Survey Geographic Names Information System (2015)
City limits: Oregon Department of Transportation (2014)
Basemap: Oregon Lidar Consortium (2014)
Hydrography: U.S. Geological Survey National Hydrography Dataset (2017)

Projection: NAD 1983 UTM Zone 10N
Software: Esri® ArcMap 10, Adobe® Illustrator CC

Cartography by:Matt C. Williams, 2022

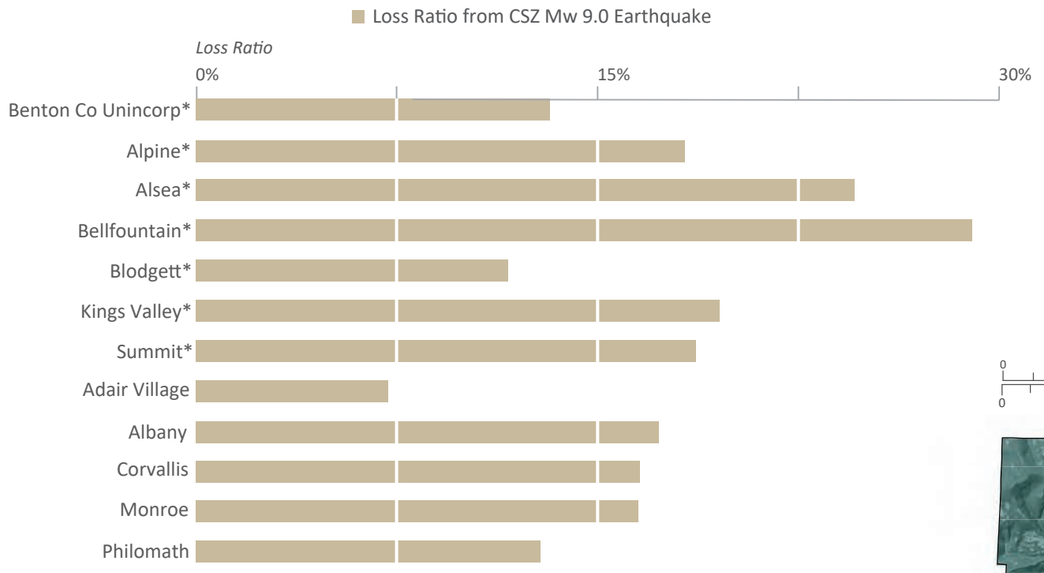
PLATE 4

Coseismic Landslide Susceptibility (Wet) Map of Benton County, Oregon

Coseismic landslide is a type of ground deformation that occurs during an earthquake where slope failure creates a mass movement of rock and debris. Saturated ground increases the susceptibility of a landslide occuring from seismic shaking. Coseismic landslides are a significant factor in the risk from earthquake hazard.

Coseismic Landslide Susceptibility (Wet)

0 (None) — 9 (High)



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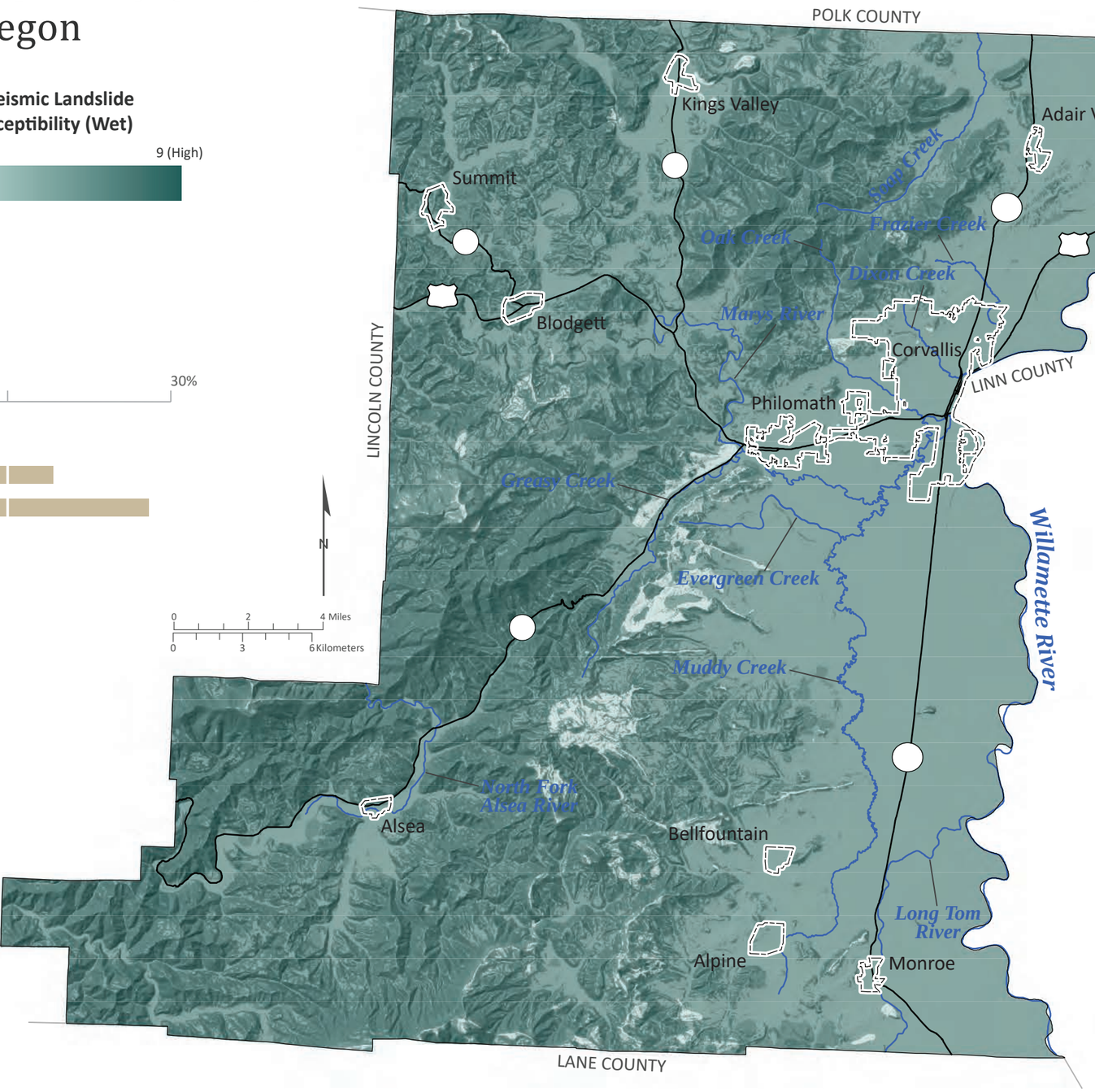

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Data Sources:
Coseismic Landslide (wet): Oregon Department of Geology and Mineral Industries (2021)
Roads: Oregon Department of Transportation Signed Routes (2013)
Place names: U.S. Geological Survey Geographic Names Information System (2015)
City limits: Oregon Department of Transportation (2014)
Basemap: Oregon Lidar Consortium (2014)
Hydrography: U.S. Geological Survey National Hydrography Dataset (2017)

Projection: NAD 1983 UTM Zone 10N
Software: Esri® ArcMap 10, Adobe® Illustrator CC

Cartography by:Matt C. Williams, 2022

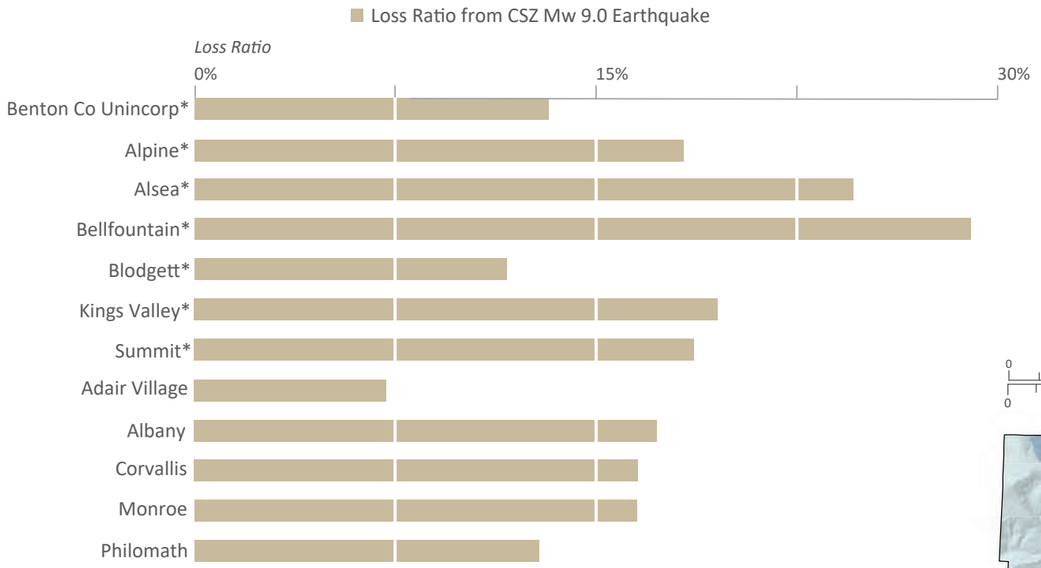
PLATE 5

Liquefaction Susceptibility Map of Benton County, Oregon

Liquefaction is a type of ground deformation that occurs during an earthquake where saturated, non-cohesive soil contracts and liquefies. The ground that becomes liquefied can no longer support heavy structures that are built on top of it. Liquefaction is a significant factor in the risk from earthquake hazard.

Liquefaction Susceptibility

- Low or None
- Moderate
- High
- Very High



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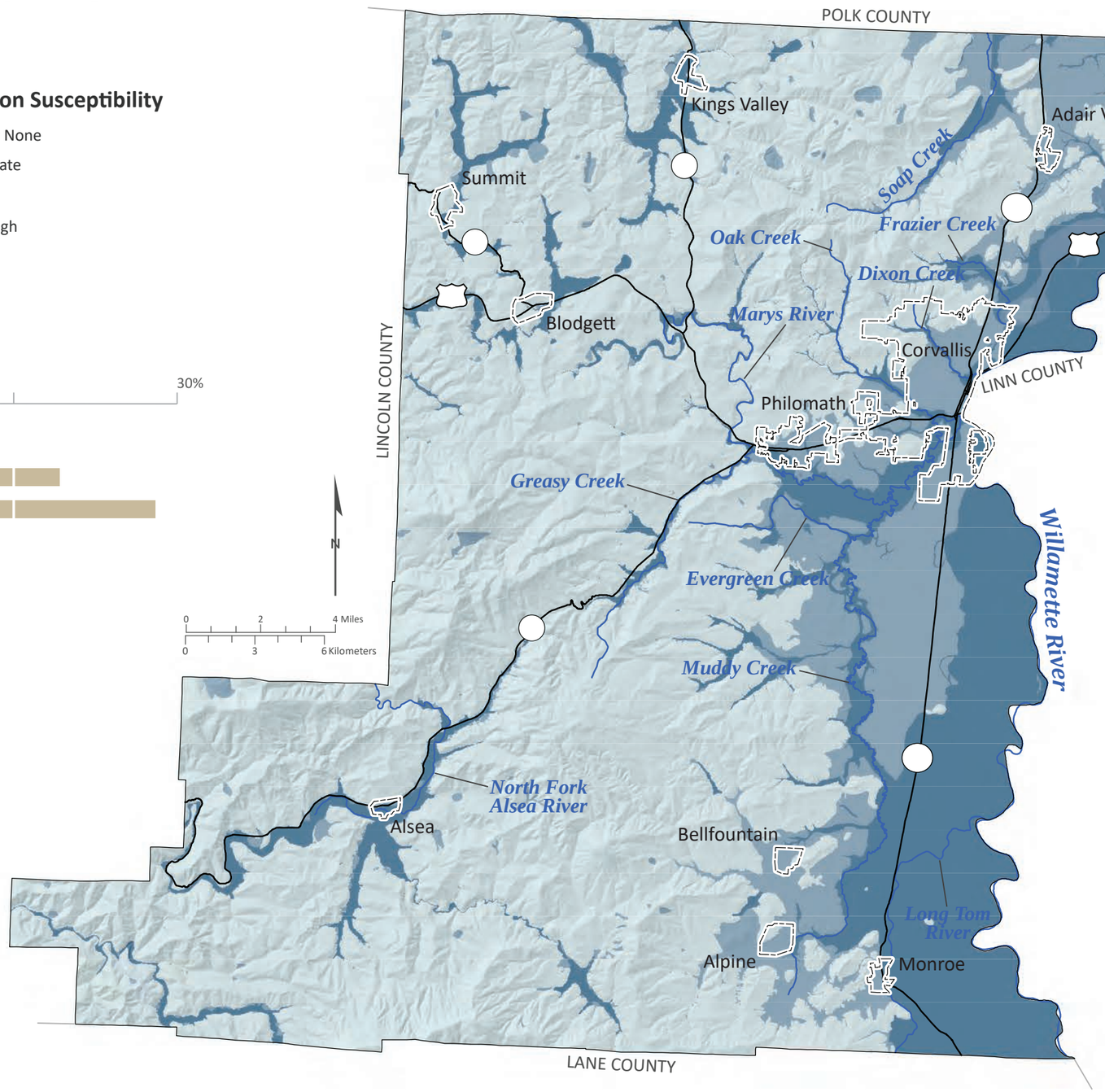

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Data Sources:
Liquefaction susceptibility: Oregon Department of Geology and Mineral Industries (2021)
Roads: Oregon Department of Transportation Signed Routes (2013)
Place names: U.S. Geological Survey Geographic Names Information System (2015)
City limits: Oregon Department of Transportation (2014)
Basemap: Oregon Lidar Consortium (2014)
Hydrography: U.S. Geological Survey National Hydrography Dataset (2017)

Projection: NAD 1983 UTM Zone 10N
Software: Esri® ArcMap 10, Adobe® Illustrator CC

Cartography by:Matt C. Williams, 2022

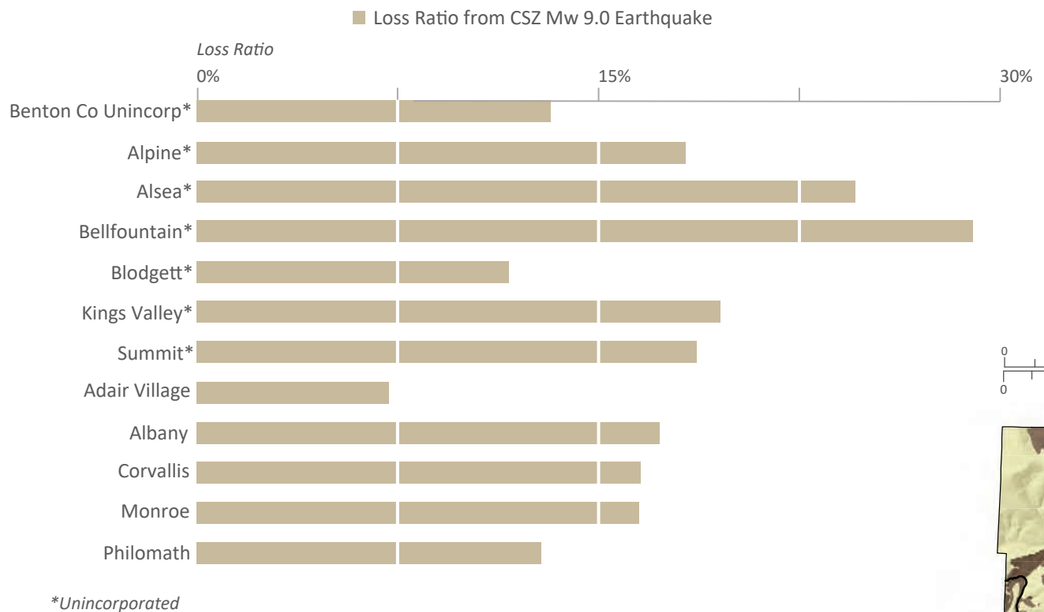
PLATE 6

Site Amplification Class Map of Benton County, Oregon

Site Amplification is the degree to which soil types attenuate (weaken) or amplify (strengthen) seismic waves produced from an earthquake. The National Earthquake Hazards Reduction Program (NEHRP) classifies these geologic units into soft rock (B), dense soil or soft rock (C), stiff soil (D), and soft clay or soil (E, F). NEHRP soils can significantly affect the level of shaking and amount of damage that occurs at a specific location during an earthquake

NEHRP Class

- B
- C
- D
- E, F



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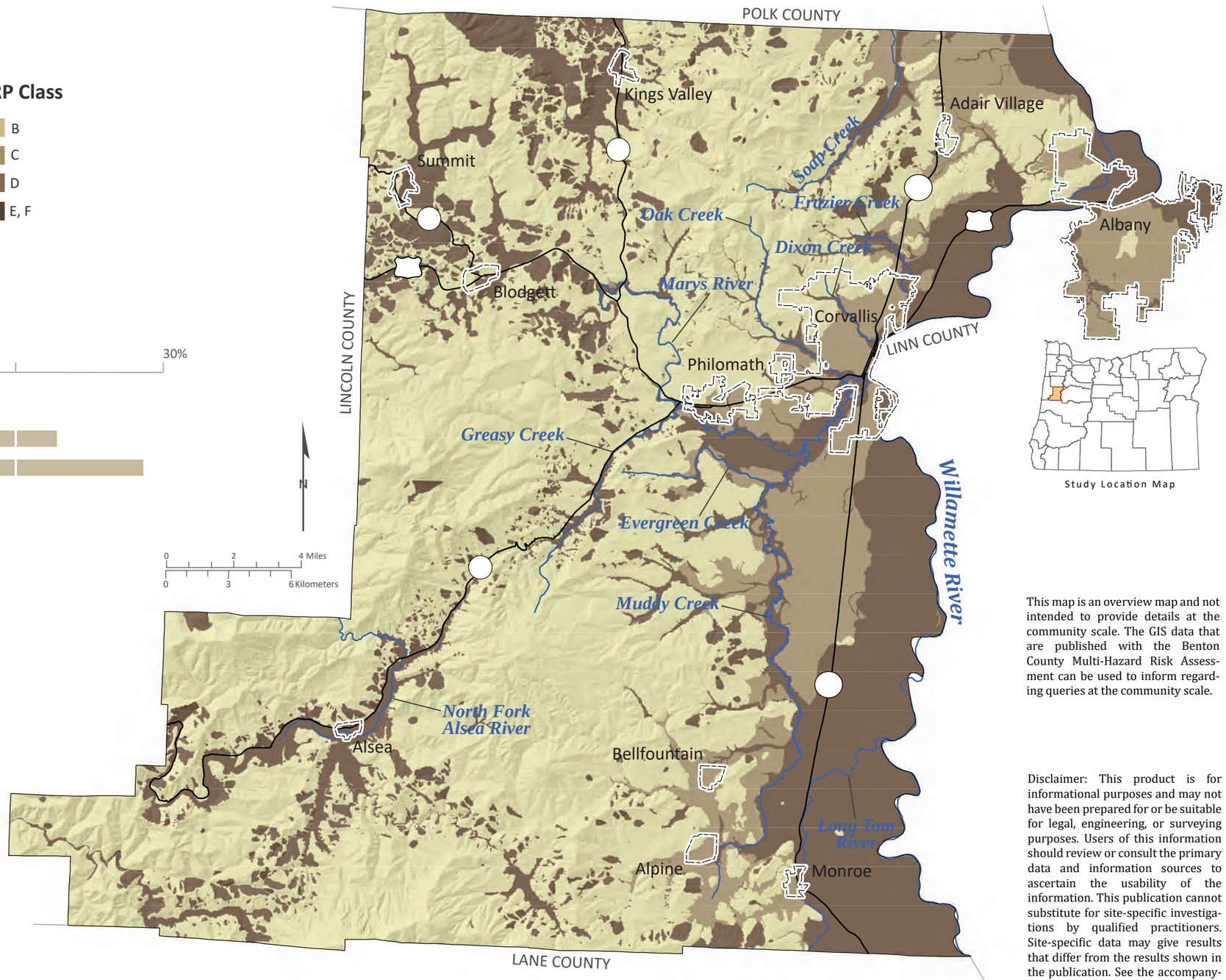

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Data Sources:
Soil amplification: Oregon Department of Geology and Mineral Industries (2021)
Roads: Oregon Department of Transportation Signed Routes (2013)
Place names: U.S. Geological Survey Geographic Names Information System (2015)
City limits: Oregon Department of Transportation (2014)
Basemap: Oregon Lidar Consortium (2014)
Hydrography: U.S. Geological Survey National Hydrography Dataset (2017)

Projection: NAD 1983 UTM Zone 10N
Software: Esri® ArcMap 10, Adobe® Illustrator CC

Cartography by:Matt C. Williams, 2022

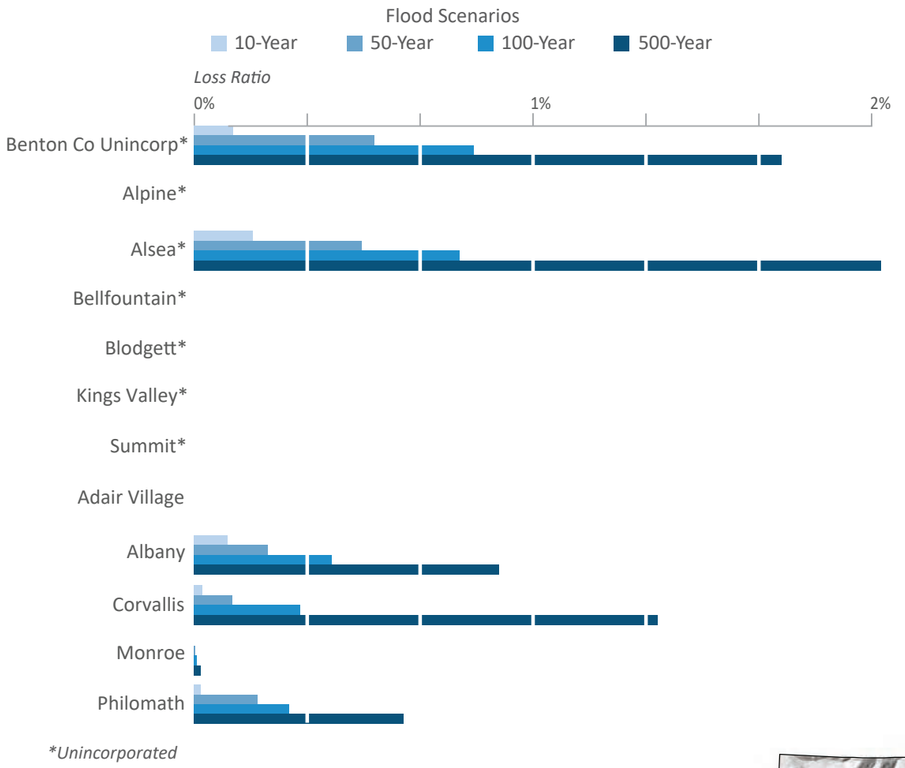
PLATE 7

Flood Hazard Map of Benton County, Oregon

The flood hazard data show areas expected to be inundated during a 100-year flood event. Flooding sources include riverine. Areas are consistent with the regulatory flood zones depicted in Benton County's Digital Flood Insurance Rate Maps.

Flood Hazard Zone

100-Year Flood
(1% annual chance)



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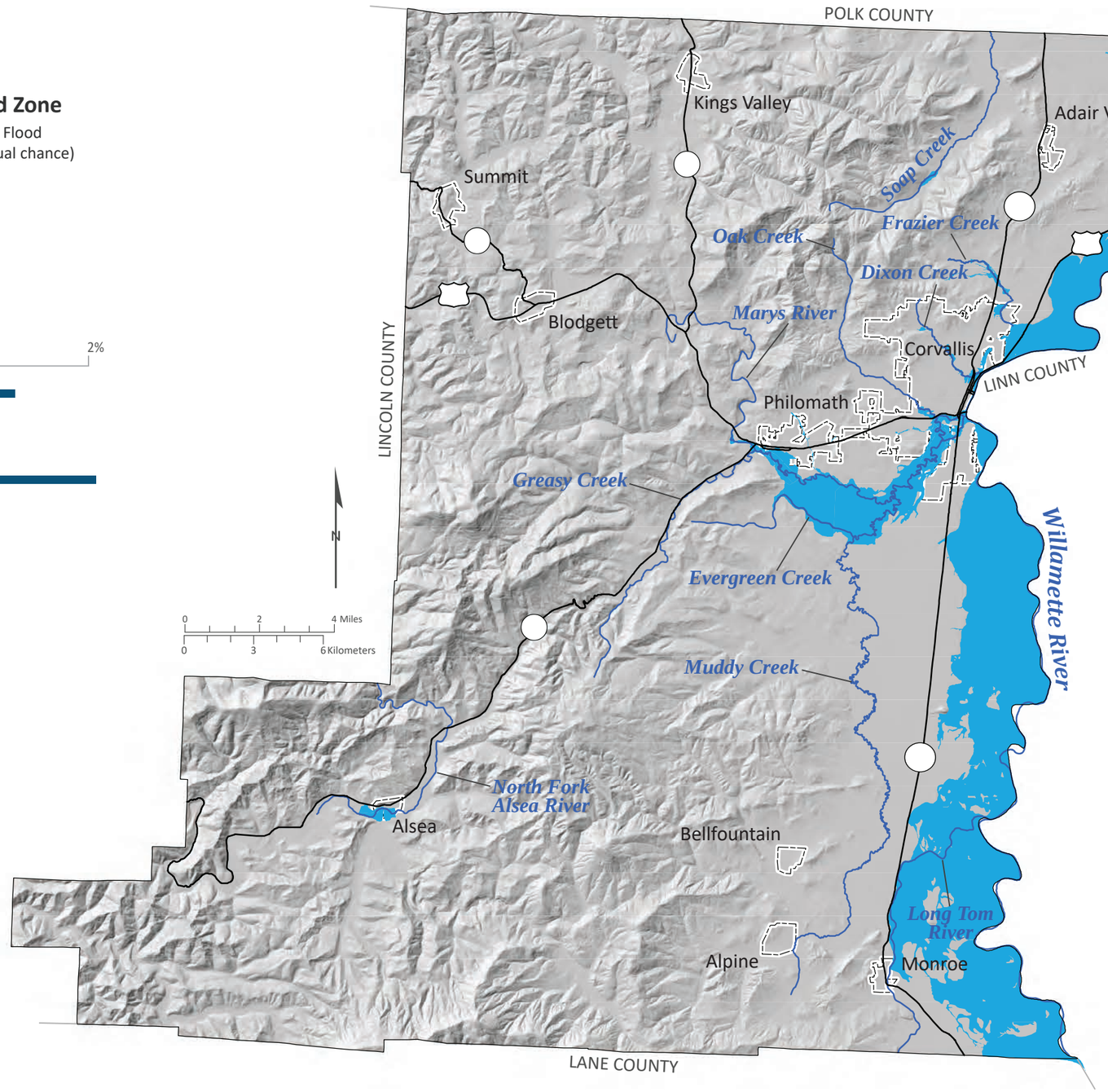

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Data Sources:
Flood hazard zone (100-year): Benton County Flood Insurance Rate Map (2016)
Roads: Oregon Department of Transportation Signed Routes (2013)
Place names: U.S. Geological Survey Geographic Names Information System (2015)
City limits: Oregon Department of Transportation (2014)
Basemap: Oregon Lidar Consortium (2014)
Hydrography: U.S. Geological Survey National Hydrography Dataset (2017)

Projection: NAD 1983 UTM Zone 10N
Software: Esri® ArcMap 10, Adobe® Illustrator CC

Cartography by:Matt C. Williams, 2022

Oregon Department of Geology and Mineral Industries Open-File Report O-23-06

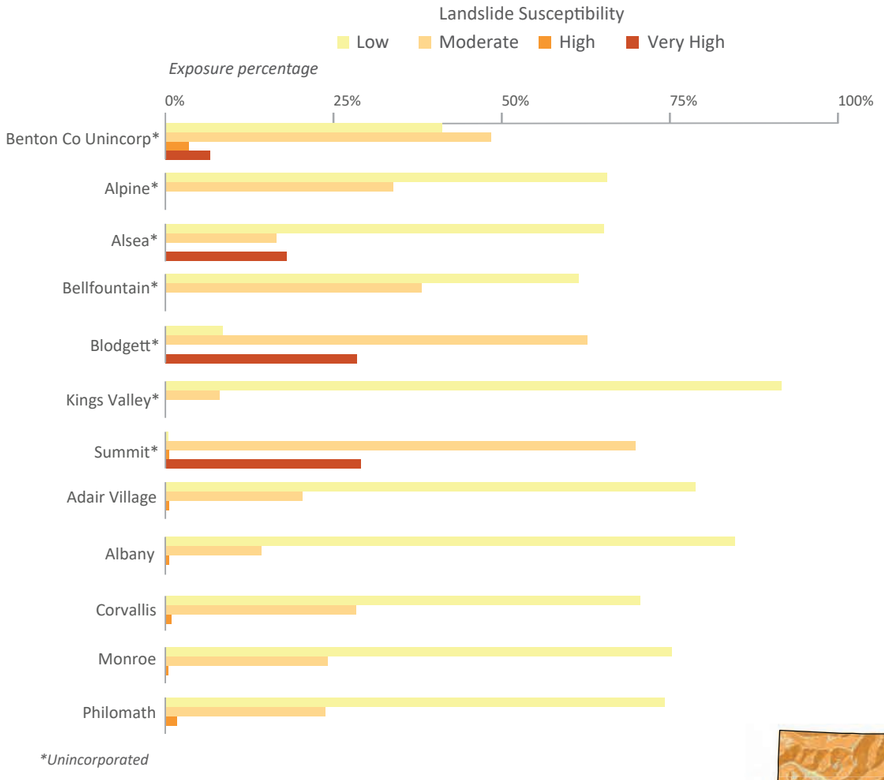
PLATE 8

Landslide Susceptibility Map of Benton County, Oregon

Landslide susceptibility is categorized as Low, Moderate, High, and Very High which describes the general level of susceptibility to landslide hazard. The dataset is an aggregation of three primary sources: landslide inventory (SLIDO), generalized geology, and slope.

Landslide Susceptibility

- Low
- Moderate
- High
- Very High



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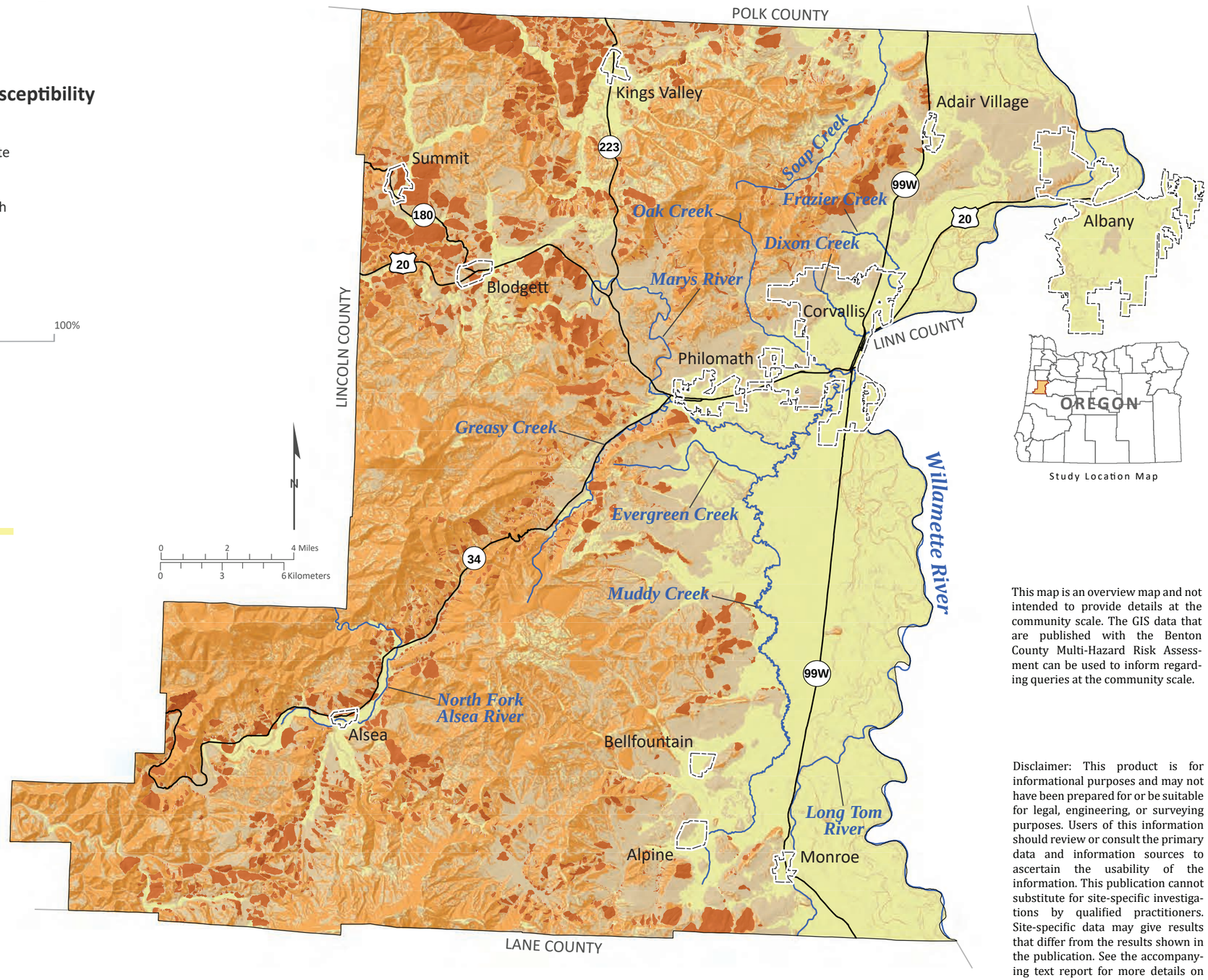

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Data Sources:
Landslide susceptibility: Oregon Department of Geology and Mineral Industries, Burns and others (2016) & Hairston-Porter and others (2021)
Roads: Oregon Department of Transportation Signed Routes (2013)
Place names: U.S. Geological Survey Geographic Names Information System (2015)
City limits: Oregon Department of Transportation (2014)
Basemap: Oregon Lidar Consortium (2014)
Hydrography: U.S. Geological Survey National Hydrography Dataset (2017)

Projection: NAD 1983 UTM Zone 10N
Software: Esri® ArcMap 10, Adobe® Illustrator CC

Cartography by:Matt C. Williams, 2022

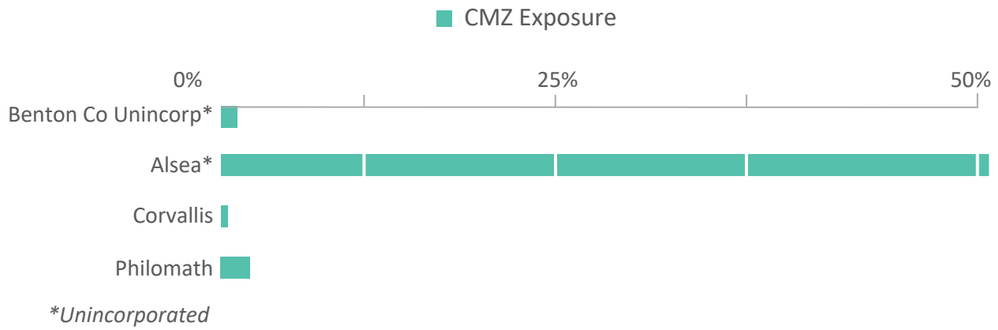
PLATE 9

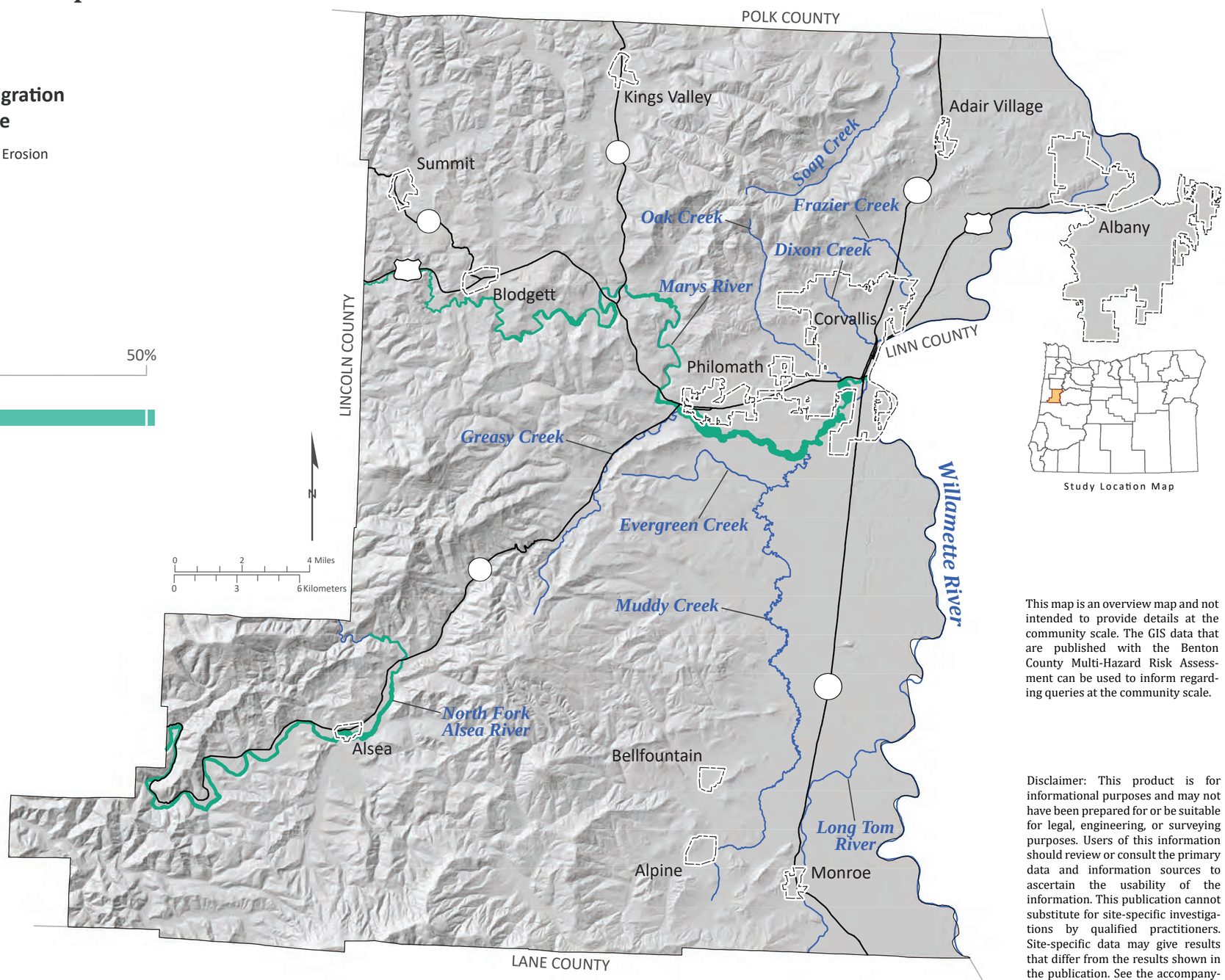
Channel Migration Hazard Map of Benton County, Oregon

Channel migration is a process by which a stream's course changes over time due to bank erosion and stream deposition. The channel migration zone is defined by the 100-year Erosion Hazard Area (EHA). Shown are the 100-year EHA in Benton County. Buildings within these areas are at greater risk to channel migration hazard than other areas.

Channel Migration Hazard Zone

100-Year Erosion





Data Sources:
Channel migration zone (30-year): DOGAMI (Appleby and others, 2021)
Roads: Oregon Department of Transportation Signed Routes (2013)
Place names: U.S. Geological Survey Geographic Names Information System (2015)
City limits: Oregon Department of Transportation (2014)
Basemap: Oregon Lidar Consortium (2014)
Hydrography: U.S. Geological Survey National Hydrography Dataset (2017)

Projection: NAD 1983 UTM Zone 10N
Software: Esri® ArcMap 10, Adobe® Illustrator CC

Cartography by:Matt C. Williams, 2022

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Oregon Department of Geology and Mineral Industries Open-File Report O-23-06

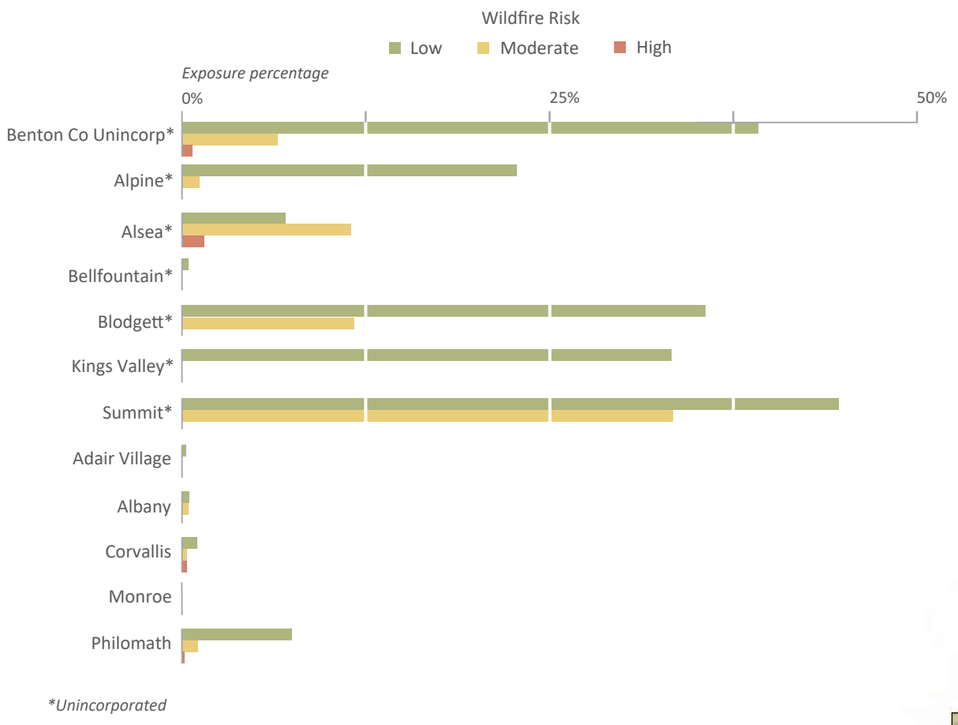
PLATE 10

Wildfire Risk Map of Benton County, Oregon

Wildfire Risk is categorized as Low, Moderate, and High and indicates the level of risk a location has to wildfire hazard. The Wildfire Risk data layer is derived from a combination of the burn probability (fire history and behavior) and conditional flame length data.

Wildfire Risk

- Low
- Moderate
- High



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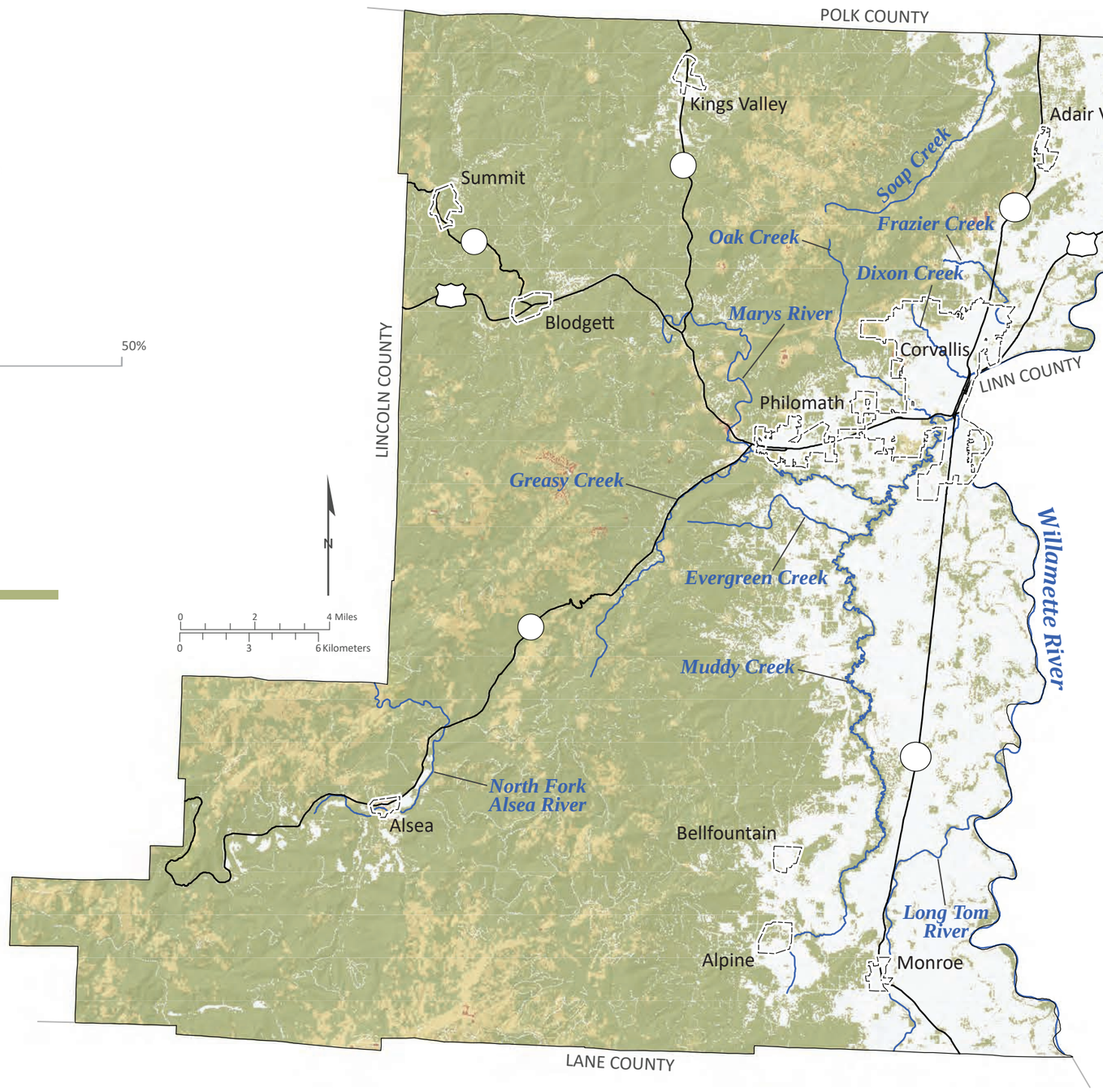

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Data Sources:
Wildfire risk data: Oregon Department of Forestry, Pyrologix, LCC. (2018)
Roads: Oregon Department of Transportation Signed Routes (2013)
Place names: U.S. Geological Survey Geographic Names Information System (2015)
City limits: Oregon Department of Transportation (2014)
Basemap: Oregon Lidar Consortium (2014)
Hydrography: U.S. Geological Survey National Hydrography Dataset (2017)

Projection: NAD 1983 UTM Zone 10N
Software: Esri® ArcMap 10, Adobe® Illustrator CC

Cartography by:Matt C. Williams, 2022