



Yamhill County Emergency Management

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Yamhill County Natural Hazards Mitigation Plan

**Report for:
Yamhill County
Emergency Management
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McMinnville, OR 97128**

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The Mid-Willamette Valley Council of Governments GIS Department and Yamhill County GIS developed the maps included in this plan. The contributions from these departments were essential in illustrating the extent and potential losses associated with the natural hazards affecting the County.

John Caputo, GIS Specialist, Yamhill County

Juan Carlos Torres, GIS Specialist, Mid-Willamette Valley Council of Governments

The information on the maps in this plan was derived from Yamhill County and Mid-Willamette Valley Council of Governments GIS. The maps depicted herein are illustrative and should be used for planning purposes only. The data used in these maps came from different sources. The MWVCOG has not field verified any of the source data or confirmed their spatial accuracy. Therefore, maps depicted herein should not be used for site-specific analysis.

Funding Acknowledgements:

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Yamhill County
Natural Hazards Mitigation Action Plan

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Executive Summary

What is the Mitigation Plan?

The Yamhill County Natural Hazards Mitigation Plan includes resources and information that will assist county residents, public and private sector organizations and other interested people in participating in natural hazard mitigation activities.

The key activities are summarized in a five-year action plan. The Five-Year Action Plan Matrix lists the activities that will assist Yamhill County in reducing risk and preventing loss from future natural hazard events. The action items address multi-hazard issues, as well as activities for flood, landslide, wildfire, severe winter storm, windstorm, drought, and earthquake.

What is the Plan's Mission?

The mission of the Yamhill County Natural Hazards Mitigation Plan is to reduce risk, prevent loss and protect life, property and the environment from natural hazard events through coordination and cooperation among public and private partners. This can be achieved by increasing public awareness, documenting the resources for risk reduction and loss prevention, and identifying activities that will guide the county towards building a safer community.

Who Participated in Developing the Plan?

The Mitigation Plan is the result of a collaborative planning effort between Yamhill County citizens, public agencies, non-profit organizations, the private sector, and federal, state and regional organizations. The project steering committee was comprised of representatives from the following organizations:

- Yamhill County Emergency Management
- Yamhill County Department of Planning and Development
- Yamhill County Public Works
- Yamhill County Health and Human Services
- Yamhill County Administrative Services
- Yamhill County Information & Geographic Systems
- McMinnville Fire Department
- Polk County Emergency Management
- Oregon Emergency Management

What are Plan Goals?

Plan goals are broad statements of direction and help focus future efforts. Goals are important because they are a bridge between the far-reaching, overall mission and the individual action items, or activities, identified to reduce Yamhill County's risk

from flood, landslide, wildfire, severe winter storm and windstorm, seismic, drought and volcanic events.

Plan goals were formulated through research, reviewing other local mitigation goals, and through steering committee work sessions. Goals were further refined by the steering committee subsequent to the Yamhill County Natural Hazards Mitigation Plan Open House held April 20 2005, where the county received public input.

Goal #1: EMERGENCY OPERATIONS

Goal Statement: Coordinate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures and with various other agencies, as appropriate.

Goal #2: EDUCATION AND OUTREACH

Goal Statement: Develop and implement education and outreach programs to increase public awareness of the risks associated with natural hazards.

Goal #3: PARTNERSHIPS

Goal Statement: Develop effective partnerships with public and private sector organizations and significant agencies and businesses for future natural hazard mitigation efforts.

Goal #4: PREVENTIVE

Goal Statements:

- Develop and implement activities to protect human life, commerce, and property from natural hazards.
- Reduce losses and repetitive damage for chronic hazard events while promoting insurance coverage for catastrophic hazards.

Goal #5: NATURAL RESOURCES UTILIZATION

Goal Statement: Link natural resources management, land use planning, and watershed planning with natural hazard mitigation activities to protect natural systems and allow them to serve natural hazard mitigation functions.

Goal #6: IMPLEMENTATION

Goal Statement: Implement strategies to mitigate the effects of natural hazards.

What are Action Items?

Action items are more specific than goals. Action items are defined activities or strategies meant to achieve the plan goals. One action item might address several plan goals. There are some action items that are considered “multi-hazard” action items because the scope of the activities apply to all natural hazards rather than a narrower scope that applies to one natural hazard in particular. The action items

are organized in the Executive Summary into a matrix, which lists all of the multi-hazard and hazard-specific action items included in the mitigation plan.

The matrix identifies action items determined through meetings with the project steering committee, local, regional, state and federal programs, stakeholder input and input from attendees of the county's open house for the plan. Activities within the matrix may be considered for funding through federal and state programs, and through the Federal Emergency Management Agency's Hazard Mitigation Grant Program, should funds be made available. The matrix includes the following five elements for each action item to help ensure implementation of the activities:

1. Coordinating organization(s)
2. Partner organizations (Internal and External)
3. Timeline
4. Notes and implementation ideas
5. Plan goals addressed.

The **coordinating organization** is the agency or public/private sector organization that is willing and able to organize resources, find appropriate funding and oversee activity implementation, monitoring and evaluation. Coordinating organizations may include local, county or regional agencies and public/private sector organizations that are in relative proximity to the county to be able to implement activities and programs.

Partner organizations are those agencies or public/private sector organizations that will assist the coordinating organization in implementing action items by providing relevant resources. Partner organizations may include regional, state and federal agencies, as well as local and county public and private sector organizations.

The partner organizations listed in the Yamhill County Natural Hazards Mitigation Plan are potential partners recommended by the project steering committee, but not necessarily contacted during the development of the mitigation plan. Partner organizations should be contacted by the coordinating organization to establish commitment of time and/or resources to action items.

The **timeline** for action items is divided into short-term and long-term activities.

- *Short-term action items* are activities that agencies and organizations are capable of implementing within their existing resources and authorities during a one to two-year period. Usually, only county agencies are listed as coordinating organizations. Occasionally, federal and state agencies, local governments, and other organizations may be included as potential cooperating partners in implementing the activity.
- *Long-term action items* are actions that will require new or additional resources or authorities to implement, and those actions that will occur within three to five years.

Each action item includes **notes** and/or **implementation ideas**, which may include grant programs, or human and organizational resources. The individual hazard sections detail this information for each action item. The matrix includes the page number within the Mitigation Plan where the more detailed information can be found.

Plan goals addressed identifies the plan goal(s) each action item addresses. The Yamhill County Natural Hazards Mitigation Plan has six plan goals, and associated goal statements, to meet the overall mission of *promote sound public policy designed to protect people, critical and essential facilities, infrastructure, utilities, private property, and the environment from natural hazards. The plan fosters partnerships, coordinated implementation and funding, public awareness, and the development of multi-objective strategies for mitigation*

What are the acronyms used in the plan?

ARC	American Red Cross
ARES	Amateur Radio Emergency Services
BLM	Bureau of Land Management (United States)
CDBG	Community Development Block Grant
CERT	Community Emergency Response Team
CVO	Cascade Volcano Observatory (USGS)
DEQ	Department of Environmental Quality (State of Oregon)
DLCD	Department of Land Conservation & Development (State of Oregon)
DOGAMI	Department of Geology & Mineral Industries (State of Oregon)
DSL	Department of State Lands (State of Oregon)
EDA	Economic Development Administration (United States)
FAA	Federal Aviation Administration (United States)
FD	Fire Department
FEMA	Federal Emergency Management Agency (United States)
FHWA	Federal Highway Administration (United States)
FIRM	Flood Insurance Rate Map
FSA	Farm Services Agency (United States)
GIS	Geographic Information System
GPS	Global Positioning System
HMGP	Hazard Mitigation Grant Program

HUD	Housing & Urban Development (United States)
IBHS	Institute of Business & Home Safety
IISOI	Insurance & Information Services of Oregon & Idaho
MWVCOG	Mid-Willamette Valley Council of Governments
NCDC	National Climate Data Center
NFIP	National Floodplain Insurance Program
NOAA	National Oceanic & Atmospheric Administration
NRCS	Natural Resources Conservation Service
NWS	National Weather Service
OAWU	Oregon Association of Water Utilities
OCS	Oregon Climate Service (State of Oregon)
ODF	Oregon Department of Forestry
ODOT	Oregon Department of Transportation
OECD	Oregon Economic & Community Development Department
OEM	Office of Emergency Management (Oregon State Police)
OSP	Oregon State Police
OSSPAC	Oregon Seismic Safety Policy Advisory Commission
OSU	Oregon State University
PGE	Portland General Electric
PSU	Portland State University
RFPD	Rural Fire Protection District
SBA	Small Business Administration (United States)
SWCD	Soil & Water Conservation District
UGB	Urban Growth Boundary
UO	University of Oregon
USACE	United States Army Corps of Engineers
USFS	United States Forest Service
USGS	United States Geological Survey
WRD	Water Resources Department (State of Oregon)

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Multi-Hazard #1	Provide assistance to incorporated communities and special districts in development of Natural Hazards Mitigation Plans.	Emergency Management	Planning Division, MWVCOG, city emergency mgt. agencies, Red Cross, emergency response agencies, OEM, FEMA	1 to 2 years, on-going		✓	✓	✓	✓		✓
Multi-Hazard #2	Consider the goals and action items from the Yamhill County Natural Hazard Mitigation Plan for implementation in other county documents and programs, where appropriate.	Steering Committee		Annually, on-going		✓	✓	✓	✓	✓	✓
Multi-Hazard #3	Evaluate the effectiveness of existing programs and identify shortcomings in natural hazard mitigation. Balance the objectives of program goals with natural hazard mitigation.	Emergency Management	Planning Division, Public Works Department	1 to 3 years, on-going					✓		✓

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Multi-Hazard #4	Identify funding opportunities for developing and implementing local and county mitigation activities	Steering Committee	Planning Department, OEM, FEMA, IISOI	1 to 2 years		✓	✓	✓	✓		✓
Multi-Hazard #5	Develop a process for the Yamhill County Natural Hazards Mitigation Plan Steering Committee to assist in implementing, monitoring, and evaluating countywide mitigation activities.	Steering Committee		1 year – upon adoption of the plan.			✓	✓	✓		✓
Multi-Hazard #6	Determine the impact that each natural hazard could have on the priority transportation routes to and from emergency facilities and first responder sites.	Emergency Management	Fire and police departments, and other 'first responders.'	On-going (every 5 years)		✓		✓	✓		✓
Multi-Hazard #7	Identify collaborative programs that recognize ways to decrease the risks of natural hazards.	Emergency Management	Planning Dept., Chambers of Commerce	1 to 2 years		✓	✓	✓	✓	✓	✓

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Multi-Hazard #8	Develop public and private partnerships to foster natural hazard mitigation program coordination and collaboration in Yamhill County.	Emergency Management	Planning Department	On-going			✓	✓	✓		✓
Multi-Hazard #9	Develop GIS inventories of essential facilities, at-risk buildings and infrastructure and prioritize mitigation projects.	County and cities' emergency management	GIS, Planning & Public Works Depts., ODOT, city planning & public works depts., utility companies, emergency response agencies, MWVCOG, ODF, BLM, USFS	1 to 2 years, on-going			✓	✓	✓		✓
Multi-Hazard #10	Strengthen emergency services preparedness and response by linking emergency services with natural hazard mitigation programs, and enhance public education on a regional scale.	Emergency Management	Planning & Public Works Depts., cities, ODOT	3 to 5 years		✓	✓		✓		✓

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Multi-Hazard #11	Develop, enhance, and implement education programs aimed at mitigating natural hazards, and reducing the risk to citizens, public agencies, private property owners, businesses and schools	School districts, facility safety personnel; Willamette ESD	Emergency Management, CERT, Planning & Building Depts., Health Department, emergency response agencies, Red Cross, utilities, MWVCOG, OEM, FEMA, media	On-going			✓	✓	✓	✓	✓
Multi-Hazard #12	Sustain a public awareness campaign about natural hazards	Emergency Management	Public Works, Planning Division, Red Cross, CERT, MWVCOG, school districts, emergency response agencies, utility companies, media, FEMA, OEM,	On-going			✓	✓	✓		✓
Multi-Hazard #13	Sustain an education and outreach program for local jurisdictions and assist them in developing emergency operations, public information and hazard mitigation plans.	Emergency Management	Planning Division, City emergency mgt. agencies, Red Cross, emergency response agencies, MWVCOG, OEM, FEMA	1 to 2 years, on-going		✓	✓	✓	✓		✓

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Multi-Hazard #14	Review and update the Yamhill County Emergency Operations Plan and the Natural Hazards Mitigation Plan on an annual basis. Conduct a complete review of the plans and have them officially promulgated by the BOC every five years.	Emergency Management	County Departments, Steering Committee, city emergency mgt. agencies, Red Cross, Yamhill Fire Defense Board, NWS, utilities, law enforcement agencies, OSP, emergency response agencies, MWVCOG, ODOT, ARES	1 to 5 years, on-going		✓	✓	✓	✓	✓	✓
Multi-Hazard #15	Make the Yamhill County Emergency Operations Plan and the Natural Hazards Mitigation Plan, and other resources on hazard planning/mitigation available to the public electronically.	Emergency Management & Planning Division	County Webmaster	1 to 2 years		✓	✓				
Multi-Hazard #16	Promote hazard-resistant utility construction and maintenance methods.	MWVCOG	County & city emergency management agencies, ARES, utility companies	3 to 5 years			✓		✓	✓	✓

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Multi-Hazard #17	Develop a system for data collection for undeclared natural hazard events.	Emergency Management	IISOL, Building Division, GIS, farm services, insurance companies	3 to 5 years		✓	✓	✓	✓		✓
Multi-Hazard #18	Improve coordination of and evaluate technical and engineering gaps in response service for natural hazard events. Develop a long-term recovery plan for Yamhill County from the effects of natural hazards.	Emergency Management	USGS, DOGAMI, neighboring counties' emergency mgt., Red Cross, hospitals, Army National Guard	1 to 5 years		✓		✓			
Short-Term Flood #1	Develop better flood warning systems	Emergency Management, Public Works	Planning Division, Yamhill Basin Council, Yamhill SWCD, cities, OSU Extension, USGS, WRD, DSL, OEM, USACE, private river gauges	1 to 2 years		✓		✓	✓		✓
Short-Term Flood #2	Maintain an inventory of all permitted dams built for flood control purposes in the county.	Emergency Management	Yamhill Basin Council, USACE, WRD, DEQ, ODFW, NRCS	1 to 2 years		✓		✓		✓	

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Short-Term Flood #3	Implement the steps needed for Yamhill County to become a participant in the NFIP's Community Rating System	Yamhill County	Planning, Emergency Management, cities, DLCD, FEMA, OEM, OECD	1 to 3 years				✓	✓	✓	✓
Long-Term Flood #1	Update and improve the FIRM maps for Yamhill County as funding becomes available.	Community Development / Planning	GIS, DLCD, FEMA	3 to 5 years				✓	✓	✓	✓
Long-Term Flood #2	Enhance data and mapping for floodplain information in the county, and identify and map flood prone areas outside of designated floodplains.	GIS, Public Works, cities	County Planning, Emergency Management, NRCS, Yamhill SWCD, FEMA	3 to 5 years				✓	✓	✓	
Long-Term Flood #3	Seek funding to train elected officials and recorders in small towns who have no emergency management background.	Emergency Management	Fire Defense Board, OEM, FEMA	On-going			✓	✓			

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Long-Term Flood #4	Provide flood event education and outreach to households and businesses.	Yamhill County	Planning, GIS, Assessor's Office, Emergency Management; IISOI; Yamhill Basin Council; Yamhill SWCD; DLCD; OEM; cities; OECDD	On-going			✓	✓		✓	✓
Long-Term Flood #5	Seek funding to retrofit culverts in Yamhill County with pipes designed for 50 to 100-year flood intervals.	Public Works	Planning, Emergency Management, cities, DSL, ODFW, USFWS, Yamhill SWCD, Yamhill Basin Council, OSU Extension	1 to 3 years				✓	✓	✓	✓

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Long-Term Flood #6	Coordinate with Yamhill SWCD, DOGAMI and NOAA to identify funding sources for further study of the gravel accumulations in the Willamette River at Lambert Bend.	Yamhill SWCD, DOGAMI, NOAA	Planning, Emergency Management, DSL, ODFW, DEQ, Yamhill Basin Council, OSU Extension	1 to 3 years	Gravel accumulations near Lambert Bend have altered the stream flow and continue to erode the riverbank in this area. Approximately 200 acres of land and two gravel operations are at risk of significant losses unless some type of solution is developed. The Willamette River floodplain is vital to both agricultural and aggregate industries.			✓	✓	✓	✓
Long-Term Flood #7	Mitigate repetitive flood loss properties.	Cities in Yamhill County, Yamhill County	Tax Assessor, FEMA, OEM	On-going				✓	✓		✓
Short-Term Landslide #1	Improve knowledge of landslide hazard areas and understanding of vulnerability and risk to life and property in hazard-prone areas.	Emergency Management	GIS, Public Works and Planning Departments; DOGAMI; ODF; cities	2 years			✓	✓	✓		✓

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Short-Term Landslide #2	Encourage construction, site location and design that can be applied to steep slopes to reduce the potential threat of landslides.	Emergency Management, Building and Public Works	Planning, DLCD, cities, IBHS	1 to 3 years			✓	✓	✓	✓	✓
Short-Term Landslide #3	Identify safe evacuation routes in high-risk debris flow and landslide areas.	Public Works	Emergency Management, GIS, ODOT; adjacent counties, DOGAMI	2 years		✓		✓	✓		
Short-Term Landslide #4	Compile relative landslide risk maps for Yamhill County.	GIS	Emergency Management, Planning, Public Works and Assessor's Office; USFS, BLM, water systems, utilities, forest industries; DOGAMI	Depending on DOGAMI funding in this biennium	DOGAMI will make the final determination of "further review areas" for rapidly moving landslides as required by Oregon Senate Bill 12.	✓	✓	✓	✓		
Short-Term Landslide #5	Increase public education related to landslide hazards by distributing DOGAMI landslide informational brochure.	Emergency Management	Planning and Public Works, city emergency managers, DOGAMI, OEM, DLCD	1 to 2 years	DOGAMI produced an information brochure on landslide hazards.		✓	✓			

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Long-Term Landslide #1	Evaluate current landslide warning systems to ensure effectiveness and efficiency and increase coordination between local jurisdictions and ODF for landslide warning systems.	Emergency Management	Planning, builders, developers, property owners, ODF, BLM	On-going		✓	✓		✓		
Long-Term Landslide #2	Mitigate activities in identified potential and historical landslide areas through public outreach.	Planning, Emergency Management	Public Works, ODF, cities, mortgage companies	3 to 5 years; on-going			✓	✓	✓		✓
Long-Term Landslide #3	Increase coordination between local jurisdictions, emergency responders, homeowners and ODF for landslide warning systems.	Emergency Management	Planning and Building Departments, city planning departments	3 to 5 years		✓	✓		✓	✓	✓
Long-Term Landslide #4	Investigate the development and implementation of a county landslide ordinance.	Planning	Emergency Management, GIS and Public Works, DOGAMI, ODF	3 to 5 years					✓	✓	

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Long-Term Landslide #5	Protect existing development in landslide-prone areas.	Emergency Management	Planning, DLCD, OEM, FEMA, ODF, cities	On-going			✓	✓	✓	✓	✓
Long-Term Landslide #6	Maintain public and private drainage systems	Public Works	GIS and Planning, cities, BLM	On-going			✓	✓	✓	✓	✓
Short-Term Wildfire #1	Work with the Yamhill Fire Defense Board in the review of plans and inspection of structures, access and water supply for fire code compliance.	Building Department	Public Works and Planning, Emergency Management, Yamhill Fire Defense Board, State Fire Marshal	1 year; on-going	Construction plans for commercial and industrial structures are reviewed, not residential plans. Identification of areas with lack of experienced fire staff to review plans may be necessary.			✓	✓	✓	
Short-Term Wildfire #2	Develop a Community Wildfire Protection Plan for susceptible urban/wildland interface areas in Yamhill County.	Emergency Management	Planning, Public Works, GIS, Yamhill Fire Defense Board, State Fire Marshal, ODF	1 to 2 years		✓		✓	✓		

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Short-Term Wildfire #3	Advocate water storage facilities with fire-resistant electrical pump systems in developments not connected to a community water/hydrant system.	Yamhill Fire Defense Board, State Fire Marshal	Building and Planning Departments, ODF	On-going		✓			✓	✓	✓
Short-Term Wildfire #4	Continue to promote public awareness campaigns for individual property owners living in the wildland/urban interface (WUI).	Emergency Management	Planning, city emergency management, media, OEM, FEMA, DLCD, State Fire Marshal, ODF, insurance and real estate industries, ODA, Oregon Garden, State Fair, Yamhill SWCD	1 to 5 years; On-going		✓	✓	✓	✓	✓	
Short-Term Wildfire #5	Seek funding and labor opportunities to staff fuel-reduction projects throughout wildfire hazard-prone areas in Yamhill County.	Emergency Management	GIS, Yamhill Fire Defense Board, State Fire Marshal, ODF, BLM, USFS, Confederated Tribes of Grand Ronde, Yamhill SWCD	2 years			✓		✓	✓	
Short-Term Wildfire #6	Create incentives and assist landowners in reducing fuel loads on private property.	Emergency Management	Planning; Yamhill Fire Defense Board, State Fire Marshal, ODF, insurance companies	1 to 2 years			✓	✓	✓	✓	

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Short-Term Wildfire #7	Increase communication, coordination and collaboration between wildland/urban interface property owners, city and county planners, and fire prevention crews and officials to address inherent risks in wildland/urban interface areas, existing mitigation (prevention/protection) measures, and federal mitigation assistance programs.	Planning, Building	Emergency Management, Yamhill Fire Defense Board, ODF, State Fire Marshal, Oregon Garden, OSU Extension, BLM, Timber Industry	1 to 5 years; On-going		✓	✓	✓	✓	✓	✓
Short-Term Wildfire #8	Seek improved information gathering and distribution and technology for enhancing fire identification, initial response and evacuation if necessary.	Emergency Management	GIS and Planning, State Fire Marshal, ODF, Yamhill Fire Defense Board, Confederated Tribes of Grand Ronde	1 to 3 years		✓	✓	✓	✓	✓	✓

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Short-Term Wildfire #9	Enhance emergency services to increase the efficiency of wildfire response and recovery activities.	Yamhill Fire Defense Board	Public Works, State Fire Marshal, ODF; telephone companies	2 years		✓		✓	✓		
Short-Term Wildfire #10	Educate agency personnel on federal cost-share and grant programs, fire protection agreements, and other related federal programs so the full array of assistance available to local agencies is understood.	Yamhill Fire Defense Board, Emergency Management	State Fire Marshal, ODF, FEMA	1 to 2 years		✓	✓	✓			✓
Short-Term Wildfire #11	Identify funding for and develop an inventory of alternative firefighting water sources and encourage the development of additional sources.	Emergency Management	Yamhill Fire Defense Board, State Fire Marshal, OAWU, irrigation districts, Yamhill SWCD, NRCS, Yamhill Basin Council, cities	1 to 2 years		✓		✓	✓	✓	

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Short-Term Wildfire #12	Identify funding for and develop an inventory of firefighting hardware to be better prepared when attacking wildfires.	Emergency Management	Yamhill Fire Defense Board, ODF, USFS, BLM	1 to 2 years		✓		✓			
Short-Term Wildfire #13	Identify funding for and develop wildland fire training for fire districts near and/or within WUI communities.	Emergency Management	Yamhill Fire Defense Board, State Fire Marshal, ODF, USFS, BLM	1 to 2 years		✓	✓		✓		
Long-Term Wildfire #1	Promote the expansion of rural fire districts.	Yamhill Fire Defense Board, County Assessor	Emergency Management, Yamhill Rural Fire Districts, State Fire Marshal, ODF	On-going		✓		✓	✓		
Long-Term Wildfire #2	Look for solutions to protect structures located outside of fire districts through partnerships, grant funding or expansion of fire district services.	Emergency Management	State Fire Marshal, Yamhill Fire Defense Board, ODF, Confederated Tribes of Grand Ronde	On-going		✓	✓	✓	✓	✓	

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Long-Term Wildfire #3	Reduce wildfire fuels.	Emergency Management	Planning, Yamhill Fire Defense Board, ODF, State Fire Marshal, BLM, USFS, Confederated Tribes of Grand Ronde	3 to 5 years		✓	✓	✓	✓	✓	✓
Long-Term Wildfire #4	Promote and continue support of agricultural uses that reduce fuel loads in WUI areas.	Yamhill SWCD	Planning, NRCS, Yamhill Basin Council, OSU Extension, ODF, ODA, DEQ	On-going			✓	✓	✓	✓	✓
Long-Term Wildfire #5	Maintain and further develop interagency and private industry relationships for continuing strong fire response in Yamhill County.	Emergency Management	Public Works, Yamhill Fire Defense Board, State Fire Marshal, USFS, BLM, Confederated Tribes of Grand Ronde, timber industry, jobs in the woods programs	On-going			✓	✓	✓	✓	

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Long-Term Wildfire #6	Seek funding to develop and implement or enhance existing outreach and education programs aimed at mitigating wildfire hazards and reducing or preventing the exposure of citizens, public agencies, private property owners, and businesses to natural hazards.	Emergency Management	Planning, Yamhill Fire Defense Board, school districts, OEM, ODF, cities	On-going			✓	✓	✓	✓	✓
Long-Term Wildfire #7	Encourage development and dissemination of maps relating to fire hazards to help educate and assist builders and homeowners in being engaged in wildfire mitigation activities, and to help guide emergency services during response.	Emergency Management	GIS and Planning, State Fire Marshal, Yamhill Fire Defense Board, ODF, DLCD, cities, insurance industry, National Fire Protection Association, utilities	1 to 3 years			✓	✓	✓	✓	✓

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Long-Term Wildfire #8	Encourage implementation of wildfire mitigation activities consistent with the goals of promoting sustainable ecological management and community stability.	Emergency Management	Public Works, Yamhill Fire Defense Board, ODF, Yamhill SWCD, Yamhill Basin Council, utilities, Confederated Tribes of the Grand Ronde, land managers	1 to 5 years; on-going			✓	✓	✓	✓	✓
Short-Term Severe Winter Storm #1	Develop and implement or enhance strategies for debris management due to severe winter storms.	Road Division of Public Works	GIS, Planning, Administrative Services Director; CERT communities	2 years		✓	✓	✓	✓	✓	✓
Short-Term Severe Winter Storm #2	Develop and implement programs to coordinate maintenance and mitigation activities to reduce risk to public infrastructure from severe winter storms.	Emergency Management	Community Development/Planning, Public Works, cities, utilities	2 years		✓		✓		✓	✓
Short-Term Severe Winter Storm #3	Seek funding to acquire necessary emergency back-up power systems for all RFPD facilities and other identified critical facilities.	Emergency Management	Administrative Services Director, Yamhill Fire Defense Board	1 to 2 years		✓		✓			✓

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Long-Term Severe Winter Storm #1	Increase and maintain public awareness of severe winter storms and the benefits of mitigation activities through education aimed at households and businesses and increase targeting of special needs populations.	Emergency Management	Community Development, utilities, cities, American Red Cross, St. Vincent DePaul, Churches, Oregon voluntary organizations active in disaster, Fire Districts	1 to 2 years; on-going		✓	✓	✓	✓	✓	✓
Long-Term Severe Winter Storm #2	Enhance weather monitoring to attain earlier severe winter storm warnings.	Emergency Management	NWS, OCS; ARES	On-going			✓		✓		✓
Long-Term Severe Winter Storm #3	Develop and implement programs to keep trees from threatening lives, property, and public infrastructure as a result of severe weather events.	Emergency Management	GIS, Public Works and Community Development Departments; overhead utilities; cities	On-going				✓	✓	✓	

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Long-Term Severe Winter Storm #4	Develop and maintain comprehensive impact database and, when possible, map and publicize historical severe weather events in Yamhill County.	Yamhill County	Community Development and GIS, cities, NWS, NOAA, ODOT, OCS, overhead utilities	On-going	ID hazardous areas for the public so precautions can be taken. Information about county road icing and road closures due to snow or other severe winter storm events may already exist within county offices, yet it can be mapped and disseminated countywide to make residents knowledgeable about severe winter (and windstorm) events.		✓	✓	✓	✓	
Long-Term Severe Winter Storm #5	Support/encourage electrical utilities through public incentives/partnerships to use underground construction methods where possible to reduce power outages from severe winter storms.	Emergency Management	Community Development and GIS, cities, overhead utilities	On-going				✓	✓		

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Long-Term Severe Winter Storm #6	Promote the benefits of tree-trimming and tree replacement programs and help coordinate local efforts by public and private agencies.	Public Works (Road Division)	GIS, Emergency Management, utility and telecommunications companies, ODOT, city public works, BLM, timber industries	3 to 5 years	Overhead utilities' tree-trimming and tree replacement programs provide tree maintenance benefits to local communities. The utilities could benefit in turn from cooperation with public and private foresters in harvest plans located adjacent to roads and/or power line easements.		✓	✓		✓	
Long-Term Severe Winter Storm #7	Encourage harvesting of trees along utility and road corridors, preventing potential winter storm damage.	Public Works (Road Division)	Emergency Management, cities, utilities, FEMA, ODFW, DSL, BLM, ODOT, timber industries	On-going					✓	✓	✓
Long-Term Severe Winter Storm #8	Encourage right-of-way coordination, education and management between property owners, utility operators, and government agencies.	Public Works (Road Division)	GIS; Planning; Building, ODOT; BLM; timber industries; utility operators; county residents	On-going				✓	✓	✓	✓

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Long-Term Severe Winter Storm #9	Encourage harvesting of trees that are blown down during a winter storm.	Emergency Management	Planning and Public Works, cities, utilities, FEMA, ODFW, DSL, BLM, ODOT, timber industries	On-going					✓	✓	
Short-Term Windstorm #1	Develop and implement programs to keep trees from threatening lives, property and public infrastructure during windstorm events.	Public Works and Community Development	GIS, cities, USFS, BLM, State Parks, utility providers	2 years		✓	✓	✓	✓	✓	✓
Short-Term Windstorm #2	Develop and implement or enhance strategies for debris management and/or removal after windstorm events.	Emergency Management	Public Works, ODOT, cities, regional recycling facilities	2 years		✓		✓	✓	✓	✓
Short-Term Windstorm #3	Maintain tree trimming for above-ground power lines.	Public Works	Emergency Management, overhead utilities, cities	On-going		✓		✓	✓	✓	✓
Long-Term Windstorm #1	Map and publicize locations around Yamhill County with the highest incidence of extreme windstorms.	Emergency Management	Planning, GIS, FEMA, NCDC, OCS, NWS	5 years					✓	✓	

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Long-Term Windstorm #2	Support/encourage electrical utilities to use underground construction methods where possible to reduce power outages from windstorms.	Public Works	GIS, Emergency Management, utility companies	On-going					✓	✓	
Long-Term Windstorm #3	Increase public awareness of windstorm mitigation activities.	Emergency Management	Planning, utilities, cities, FEMA	On-going		✓	✓		✓	✓	
Long-Term Windstorm #4	Support/encourage contractors, homeowners and electrical utilities to use windstorm resistant construction methods where possible to reduce damage and power outages from windstorms.	Building Department	Planning Department, cities, utilities	5 years			✓		✓		
Long-Term Windstorm #5	Develop and implement programs to keep trees from threatening lives, property and public infrastructure during windstorm events.	Public Works	Planning, utilities, cities	On-going					✓	✓	

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Long-Term Windstorm #6	Identify trees that are potentially susceptible to wind throw.	Planning Department	Emergency Management, GIS, cities, overhead utilities	On-going					✓	✓	
Long-Term Windstorm #7	Encourage critical facilities to secure emergency power.	Emergency Management	Community Development, cities, neighboring counties, Yamhill Fire Defense Board, police stations, water systems	On-going		✓		✓		✓	✓
Long-Term Windstorm #8	Encourage harvesting of trees along utility and road corridors, preventing potential windstorm damage.	Emergency Management	Planning, Public Works, cities, utilities, FEMA, USFS, ODFW, DSL, BLM, ODOT, forest products industries	On-going					✓	✓	
Long-Term Windstorm #9	Encourage harvesting of trees that are blown down during a windstorm	Emergency Management	Planning, Public Works, cities, utilities, FEMA, USFS, ODFW, DSL, BLM, ODOT, forest products industries	On-going					✓	✓	

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Long-Term Windstorm #10	Increase and maintain public awareness of severe windstorms and the benefits of mitigation activities through education aimed at households and businesses; increase targeting of special needs populations.	Emergency Management	Community Development, utilities, cities, American Red Cross, St. Vincent DePaul, Churches, ARES, Yamhill Fire Defense Board	On-going			✓	✓	✓		
Short-Term Drought #1	Support the technical services provided by county-based agencies on effective methods of water use curtailment.	Yamhill SWCD, Yamhill Basin Council, OSU Extension Service	Planning, Emergency Management, NRCS, WRD, water systems	2 years; on-going			✓	✓	✓	✓	✓
Short-Term Drought #2	Encourage local governments to inter-tie water systems.	Yamhill County, MWVCOG	Planning, Public Works, McMinnville Water & Light, Valley View Water Company, cities and rural communities; OECDD, Rural Development (funding sources), WRD, ODFW, PUC, NRCS, Yamhill SWCD, BLM	2 years; on-going				✓	✓		✓

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Long-Term Drought #1	Support local agencies' training on water conservation measures to farmers and ranchers, including drought management practices for crops and livestock.	Yamhill SWCD	Planning, OSU Extension Service, NRCS, Yamhill Basin Council, Farm Bureau, ODA, WRD, ODFW	1 to 2 years; on-going			✓	✓	✓	✓	✓
Long-Term Drought #2	Support the technical service and low-interest loans provided to farmers and ranchers so that they can develop livestock watering systems.	Yamhill SWCD	ODA, WRD, OECDD, DEQ, ODFW, NRCS, OSU Extension Service	On-going	Livestock water systems provide additional options for farmers and ranchers to provide drinking water, and can sometimes also improve riparian habitat. 3 types of systems: 1) controlled access (to a river or stream); 2) gravity flow; and 3) pressure systems run by pumps sometimes powered by wind or solar electricity.		✓		✓		✓

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Long-Term Drought #3	Encourage storage of water, especially off-stream storage.	Public Works	GIS, Planning, OSU Extension Service, Yamhill Basin Council, NRCS, Yamhill SWCD, ODA, WRD, DSL, ODFW, DEQ	On-going				✓	✓	✓	✓
Long-Term Drought #4	Support agencies' determination of locations for additional aquifer studies that might lead to greater water supplies and help determine funding sources for the studies.	Public Works	Planning and GIS, Yamhill SWCD, WRD, ODA, DEQ, ODFW, OECDD, DOGAMI, DLCD	3 to 5 years	Studying alternative sources may reveal under-utilized water resources and other information useful to water managers.			✓		✓	
Short-Term Earthquake #1	Integrate new earthquake hazard mapping data for Yamhill County and improve technical analysis of earthquake hazards.	GIS	Public Works, Planning, Emergency Management, OSU, USGS, BLM, MWVCOG, OEM, FEMA, DOGAMI	2 years			✓	✓	✓	✓	

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Short-Term Earthquake #2	Encourage reduction of nonstructural and structural earthquake hazards in homes, schools, businesses and government offices.	Emergency Management	Building and Planning, city building officials, school districts, builders' associations, IBHS, Red Cross, DOGAMI, IISOI, OSSPAC, Yamhill Fire Defense Board, FEMA, OEM	1 to 2 years; on-going		✓			✓	✓	✓
Short-Term Earthquake #3	Encourage purchase of earthquake hazard insurance by forming partnerships with the insurance and real estate industries.	Emergency Management	IISOI through local insurance agencies, mortgage companies, Insurance and real estate industries, DOGAMI	On-going			✓		✓	✓	
Short-Term Earthquake #4	Maintain an inventory of all permitted dams in Yamhill County	Emergency Management	Watermasters, Yamhill Basin Council, WRD, McMinnville Power & Light	1 to 5 years			✓		✓	✓	
Short-Term Earthquake #5	Identify funding sources for and implement high priority structural and nonstructural retrofits of structures that are identified as seismically vulnerable.	Emergency Management	County Building, Planning and Assessor; IISOI; OSSPAC; Local Banks; Credit Unions; SBA; Rural Development (USDA); OECD; FEMA; OEM	1 to 2 years	Lack of capital to upgrade structures is a major reason why many public and privately owned buildings and bridges are not retrofitted to stricter seismic standards.		✓	✓			✓

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Long-Term Earthquake #1	Promote and continue building code standards.	Building Department	Planning, city planning departments, builders, developers, property owners	On-going			✓		✓	✓	
Long-Term Earthquake #2	Encourage seismic strength evaluations of critical facilities to identify vulnerabilities and to meet current seismic standards.	Emergency Management	Planning, Building, city planning departments, water service providers, OAWU, school districts, hospitals, ODOT, colleges and universities, dam/reservoir owners/managers, architects, Willamette ESD, Oregon Building Codes Division, WRD	On-going		✓	✓	✓	✓		✓
Long-Term Earthquake #3	Identify and enhance water, sewer, electric, gas and other utilities to improve their survivability in an earthquake.	Emergency Management	Planning, Building and Public Works; city planning departments; utilities	On-going			✓	✓	✓	✓	
Long-Term Earthquake #4	Encourage earthquake safety promotion and drills to community groups	Emergency Management	Planning, city planning departments, school districts, community organizations, Housing Authority	On-going		✓	✓	✓	✓	✓	

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes	Plan Goals Addressed					
						Emergency Operations	Education and Outreach	Partnerships	Preventive	Natural Resources Utilization	Implementation
Long-Term Earthquake #5	Improve local capabilities to perform earthquake building safety evaluations.	Emergency Management	Building Department, FEMA, OEM, Oregon Building Codes Division, IISOI	On-going					✓		✓

Section 1: Introduction

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Introduction

Yamhill County, the tenth most populous county in Oregon, is located in the heart of the Willamette Valley, with the Willamette River as its eastern boundary and the Coast Range on the west. These natural features contribute to the beauty of the County and region, but also make the environment and population vulnerable to natural disaster situations. The county is subject to flooding, earthquakes, landslides, wildfires, severe winter storms, drought and windstorms. It is impossible to predict exactly when these disasters will occur, or the extent to which they will affect the county. With careful planning and collaboration among public agencies, private sector organizations, and citizens within the community, however, it is possible to minimize the losses that can result from natural disasters.

Yamhill County experienced several significant natural disasters during the 1990s. On March 25, 1993, at 5:34 AM, a 5.6 magnitude earthquake occurred near the town of Scotts Mills, which is approximately 32 miles south of Portland, 20 miles northeast of Salem, and 22 miles southeast of Dayton. Although considered moderate, in terms of magnitude/intensity and damage, this was the largest earthquake that Yamhill County felt in recent recorded history and caused major damage to the Dayton Bridge on Highway 18, and at least 90 buildings in Newberg suffered some damage. No serious injuries were reported.

Yamhill County most recently experienced large-scale destruction during the severe weather events in February 1996. The Willamette River and its tributaries swelled beyond the 100-year flood level, causing flooding in both rural and urban areas. Prolonged precipitation accompanied by an early snowmelt caused very unstable soil conditions, resulting in many landslides and debris flows in the county. The damage to Yamhill County businesses, residences, and infrastructure was estimated at about \$4.35 million.¹

The Yamhill County Natural Hazards Mitigation Plan

During the summer of 2003, Marion, Polk, Linn, Benton, and Lane Counties obtained an Emergency Management Performance Grant to complete Phase I of the respective counties' Natural Hazards Mitigation Plan. During Phase I, the Mid-Willamette Valley Council of Governments (MWVCOG) and the Oregon Natural Hazards Workshop (ONHW), under contract, identified known hazards, compiled a community profile and other background information, and completed vulnerability assessments for known hazards.

In October 2003, Yamhill County joined with Polk, Marion, Linn, Benton, and Lane counties to submit a competitive planning grant application to FEMA to continue the natural hazards planning process for each of the six counties. In 2004, FEMA awarded grant funds to the Oregon Department of Geologic and Mineral Industries (DOGAMI) to fund completion of the natural hazards mitigation planning process for Lane, Linn, Benton, Marion and Polk Counties, and to commence with and complete the process for Yamhill County.

The county contracted with the Mid-Willamette Valley Council of Governments (MWVCOG) to identify known hazards, compile a community profile and other background information, and complete vulnerability assessments for known hazards. MWVCOG will help Yamhill County develop specific strategies and action items to better assess the impacts of natural hazards to life and property within the County and to minimize or mitigate those impacts.

The natural hazards mitigation planning process for Yamhill County first focuses on data collection and analysis to: (1) provide a profile of existing conditions within the county, including demographics, geography, development trends, and transportation patterns; (2) identify areas of the county that are vulnerable to specific natural hazard events; and (3) describe the history of past natural hazard events that impacted Yamhill County. Once this portion of the planning process is complete, MWVCOG will assist the county in developing specific strategies and action items to better assess the impacts of natural hazards to life and property within the county and to minimize or mitigate those impacts.

Why Develop a Mitigation Plan?

The rising cost of natural disasters has led to a renewed interest in identifying effective ways to reduce vulnerability to disasters. Natural hazard mitigation plans assist communities in reducing risk from natural hazards by identifying resources, information, and strategies for risk reduction, while helping to guide and coordinate mitigation activities throughout the Yamhill County.

The plan provides a set of action items to reduce risk from natural hazards through education and outreach programs, the development of partnerships, and implementation of preventative activities such as land use or watershed programs.

The resources and information within the Mitigation Plan: (1) establish a foundation for coordination and collaboration among agencies and the public in Yamhill County; (2) identify and prioritize future mitigation projects; and (3) assist in meeting the requirements of federal assistance programs. The mitigation plan works in conjunction with other county plans, including the County Comprehensive Land Use and Emergency Operations Plans.

What is natural hazard mitigation? *Natural hazard mitigation is the development and implementation of activities designed to reduce or eliminate losses resulting from natural hazards.*

Whom Does the Mitigation Plan Affect?

The Yamhill County Natural Hazards Mitigation Plan affects unincorporated urban areas, and the rural, unincorporated areas of the county. Map 1 shows cities, urban unincorporated areas, and major roads and rivers in Yamhill County. While this plan does not establish requirements for the cities in the County, it does provide them with a framework for planning for natural hazards. The resources and background information in the plan is applicable countywide, and the goals and recommendations can lay groundwork for local mitigation plans and partnerships.

Natural Hazard Land Use Policy in Oregon

Planning for natural hazards is an integral element of Oregon's statewide land use planning program, which began in 1973. All Oregon cities and counties have comprehensive plans and implementing ordinances that are required to comply with the statewide planning goals. The continuing challenge faced by local officials and state government is to keep this network of coordinated local plans effective in responding to the changing conditions and needs of Oregon communities.

This is particularly true in the case of planning for natural hazards where communities must balance development pressures with detailed information on the nature and extent of hazards. Oregon's land use program has given its communities and citizens a unique opportunity to ensure that natural hazards are addressed in the development and implementation of local comprehensive plans.

In 1996, FEMA estimated that Oregon saves about \$10 million a year in flood losses because of strong land-use planning. Statewide land use planning Goal 7, Areas Subject to Natural Disasters and Hazards, calls for local plans to include inventories, policies, and ordinances to guide development in hazard areas. Goal 7, along with other land use planning goals, has helped to reduce losses from natural hazards.

State Support for Natural Hazard Mitigation

All mitigation is local, and the primary responsibility for development and implementation of risk reduction strategies and policies lies with local jurisdictions. Local jurisdictions, however, are not alone. Partners and resources exist at the state and federal levels. Numerous Oregon state agencies have a role in natural hazards and natural hazard mitigation. Some of the key agencies include:²

- **Oregon State Police - Office of Emergency Management**

(OEM) is responsible for disaster mitigation, preparedness, response, recovery, and the administration of federal funds after a major disaster declaration;

- **Building Codes Division (BCD)** and local counterparts, are responsible for construction and for some hazards that are building-specific in their occurrence (such as earthquakes); also included are provisions for expansive soils, and damage assessment of buildings after an earthquake;
- **Oregon Department of Forestry (ODF)** is responsible for all aspects of wildland fire protection on private, state, and in Western Oregon, Bureau of Land Management (BLM) forestlands, and administers forest practices regulations, including landslide mitigation, on non-federal lands;³
- **Oregon Department of Geology and Mineral Industries (DOGAMI)** is responsible for geologic hazard characterization, public education, the development of partnerships aimed at reducing risk, and exceptions (based on science-based refinement of tsunami inundation zone delineation) to state mandated tsunami zone restrictions; and
- **Department of Land Conservation and Development (DLCD)** is responsible for planning-based hazard management including implementation of land use planning and Goal 7 (natural hazards), with attention given to hazard assessments and hazard mitigation.

Plan Methodology

Information in the Mitigation Plan is based on research from a variety of sources. The research methods and various contributions to the plan include:

Executive Summary: Five-Year Action Plan

Input from the steering committee:

The steering committee, comprised of representatives from county departments, the McMinnville Fire Department, and the Polk County Emergency Manager, met eight times over the course of nine months. The steering committee developed the plan's mission statement and plan goals; contributed to the development of mitigation action items; and continually reviewed the plan.

Stakeholder interviews:

Stakeholders consisted of the fire districts within Yamhill County, all of the county's incorporated cities, major employers within the county, school districts, Chemeketa Community College's McMinnville campus, Willamette Education Service District, Yamhill Soil & Water Conservation District, the Yamhill Basin Council Coordinator, Oregon Department of Forestry, U.S. Bureau of Land Management, and public utility companies. Stakeholder interviews identified historic natural hazards events in the county, additional information regarding current natural hazards mitigation activities,

identified mitigation needs or gaps, potential action items, and additional resources.

Hazard specific research:

Historical data is presented on seven natural hazards: flood, landslide, severe winter storm, windstorm, wildfire, earthquake, and drought.

Community Open House:

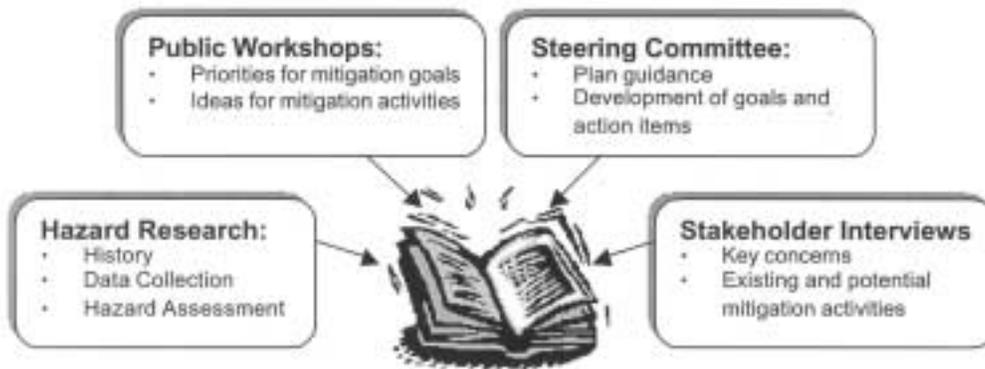
An open house was held on April 20, 2005, to inform the public on Yamhill County Natural Hazards. The purpose of the open house was to gather comments and ideas from the residents of Yamhill County about natural hazards mitigation planning, to inform the public about natural hazards that occur in Yamhill County, and identify community priorities, and potential strategies for achieving these priorities.

Meetings with the project steering committee, stakeholder interviews and the public open house all served as methods to obtain input and priorities in developing goals for reducing risk and preventing loss for natural hazards in Yamhill County.

How Do I Use the Plan?

The resources and information cited in the mitigation plan provide a strong local perspective and help identify strategies and activities to make Yamhill County more disaster resilient. **Figure 1.1** shows the mitigation planning process components and the key outcomes.

Figure 1.1. Hazard Mitigation Planning Process



Each section of the mitigation plan provides information and resources to assist people in understanding the county and the hazard-related issues facing citizens, businesses, and the environment. Combined, the sections of the plan work together to create a document that guides the mission to reduce risk and prevent loss from future natural hazard events.

The structure of the plan enables people to use a section of interest to them. It also allows county government to review and update sections when new data becomes available. The ability to update individual sections of the mitigation plan places less of a financial burden on the county. Decision makers can allocate funding and staff resources to selected pieces in need of review, thereby avoiding a full update, which can be costly and time-consuming. New data can be easily incorporated, resulting in a natural hazards mitigation plan that remains current and relevant to Yamhill County.

Executive Summary: Five-Year Action Plan

The Executive Summary can be used as a quick-reference document for the Yamhill County Natural Hazards Mitigation Plan. It includes brief discussion of what is in the plan; the plan goals, which entities participated in the plan; and a matrix that lists all of the county's action items and the applicable plan goals.

Section I: Introduction

The *Introduction* describes the background and purpose of developing the mitigation plan for Yamhill County.

Section 2: Community Profile

This section presents the history, geography, demographics, and socioeconomics of Yamhill County. It serves as a tool to provide an historical perspective of natural hazards in the county.

Section 3: Risk Assessment

This section provides general information on hazard identification, vulnerability and risk associated with natural hazards in Yamhill County.

Section 4: Mitigation Plan Mission, Goals, and Action Items

This section provides information on the process used to develop goals and action items that cut across the seven natural hazards addressed in the mitigation plan.

Section 5: Plan Implementation, Maintenance and Public Participation

This section provides information on plan implementation, monitoring and evaluation.

Volume II: Hazard-Specific Information

This plan addresses six chronic hazards and one catastrophic hazard. Chronic hazards occur with some regularity and may be predicted through historic evidence and scientific methods. The chronic hazards addressed in the plan include:

- *Section 6: Flood*
- *Section 7: Landslide*
- *Section 8: Wildfire*
- *Section 9: Severe Winter Storm*
- *Section 10: Windstorm*
- *Section 11: Drought*

Catastrophic hazards do not occur with the frequency of chronic hazards, but can have devastating impacts on life, property, and the environment. The catastrophic hazard presented in the plan is:

- *Section 12: Earthquake*

Each of the hazard-specific sections includes information on the history, hazard causes and characteristics, hazard assessment, goals and action items, and local, state, and national resources.

Volume III: Resources

The plan appendices are designed to provide users of the Yamhill County Natural Hazards Mitigation Plan with additional information to assist them in understanding the contents of the mitigation plan, and potential resources to assist them with implementation.

Appendix A: Plan Resource Directory

The resource directory includes county, regional, state, and national resources and programs that may be of technical and/or financial assistance to Yamhill County during plan implementation.

Appendix B: Public Participation Process

This appendix includes specific information on the various public processes used during development of the plan.

Appendix C: Benefit-Cost Analysis

This section describes FEMA's requirements for benefit-cost analysis in natural hazards mitigation, as well as various approaches for conducting economic analysis of proposed mitigation activities.

Appendix D: Driveway Construction Checklist/Inspection Form and Enabling Ordinance 514

This section provides information on how the county requires private driveways to be accessible for fire, life and safety vehicles.

Appendix E: List of Acronyms

This section provides a list of acronyms for county, regional, state, and federal agencies and organizations that may be referred to within the Yamhill County Natural Hazards Mitigation Plan.

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- ¹ Mid-Willamette Valley Council of Governments. 1996. *Flood Economic Recovery Coordination Project for Marion, Polk, and Yamhill, Counties, Oregon*. Salem, OR: MWVCOG.
- ² Agency descriptions (with the exception of the ODF description) are derived from: OR Department of Geology and Mineral Industries, Special Paper 31, *Mitigating Geologic Hazards in Oregon: A Technical Reference Manual*, 1999.
- ³ Oregon State Police, Office of Emergency Management. June 2000. *State Natural Hazards Mitigation Plan*.

Section 2:
Community Profile

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Why Plan for Natural Hazards in Yamhill County?

In 2000, the Federal Emergency Management Agency issued the Disaster Mitigation Act of 2000, commonly known as DMA 2000. Under DMA 2000, communities, states, and tribal governments must complete FEMA-approved natural hazard mitigation plans by December 31, 2004 to be eligible for certain federal assistance programs such as the Hazard Mitigation Grant Program (HMGP).¹

While Yamhill County is generally described as having a mild climate and a relatively flat terrain, with the exception of hills located toward the Coast Range, natural hazards do present a threat to public and private property and to the health and safety of the county's residents. The next few chapters demonstrate how natural disasters have caused major concerns related to earthquakes, floods, winter storm events, windstorms, and landslides in the Yamhill County region. The county's proximity to the banks of the Willamette River increases the threat of flood occurrences and damage. To minimize risk of harm to humans and personal property, it is vital to plan for the occurrence of potential natural hazards.

History of Natural Hazards in Yamhill County

Yamhill County is located in one of the largest agricultural income sectors in Oregon. Agricultural industry is the major user of land resources for both historic and current food and fiber production within the county. Outside the Urban Growth Boundary, over 68 percent of the drainage area in Yamhill County is in agricultural production, the U.S. Bureau of Land Management manages around nine percent (9%) of land in the county, and nearly eight percent (8%) is urbanized.^{2,3} Historically, the region has experienced periodic fires, floods, windstorms, and landslides. For almost 4,000 years, the Kalapuya Native Americans and early settlers regularly burned areas of the Willamette Valley to maintain "favorable plant community characteristics".⁴ Because the frequency and location of fires is not well documented, the impact on historical settlements cannot fully be assessed. Many large fires occurred in 1902 and 1910, however, which raised the public's awareness of deaths and loss of property related to fire hazards.⁵ Recent research indicates the potential for fire hazards in forested areas of the county from the lack of fire breaks surrounding rural residential properties, lack of water availability, and the absence of fire over the last 100 years.⁶

With many communities located along riverbanks and near local streams, Yamhill County has always been subject to winter flooding events. Such events often begin with intense storm events that tend to increase the chance for local streams and rivers to flood. Almost a dozen historical flood events, half of which are recorded as "major floods", have been documented between 1861 and 1996. Flood severity in the county depends on the size of drainage areas, existing moisture

levels, and obstacles located within flood prone areas. The most recent high water event in the Yamhill County area was flooding in January 1997, which was rooted in the last days of December 1996. On January 1, 1997, the South Yamhill River at McMinnville crested at 55 feet – flood stage is 50 feet.

Yamhill County has also experienced severe windstorms over the years. Most of these storms resulted in building and property damage, utility failures, and in some cases injury or death. One of the strongest windstorms to hit Yamhill County occurred in 1962. The Columbus Day Storm of 1962 caused trees to blow down on the average of 80 acres per square mile.⁷

Other natural hazards that have affected the county include earthquakes, wildfires, and landslides. All have affected the County in the past.

Yamhill County's past experiences with natural hazards serve as important lessons about the potential impacts of future events. The potential threat from any one of these events points to the importance of planning for and reducing the risks posed by natural hazards.

Geography and Environment

As the oldest county in Oregon, established in 1843 as one of four original Oregon Counties, Yamhill County lies on the west side of the lower middle part of the Willamette Valley. Yamhill County is bounded by Washington, Clackamas, Polk, Marion and Tillamook Counties. The Willamette River is the eastern boundary of Yamhill County.

Although one of the smallest counties in Oregon, Yamhill County ranks tenth in population, fourteenth in taxable property value, and eighth in annual worker salary.⁸ Less than ten percent (10%) of Yamhill County is state or federally owned, compared to over 50 percent for the rest of Oregon.⁹

Yamhill County extends from about fifteen (15) miles southwesterly of Portland to within eleven (11) miles of the Pacific Ocean (Coast Range). The county has an area calculated to be between 728 square miles (ODOT) to 714 square miles (older publications), with the *Oregon Bluebook* currently setting the area at 718 square miles.

Located in the heart of the Mid-Willamette Valley, Yamhill County has ten (10) incorporated and 28 unincorporated communities. All ten cities are either surrounded by farmland or forest land.¹⁰ Agriculture is the principal industry in Yamhill County, with a proportion of employment in agriculture being twice that of the average in the state.¹¹ The county ranks fourth out of the 36 counties in 2004 gross farm and ranch sales (\$242 million).¹² Nineteen wineries lie scattered about the eastern half of the county, which is the largest concentration of any county.¹³ Ninety (90) percent of the nation's hazelnuts (filberts) are grown in Yamhill County.¹⁴

Yamhill County has an abundance of natural resources. A third of the county is covered with commercial timber.¹⁵ The Willamette River is the major river basin and is the county's eastern boundary. Drainage is predominantly easterly into streams and creeks feeding the Willamette River. Dozens of small creeks supply three sub-basins; North Yamhill, South Yamhill, and the Yamhill River main stem. Major waterbodies include McGuire Reservoir, Haskins Creek Reservoir, Rainbow Lake and Peavey Reservoir. Several smaller water bodies exist within the county and include (among others) but are not limited to Willamina Creek, Rock Creek, Deer Creek, Muddy Creek, Mill Creek, Salt Creek and Palmer Creek located to the south; and the headwaters of the Nestucca River, and Panther Creek and Turner Creek to the north.

Yamhill County is divided into two general geographic areas: a smooth valley area in the southern and eastern parts used for farming and containing most cities and communities, and a hilly or mountainous area in the western and northern parts used for timber. Elevations range between 150 feet on the Willamette River to 3522 (or 3422) feet at Trask Mountain, located in northwest Yamhill County.¹⁶ Mountain ranges include Parrott, Chehalem, and the Coast Range. The Amity and Red Hills lie near Amity and Dundee, respectively. Slopes are steep and precipitous in the northwestern part of the Coast Range, and they become more rounded and moderately steep toward the eastern and southern foot slopes.

The lowest point within Yamhill County is on the bottomland east of Newberg where the Willamette River enters Clackamas County. The valley floor rises gradually from 150 feet elevation to more than 300 feet in the southwestern end of the county.¹⁷

Emergent Wetland and Bottomland/Wet Prairie lands were once pervasive throughout parts of Yamhill County and within the Willamette Valley region.¹⁸ These areas were once covered mostly by native prairie grasses and characterized by an oak savanna ecosystem. Early land surveying records indicate that these scenic oak savannas and native grass prairies were a direct result of fire ecology.¹⁹ Historical accounts of the river ecosystem indicate the primary tree species include cottonwood, alder, and other hardwoods.

Rivers and Streams

With the exception of a few small streams and the Nestucca River, which originate near the summit of the Coast Range and flow westward to the Pacific Ocean, the drainage of more than 95 percent of Yamhill County is eastward. The eastward drainage is through the forks of the Yamhill River and Chehalem Creek into the Willamette River, which flows into the Columbia River at Portland.

Willamette River

The Willamette River flows 187 miles from the Cascade Mountains in the east through northwestern Oregon to the Columbia River, which then flows into the Pacific Ocean. The Willamette River is known as the tenth largest river with respect to water volume in the continental

United States.²⁰ With approximately 70 percent of Oregon's population living within this basin, the Willamette River plays an integral role in the rural and urban landscapes through which it flows. The potential for natural hazards exists when the Willamette River experiences flood events within populated areas of Yamhill County. When the river rises, the extent of flooding on county roads depends on local stream flows.

Yamhill River²¹

The Yamhill River consists of three branches, south, north and mainstem. The North Yamhill runs past Yamhill and Carlton, and drains a smaller area than the South Yamhill. The two join east of McMinnville to create the mainstem Yamhill, which empties into the Willamette.

Yamhill River is twelve miles (19 km) long; formed two miles (3.2 km) east of McMinnville by the North Yamhill River and South Yamhill River. The Yamhill River rises in the Coast Range, and flows east to the Willamette River five miles (8 km) south of Newberg. The principal tributary, the South Yamhill River, is 60 miles (95 km) long.²² The North Yamhill is approximately 29 miles (46 km) in length.²³ The entire system drains an area of 770 square miles.²⁴

The Yamhill River contains winter steelhead, which use the river for juvenile rearing, and cutthroat trout, which require many of the same conditions as steelhead, but are a more dominant population. Until the 1970s, the state stocked lakes and ponds with non-native fish, among them carp, catfish, bass and coho salmon.²⁵

Other fish known to be present in the Yamhill River system are: northern pike minnow, dace, sculpin, redbreast shiner, three-spine stickleback, pacific lamprey, brook lamprey, coarse-scaled sucker and crayfish.^{26,27} Nonetheless, it was stocked with several exotic species by the state. There are large and small mouth bass populations in the river, competing with the native fish, but also preying on them.

The main stem of the Yamhill River is twelve miles in length from the confluence of the North and South Yamhill Rivers downstream to the Willamette River. The basin of the Yamhill River consists of low, flat, agricultural land. This basin lies within the Willamette Valley floodplain.

There is only one tributary of note entering the main stem below the junction of the North and South Yamhill Rivers. This tributary is Palmer Creek, which joins the Yamhill River about five miles above its mouth. Palmer Creek, nine miles long, flows through flat, agricultural lands and has a slight gradient.²⁸

North Yamhill River Main Stem

The North Yamhill River originates on the eastern slopes of the Coast Range and flows in an easterly then southerly direction. It joins the

South Yamhill to from the main stem of the Yamhill two miles northeast of McMinnville. The North Yamhill main stem is approximately 29 miles long. The four larger tributaries (Panther, Turner, Haskins, and Fairchild Creeks) vary in length from six to thirteen miles.

Panther Creek

Panther Creek is the only tributary that enters the North Yamhill below Carlton Dam. Panther Creek, around thirteen miles long, contains two falls about eleven miles above the mouth, approximately 3.7 miles above the confluence of Kane Creek. Baker Creek and Fall Creek enter Panther Creek – two miles and eleven miles above the mouth, respectively. The City of Carlton receives their domestic water from Panther Creek.

Turner Creek

Turner Creek enters the North Yamhill River about fifteen miles above the mouth or four miles northwest of the town of Yamhill. The stream is about seven miles in length. The Yamhill city water supply dam is located three miles above the mouth of Turner Creek. There is a high potential for landslides along Turner Creek.

Haskins Creek

Haskins Creek enters the North Yamhill River about 20 miles above the mouth, or one mile east of Fairdale. The stream is approximately ten miles long. One of the sources for domestic water for the City of McMinnville comes from Haskins Creek and is stored in Haskins Reservoir. The City of McMinnville also receives domestic water from McGuire Reservoir, which is on the Nestucca River, within the Wilson-Trask-Nestucca Subbasin of the North Oregon Coastal Basin.

Fairchild Creek

Fairchild Creek enters the North Yamhill River about 21 miles above the mouth or ten miles northwest of the town of Yamhill. The stream basin is a steep, narrow canyon in the Coast Range foothills and vegetation is largely second-growth firs and alders. Fairchild Creek is six miles in length and eleven miles above the mouth, respectively.

South Yamhill River Main Stem

The South Yamhill River originates in the low foothills on the east slope of the Coast Range. The river flows in a westerly direction and joins the North Yamhill River to form the Yamhill River about two miles northeast of the town of McMinnville. The South Yamhill main stem is approximately 60 miles in length. The basin is extensively used as agricultural and pastureland. The Cities of Amity and Sheridan receive their domestic water from the South Yamhill River. The four major tributaries of the South Yamhill are Mill, Willamina, Rock and Agency Creeks.

Mill Creek

Mill Creek enters the South Yamhill River about 35 miles above the mouth and three miles above Sheridan. The stream is approximately 20 miles in length and drains more than 34 miles of tributary streams. Tributaries of Mill Creek include Gooseneck and Cedar Creeks.

Willamina Creek

Willamina Creek enters the South Yamhill River approximately 37 miles above the mouth. The stream is 20 miles long and drains over 53 miles of tributary streams. The City of Willamina receives its domestic water from Willamina Creek. Willamina Creek has two major tributaries – Coast and East Fork Willamina Creeks.

Coast Creek enters Willamina Creek around eight miles above the mouth. The stream is nine miles in length and drains more than fifteen miles of tributary streams. The three large tributaries are Gilbert, Canada, and Burton Creeks. East Fork Willamina Creek, about eight miles long, has its origin on the eastern slope of the Coast Range. The stream flows in a southwesterly direction to enter Willamina Creek, about nine miles above the mouth.

Rock Creek

Rock Creek joins the South Yamhill River approximately 46 miles above the mouth. The stream is approximately twelve miles in length and drains over thirteen miles of tributary streams. Rock Creek has two named tributaries – Joe Day and Cow Creeks.

Agency Creek

Agency Creek enters the South Yamhill River about 48 miles above the mouth. The stream is about twelve miles in length and drains over seventeen miles of tributary streams. Larger tributaries are Wind River, and Joe and Yoncalla Creeks. Joe Creek enters Agency Creek a little more than three miles above the mouth. The stream is about two miles in length. Wind River, which is really a creek but is labeled 'Wind River' on the USGS topographic quadrangle map, enters Agency Creek about four miles above the mouth. The stream is about four miles long. Yoncalla Creek is steep and boulder strewn.

Climate

Yamhill County, in common with all of western Oregon, has a modified marine climate. Yamhill County has three climate zones, distinguished mainly by elevation: the valley floor, the foothills of the Coast Range, and the Coast Range.

In Yamhill County, rain falls mostly in winter. Approximately 70 percent of the annual total falls in the period November through March and only five to ten percent in the period June to August.²⁹ In the main agricultural areas, nearly all precipitation falling in winter falls as rain.

Only on the higher slopes of the Coast Range can significant amounts of snow normally be expected.

Since Yamhill County spans a wide range of physiographic regions, there is considerable variation in precipitation, with elevations as the largest factor in precipitation totals. The higher elevations receive up to 60 inches of precipitation annually, while the bottomlands receive about 40 inches annually. Precipitation is not spread evenly over the calendar year but rather falls during the winter and spring months in a water year, that runs from October to April.³⁰

Snow and ice do not accumulate often, even at the higher elevations of the county. As a result, “rain on snow events”³¹ are rare. During the 1964 and 1996 winter storms, however, enough snow accumulated in the Coast Range to contribute to the record flooding that occurred in those years.

Minerals and Soils

Soil types in the Mid-Willamette Valley are valuable for land use practices that involve human, agricultural or forestry activities and urban development. Land capability classes consist of broad groupings of soils based on the risk of soil damage if mismanaged (e.g., loss of topsoil from erosion or sediment deposition) and whether soil limitations prevent the sustained cultivation of crops, pasture and rangeland vegetation.³² In general, Class I through IV soils can be used for crop production with Class IV soil requiring conservation efforts such as erosion control terraces, grassed waterways, or tillage and residue management.³³ Class VI and VII are typically reserved for hay, pasture, and rangeland grazing activities.

According to the Soil Survey of Yamhill Area, Oregon,³⁴ soils in Yamhill County primarily are Class III and range from Class I through VI.

Several common natural hazards are related to soil stability and water retention. Hazards include landslides, erosion, flooding, and liquefaction resulting from an earthquake. Mineral and soil compositions are important factors for determining whether Yamhill County is prone to hazards such as landslides.

Significant Geological Factors

Figure 1 shows how most of the Pacific Northwest lies within the Cascadia Subduction Zone, where the Juan de Fuca and North American plates meet. The convergence of these tectonic plates puts most areas of western Oregon and Washington at risk for a catastrophic earthquake with a magnitude of 8.0 or higher. Yamhill County lies in this area

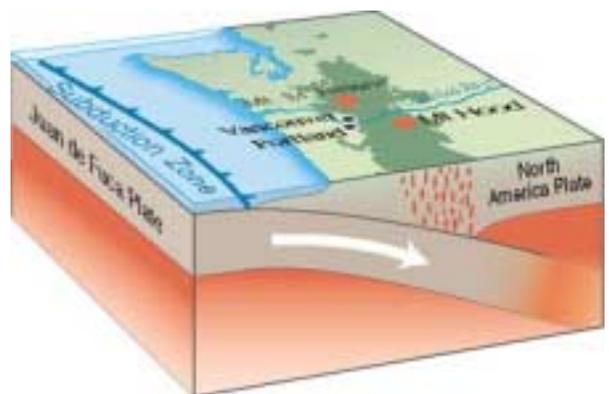


Figure 1 Cascadia Region Subduction Zone

of risk. As an inland valley, the Willamette Valley was once a part of a broad continental shelf. The Red Hills of Dundee, Parrett and Chehalem Mountains, and the tops of Amity-Eola Hills are examples of Columbia River Basalts or volcanic rocks uplifted along faults.³⁵ In a feature unique to this area, the Willamette River flows not along wide stretches of flat floodplain, but rather converges between the bedrock hills of South Salem and Eola Hills.

Population and Demographics

In 2000, the population of Yamhill County was 84,992, representing an increase of almost 30 percent during the last ten years. Table 1 shows that growth for Yamhill County is almost ten percent above the State of Oregon.

Table 1. Population Trends in Yamhill County and Oregon, 1990-2000

Area	1990 Population	2000 Population	% Change, 1990-2000
Yamhill County	65,551	84,992	29.7
Oregon	2,842,321	3,421,399	20.4

Source: U.S. Bureau of Census

The percentage of Oregon's total population is 2.5 percent for Yamhill County, which ranks it as the state's tenth largest county.³⁷ Table 2 illustrates the populations living in incorporated and unincorporated areas of Yamhill County. In 2000, the ten incorporated cities within the county comprise about 72 percent of the county population, with the remaining 28 percent of the population in unincorporated areas. The largest cities include McMinnville, Newberg, and Sheridan.

Table 2. Incorporated and Unincorporated Communities in Yamhill County, Oregon

Incorporated Cities	Population	Unincorporated	Communities	
Amity	1,478	Bellevue	Fairdale	Springbrook
Carlton	1,514	Briedwell	Gopher	
Dayton	2,119	Camp Smith	Grande Ronde	Sunnycrest
Dundee	2,598	Camp Yamhill	Hopewell	Tompkins Landing
Lafayette	2,586	Cove Orchard	Lunville	Unionvale
McMinnville	26,499	Dellwood	Midway	Weston Landing
Newberg	18,064	Dewey	Orchard View	Whites Landing
Sheridan	3,570	Dukes Landing	Pike	Whiteston
Willamina	1,844	Eola Crest	Pleasantdale	Woods Landing
Yamhill	794	Eola Village	Saint Joseph	

Source: U.S. Bureau of Census

Yamhill County has an incorporated population of 61,066, while the unincorporated population is 23,926. Table 3 demonstrates the percent change in Yamhill County’s incorporated cities from 1990 to 2000. Population in incorporated areas has increased 27.1 percent during this time frame, while population has increased by twelve (12) percent in unincorporated areas.

Table 3. Yamhill County Population, Incorporated and Unincorporated Areas

Area	1990	2000	Percent Change 1990-2000
Incorporated Areas	44,488	61,066	+27.1
Unincorporated Areas	21,063	23,926	+12.0

Source: US Bureau of Census

This urban and rural growth pattern determines how agencies prepare to handle emergencies, as changes in population and development can increase risks associated with hazards.³⁸ For example, more people living on the urban fringe can increase their risk of fire. Wildfire has an increased chance of starting due to human activities in the urban/rural interface, and has the potential to injure more people and cause more property damage.³⁹

While natural hazards do not discriminate, the impacts in terms of risk of vulnerability and the ability to recover differ among the population.⁴⁰ According to a representative of the Federal Emergency Management Agency (FEMA), 80 percent of the disaster burden falls on the public, with a disproportionate burden placed upon special needs groups: women, children, minorities, and the poor.⁴¹

According to the 2000 census, approximately 10.6 percent of current residents in Yamhill County are Hispanics or Latinos. The 2000 US Census reports that 1.5 percent of the County's residents are American Indian or Alaskan Native, 1.1 percent are Asian, 0.8 percent are Black or African American, and 5.2 percent of the county's residents are "some other race."⁴² Such ethnic diversity suggests a need to address multicultural needs and services.

Approximately 9.2 percent of individuals live in poverty in Yamhill County, of whom 7.5 percent are over 65. Approximately six percent are families and of that, 8.9 percent include children under 18 years old.⁴³ Vulnerable populations, including children, women, seniors, disabled citizens, as well as people living in poverty, may be disproportionately impacted by natural hazards in Yamhill County. To increase access to services and programs, hazard mitigation policies must reflect such special needs populations. FEMA addresses such needs by encouraging agencies and organizations planning for natural disasters to identify special needs populations, make recovery centers more accessible, and review practices and procedures to resolve any discrimination in disaster relief or assistance.⁴⁴

A sense of inequity emerges when the financial responsibility of natural hazards recovery is placed on the general population, even though only a small proportion may benefit from governmental funds to rebuild private structures.⁴⁵ To ensure all members of the population are included in the decision making process, a natural hazards dialogue in Yamhill County should include local citizen groups, insurance companies, and other public and private sector organizations.

Land and Development

Prior to early settlement of Yamhill County, the area was home to a scenic oak savanna, tall grassy prairies, and colorful wildflowers. During early settlement, the alluvial valley of the Willamette River was one of the first areas to use waterways as arterials for commerce and to be cleared for agriculture. Over time, an increase in awareness regarding the benefits of land use and development regulations is corresponding with an increase in awareness of the county's land and water resource limitations.

Today, Yamhill County is a community of residential, commercial, and agricultural land uses. As noted above, one main basin is found within Yamhill County. The Yamhill Basin is the largest drainage basin in the county and includes all of the communities within Yamhill County. There are seven sub-basins within the Yamhill Basin, four of which include portions of Polk County.^{46,47}

With increased development and population growth, Yamhill County has lost many of the ecosystems that existed prior to early European settlement. Such historical ecosystems not only were home to rare plant and animal species, they also served to control flooding, recharge groundwater, and stabilize riverbanks. The problems associated with urbanization of rural land resources is especially important in Yamhill

County with the importance of its land resources to the local economy. Yamhill County ranks third in the state for farm and ranch sales in 2003 - \$225,001,000.⁴⁸

Table 5 shows the acres by various land use designations within Yamhill County. Land within incorporated city limits is designated as urban in the table. More than 97 percent of the land within Yamhill County is zoned for agricultural or forest (timber) uses.

Table 5. Acres by Land Use Designation Yamhill County

Land Use Designation	Acres	Percent of Total Acres
Forest	353,714	64.6
Agriculture	178,447	32.6
Urban	7,444	1.4
Public	2,967	0.5
Residential	2,744	0.5
Industrial	1,447	0.3
Commercial	706	0.1
Total	547,469	100.0

Source: Yamhill County GIS, 2004

Rural development is the conversion of land outside all urban growth boundaries to a more intensive non-resource oriented use such as residential structures. Existing rural development in Yamhill County is predominately scattered single-family residences and a few rural communities that include a mix of rural residential, commercial, industrial, and public uses.

Yamhill County adopted revised goals and policies for the Yamhill Comprehensive Plan in 1996 to ensure that rural development occurs in a way that will help protect agricultural land and other natural lands from premature development. For example, Goal Statement 2 of Section 1.B., “Rural Area Development” states:

To accommodate the demand for rural residential development at very low densities and in areas which are not amenable to integrated neighborhood designs, provided such areas are suited to the uses intended and exhibit high amenity value, and such developments do not preempt farm or forest lands, or generate inordinate service demands of their own.⁴⁹

Development Regulations

There are a number of current regulations and Comprehensive Plan policies regarding development in areas subject to natural hazards. Policy C.2 for Rural Area Development states that all proposed rural area development and facilities “[s]hall not be located in any natural hazard area, such as a floodplain or area of geologic hazard, steep slope, severe drainage problems or soil limitations for building or sub-surface sewage disposal, if relevant.”⁵⁰ The Floodplain Overlay District included in the Yamhill County Zoning Ordinance requires developers to

obtain a “Floodplain Development Permit” application before any construction or development occurs within the Floodplain Overlay District.⁵¹

Housing and Community Development

Gaining an understanding of the County’s current housing stock, as well as trends in community development, is important when planning for natural hazards. To accommodate rapid growth, communities engaging in mitigation planning should evaluate the following: infrastructure and service needs, specific engineering standards and building codes.⁵² Discontinuing or decreasing development in floodplains may potentially reduce an area’s vulnerability to hazards. While Oregon has land use goals that address mitigation planning in rural and urban areas, communities must make sure these goals are being met when developing land for housing and industry.

According to the 2000 US Census, around 8,790 housing structures were built in Yamhill County over the last decade as shown in Table 6.

Table 6. Housing Age-Structure in Yamhill County

<u>Year</u>	<u>Number</u>	<u>Percent</u>
1999 – March 2000	840	2.8
1995 to 1998	4,142	13.7
1990 to 1994	3,808	12.6
1980 to 1989	4,112	13.6
1970 to 1979	6,944	22.9
1960 to 1969	2,435	8.0
1940 to 1959	4,014	13.3
1939 or earlier	3,975	13.1

Source: U.S. Bureau of Census, Census 2000

Between 1970 and 1989, roughly 37 percent of Yamhill County’s houses were built, followed by another 24 percent between 1990 and March 2000.⁵³

The year-built date is important for mitigation because the older the home, the greater risk of damage from natural disaster. For example, structures built after the late 1960’s in the Northwest and California used earthquake resistant designs and construction techniques.⁵⁴ Likewise, FEMA began assisting communities with floodplain mapping during the 1970’s, and communities developed ordinances that required homes in the floodplain to be elevated at least one foot over Base Flood Elevation.

Employment and History

According to the Oregon Department of Employment, the Central Willamette Region added approximately 68,400 jobs during the 1990s. Historically, the region relied on the lumber industry for jobs and income. According to the recently completed statewide hazard plan for the Central Willamette Valley, the sectors expected to grow in this region include industrial, high tech, healthcare, administrative, tourism

and retail trade. Table 7 describes the county's employment by industry for the year 2000. It appears the highest percentage of workers in Yamhill County is employed in the educational/ health/social services, manufacturing and retail trade sectors.

Table 7. Employment by Industry for Yamhill County

Industry	Number	Percent
Agriculture/Fishing/Forestry	1,782	4.5
Construction	2,832	7.2
Manufacturing	7,600	19.4
Wholesale Trade	1,695	4.3
Retail Trade	4,488	11.5
Transportation/Warehousing	1,778	4.5
Information	740	1.9
Finance/Insurance/Real Estate	1,896	4.8
Mgmt/Scientific/Waste	2,530	6.5
Education/Health/Social Services	7,279	18.6
Arts/Entertainment/Recreation/ Accommodation & Food Service	2,866	7.3
Misc.	1,777	4.5
Public Administration	1,933	4.9

Source: U.S. Bureau of the Census, Census 2000.

Median household income can be used as an indicator for the strength of the region's economic stability. It can also be used to compare economic areas as a whole, yet does not reflect how the income is divided among area residents. The 2000 Census indicates that the median household income for Yamhill County was \$44,111. This is slightly higher than the national average of \$41,433 and the state's average of \$40,916.

Mitigation plans and activities are essential at the business level to ensure the safety and welfare of workers and limit damage to industrial infrastructure. Employees are highly mobile, commuting from the surrounding areas to industrial and business centers within the county. The result is greater dependency on roads, communications, accessibility and emergency plans to reunite people with their families. Before a natural hazard event occurs, small and large businesses can develop strategies to prepare for and respond to natural hazards. Planning ahead in this manner can prevent the loss of life and property.

Transportation and Commuting

Rapid growth in an area contributes to local road traffic from workers commuting, trucks on the road, and an increase in general automobile traffic. A high percentage of commuters driving alone to work can cause traffic congestion and accidents.⁵⁵ The large increase in automobiles can place stress on roads, bridges, and infrastructure within the cities, and also in rural areas where you find fewer transit roads. During an emergency, local transit systems can be shut down, affecting evacuations. In addition, roads may become unusable from localized flooding and severe winter storms can potentially disrupt the daily driving routine of county residents.

According to the 2000 Census data, the average commute time for commuting workers in the Central Willamette Region is 22 minutes each way. In Yamhill County, approximately 75 percent of workers over the age of 16 commute to work alone by automobile and less than one-half (0.4) percent use public transportation.⁵⁶ Other modes of transportation in Yamhill County include carpooling (14 percent), working at home (4.7 percent), walking (4.4 percent), and using other means (1.4 percent).

Historic and Cultural Resources

As an important historical and cultural resource, the Willamette River and North and South main stems of the Yamhill River offer natural beauty, abundant wildlife, and diverse recreational opportunities. In addition to natural resources, Yamhill County also has 78 structures on the national historic register.⁵⁷ The County is forming the Yamhill County Cultural Trust Coalition Planning Committee in November 2002 with the intent to develop a cultural plan to guide the coalition in its efforts to protect the culture, arts, and heritage of Yamhill County.⁵⁸

Critical Facilities and Infrastructure

Critical and essential facilities are those facilities vital to the continued delivery of key governmental services that may significantly impact the public's ability to recover from the emergency. These involve local police and fire stations, public works facilities, sewer and water facilities, hospitals, bridges, roads, and shelters. Map 2 and Table 8 shows critical facilities in Yamhill County. Map 3 shows essential facilities in Yamhill County.

Table 8. Critical Facilities in Yamhill County

	N u m b e r
H o s p i t a l s	
N u m b e r o f h o s p i t a l s	2
N u m b e r o f b e d s	4 2 4
P o l i c e S t a t i o n s	1 7
F i r e a n d R e s c u e S t a t i o n s	1 8
S c h o o l D i s t r i c t s & C o l l e g e s	6 d i s t r i c t s - 2
P o w e r P l a n t s	U n i v e r s i t i e s 0
D a m s	
N u m b e r o f d a m s	4 0
S i g n i f i c a n t H a z a r d	7

Source: Newberg Community Hospital, Willamette Valley Medical Center, Yamhill County Sheriff Office, Oregon Department of Education, Oregon Department of Energy, Oregon Water Resources Department.

At any time, dam failures can occur and are recorded quite often. While most result in minor damage and pose little threat, some have the potential for severe damage where fatalities exist. There are many more unregistered dams in Yamhill County. According to Jon Falk, Dam Safety Coordinator for the Oregon Water Resources Department (WRD), only those dams that are ten feet or greater in height and that store more than 9.2 acre feet are required to be engineered and recorded in a dam safety database. Smaller structures are not recorded although all storage projects require a reservoir permit. Mr. Falk notes that a structure less than ten feet high could have a storage pond of 9.2 acre-feet or approximately three million gallons of water.

Jon Falk stated that within the WRD dam database, “significant hazard” is often confused with ‘risk.’ Significant hazard does not speak to the condition of the dam. Significant hazard indicates a direct loss of human life if a dam were to suddenly fail.⁵⁹ Dam types, purposes, and sizes are available from the Water Resources Department web site.

Other critical and necessary facilities vital to the efficient delivery of key governmental services, or that may significantly impact the public’s ability to recover from emergencies, include correctional institutions, public services buildings, law enforcement centers, courthouses, and juvenile service buildings. These and other public facilities are detailed in the local and regional mitigation plans.

¹ DMA 2000, State and Local Plan Criteria: Mitigation Planning Workshop for Local Governments,

http://www.fema.gov/fema/planning_toc4.shtm (Accessed 7/21/03)

² U.S. Department of Agriculture, Natural Resources Conservation Service, in cooperation with Oregon Agricultural Experiment Station. January 1974. *Soil Survey of Yamhill Area, Oregon*.

³ *Oregon Blue Book*. 2005. Available on the World Wide Web <http://bluebook.state.or.us/default.htm>. Accessed February 17, 1005.

⁴ Lower South Yamhill-Deer Creek Watershed Assessment. Yamhill Basin Council, September 2000.

⁵ *Id.*

⁶ *Id.*

⁷ Lower South Yamhill-Deer Creek Watershed Assessment. Yamhill Basin Council, September 2000.

⁸ Yamhill Soil & Water Conservation District website, accessed August 9, 2004, available from the World Wide Web (<http://www.yamhillswcd.org/>).

⁹ *Id.*

¹⁰ Yamhill County Comprehensive Plan.

¹¹ Yamhill County, Oregon website, accessed August 9, 2004 available from the World Wide Web (<http://www.co.yamhill.or.us/index>)

¹² “Agriculture is Important to All 36 Oregon Counties.” Oregon Department of Agriculture Web site, accessed February 8, 2005 available from the World Wide Web

<http://egov.oregon.gov/ODA/news/050202County.shtml>

¹³ Yamhill County, Oregon website, accessed August 9, 2004 available from the World Wide Web (<http://www.co.yamhill.or.us/index>).

¹⁴ Greater Yamhill County Telephone Directory, 2001.

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- ¹⁵ Id.
- ¹⁶ Id.
- ¹⁷ U.S. Department of Agriculture, Natural Resources Conservation Service, in cooperation with Oregon Agricultural Experiment Station. January 1974. *Soil Survey of Yamhill Area, Oregon*.
- ¹⁸ Lower Yamhill Watershed Assessment. February 2001. Available on the World Wide Web (<http://www.co.yamhill.or.us/ybc/Lyamhill/LYAssmnt.pdf>). Accessed September 30, 2004.
- ¹⁹ Boyd, R., ed. 1999. *Indians, Fire, and Land in the Pacific Northwest*. Corvallis, OR: Oregon State University Press.
- ²⁰ American Heritage Rivers Progress Report. 2000. Federal EPA Interagency Task Force.
- ²¹ The majority of the following information on streams within the Yamhill Subbasin to the Willamette Basin is provided from Robert N. Thompson and James B. Haas, "Environmental Survey Report Pertaining to Salmon and Steelhead in Certain Rivers of Eastern Oregon and the Willamette River and Its Tributaries." (Thompson & Haas) June 1960. Available on the World Wide Web (<http://www.fishlib.org/Subbasins/envsurvey.html>) (StreamNet Library), accessed August 9, 2004.
- ²² Thompson & Haas.
- ²³ Id.
- ²⁴ Id.
- ²⁵ Nicole Montesano, "Yamhill River System in Bad Shape." September 27, 2001. Accessed August 9, 2004. Available from World Wide Web (http://www.newsregister.com/news/story.dfm?story_no=136831)
- ²⁶ Thompson & Haas.
- ²⁷ N. Montesano, "Yamhill River System in Bad Shape." September 27, 2001.
- ²⁸ Thompson & Haas.
- ²⁹ USDA, NRCS, in cooperation with Oregon Agricultural Experiment Station. January 1974. *Soil Survey of Yamhill Area, Oregon*.
- ³⁰ Lower Yamhill Watershed Assessment. The Yamhill Basin Council. February 2001.
- ³¹ "Rain on snow events" occur when intensive rains follow heavy snow accumulation. They can greatly increase the volume of runoff and may cause flooding.
- ³² Atlas of Oregon, 2002. University of Oregon Press
- ³³ Ibid
- ³⁴ USDA, NRCS, January 1974.
- ³⁵ Chehalem Watershed Assessment, June 2001; and Lower Yamhill Watershed Assessment, February 2001. The Yamhill Basin Council, Yamhill and Polk Counties, Oregon.
- ³⁶ Pringle, Glenn-Gibson, Claggett, and Mill Creeks Watershed Assessment. January 2002.
- ³⁷ Atlas of Oregon, 2002. University of Oregon Press
- ³⁸ Region 3 Profile of Central/Southern Willamette Valley (2003)
- ³⁹ Clackamas County Mitigation Plan, September 2002. INFO SHOULD COME FROM A 'BETTER' CITE. I'VE READ IT ELSEWHERE MORE THAN ONCE.
- ⁴⁰ Ibid
- ⁴¹ <http://www.fema.gov/>(Accessed 8/4/03)
- ⁴² U.S. Bureau of Census, Census 2000.
- ⁴³ Ibid.
- ⁴⁴ Hazards Workshop Session summary #16, Disasters, Diversity, and Equity. Annual Hazards Workshop (July 12, 2000) University of Colorado, Boulder
- ⁴⁵ Ibid
- ⁴⁶ The seven sub-basins are, from north to south: North Yamhill River, Chehalem Valley, Lower Yamhill, Willamina Creek, Lower South Yamhill/Deer Creek, Upper South Yamhill, Salt Creek, and Mill Creek.
- ⁴⁷ Sub-basins with portions within Polk County: Lower South Yamhill-Deer Creek Watershed (17%), Upper South Yamhill Watershed (55.75%), Salt Creek Watershed (78%), and Mill Creek Watershed (almost all of the watershed is within Polk County, but flows north towards the South Yamhill River).
- ⁴⁸ Oregon Agriculture Facts and Figures, available on the World Wide Web (<http://www.nass.usda.gov/or/factsfigures04.pdf>). Accessed September 30, 2004.
- ⁴⁹ *Yamhill County Comprehensive Land Use Plan*. December 30, 1996. Department of Planning and Development, Yamhill County.

⁵⁰ *Id.*

⁵¹ Section 901, Yamhill County Zoning Ordinance. Revised June 1998. Available on the World Wide Web

(http://www.co.yamhill.or.us/plan/planning/ordinance/zoning_0901.asp)

⁵² Region 3 Profile of Central/Southern Willamette Valley (2003)

⁵³ U.S. Bureau of the Census, Census 2000.

⁵⁴ Clackamas County Mitigation Plan, September 2002

⁵⁵ *Ibid*

⁵⁶ US Bureau of the Census, Census 2000.

⁵⁷ <http://www.nr.nps.gov/iwisapi/explorer>. (Accessed 8/12/04)

⁵⁸ <http://yamhillcountyculture.org> (Accessed 8/12/04)

⁵⁹ Telephone conversation with John Falk, September 24, 2004.

Section 3: **Risk Assessment**

What is a Risk Assessment?..... 2
 Federal Requirements for Risk Assessment... 4
 Critical Facilities and Infrastructure..... 4
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What is a Risk Assessment?

Conducting a risk assessment can provide information on the location of hazards, the value of existing land and property in hazard locations, and an analysis of risk to life, property, and the environment that may result from natural hazard events. Specifically, the three levels of a risk assessment are as follows:

- 1) **Hazard Identification** identifies the geographic extent of the hazard, the intensity of the hazard, and the probability of its occurrence. Maps are frequently used to display hazard identification data. Yamhill County identified seven major hazards that consistently affect this geographic area: floods, landslides, wildfires, earthquakes, severe winter storms, windstorms, and drought. The geographic extent of each of the identified hazards has been identified by the Yamhill County GIS department using the best available data, and is illustrated by the maps listed in Table 3-1.

Profiling Hazard Events describes the causes and characteristics of each hazard, how it has affected Yamhill County in the past, and what part of Yamhill County's population, infrastructure, and environment has historically been vulnerable to each specific hazard. A profile of each hazard discussed in this plan is provided in each hazard section. For a full description of the history of hazard specific events, please see the appropriate hazard chapter.

- 2) **Vulnerability Assessment/Inventorying Assets** combines hazard identification with an inventory of the existing (or planned) property and population exposed to a hazard. Critical facilities are of particular concern because these entities provide essential products and services to the general public that are necessary to preserve the welfare and quality of life in the county and fulfill important public safety, emergency response, and/or disaster recovery functions. The critical facilities have been identified, mapped, and are illustrated in Map 3 in Section 2 of this plan. A description of the critical facilities in Yamhill County is also provided in Section 2. In addition, this plan includes a community issues summary in each hazard section to identify the most vulnerable and problematic areas in the county, including critical facilities, and other public and private property.
- 3) **Risk Analysis/Estimating Potential Losses** involves estimating the damage, injuries, and financial losses likely to be sustained in a geographic area over a given period of time. This level of analysis involves using mathematical models. The two measurable components of risk analysis are magnitude of the harm that may result and the likelihood of the harm occurring. Describing vulnerability in terms of dollar losses provides the community and the state with a common framework with which to measure the effects of hazards on assets. For each hazard where data was available, quantitative estimates for potential losses are included in the hazard assessment.

Assessing Vulnerability/Analyzing Development Trends

provides a general description of land uses and development trends within the community so that mitigation options can be considered in land use planning and future land use decisions. This plan provides comprehensive description of the character of Yamhill County in the Community Profile. This description includes the geography and environment, population and demographics, land use and development, housing and community development, employment and industry, and transportation and commuting patterns. Analyzing these components of Yamhill County can help in identifying potential problem areas, and can serve as a guide for incorporating the goals and ideas contained in this mitigation plan into other community development plans.

Table 3-1. List of Hazard Mitigation Plan Maps

Map #	Type of Map	Section of the Plan
1	Base Map of Yamhill County	Section 1: Introduction
2	Critical Facilities	Section 2: Community Profile
3	Essential Facilities	Section 2: Community Profile
4	County 100-Year Flood plain	Section 6: Flood
5	Hydrologic Subbasins Map	Section 6: Flood
6	Fire Districts	Section 8: Wildfire
7	Geological Fault Lines	Section 12: Earthquake

Risk assessments are subject to the availability of hazard-specific data. Gathering data for a risk assessment requires a commitment of resources on the part of participating organizations and agencies. Each hazard-specific section of the plan includes a section on hazard identification using data and information from county or state agency sources.

**THREE PHASES OF RISK ASSESSMENT:
Hazard Identification → Vulnerability Assessment → Risk Analysis**

Yamhill County conducted a vulnerability assessment for the flood hazard using Geographic Information Systems (GIS) to identify the geographic extent of the hazard and assess the land use and value at risk from the flood hazard. The vulnerability assessment for the earthquake hazard is addressed in part from FEMA’s HAZUS analysis model. Insufficient data exists to conduct vulnerability assessments and risk analyses for the other hazards addressed in the plan: landslides, severe winter storms, windstorms, drought and wildfires.

Regardless of the data available for risk assessments, there are numerous strategies the county can take to reduce risk. These strategies are described in the action items detailed in each hazard section of this Plan. Mitigation strategies can further reduce disruption to critical services, reduce the risk to human life, and alleviate damage to personal and public property and infrastructure. Action items throughout the

hazard sections provide recommendations to collect further data to map hazard locations and conduct hazard assessments.

Federal Requirements for Risk Assessment

Recent federal regulations for hazard mitigation plans outlined in 44 CFR Part 201 include a requirement for risk assessment.¹ This risk assessment requirement is intended to provide information that will help communities identify and prioritize mitigation activities that will reduce losses from the identified hazards. There are seven hazards profiled in the mitigation plan: floods, landslides, wildfires, earthquakes, winter storms, drought and windstorms. The Federal criteria for risk assessment and information on how the Yamhill County Natural Hazard Mitigation Plan meets those criteria is outlined in Table 3-2 below.

Table 3-2. Federal Criteria for Risk Assessment

Section 201 Requirement	How is this addressed?
Identifying Hazards	Each hazard section includes an inventory of the best available data sources that identify hazard areas. To the extent that GIS data are available, the county developed maps identifying the location of the hazard in the county. The Executive Summary and the Hazard Assessment sections of the plan include a list of the hazard maps.
Profiling Hazard Events	Each hazard section includes documentation of the history, and causes and characteristics of the hazard in the county.
Assessing Vulnerability: Identifying Assets	Where data is available, the vulnerability assessment for each hazard addressed in the mitigation plan includes an inventory of all publicly owned land within hazardous areas. Each hazard section provides information on vulnerable areas in the county in the Community Issues section. Each hazard section also identifies potential mitigation strategies.
Assessing Vulnerability: Estimating Potential Losses	The Hazard Assessment Section of this mitigation plan identifies key critical facilities and lifelines in the county and includes a map of these facilities. Vulnerability assessments have been completed for the hazards addressed in the plan, and quantitative estimates were made for each hazard where data was available.
Assessing Vulnerability: Analyzing Development Trends	The Yamhill County Community Profile Section of this plan provides a description of the development trends in the county, including the geography and environment, population and demographics, land use and development, housing and community development, employment and industry, and transportation and commuting patterns.

Critical Facilities and Infrastructure

Facilities critical to government response and recovery activities (i.e., life, safety and property and environmental protection) include: 911 centers, emergency operations centers, police and fire stations, public works facilities, sewer and water facilities, hospitals, bridges and roads, shelters, and shelters. Facilities that, if damaged, could cause serious

secondary impacts may also be considered “critical.” A hazardous material facility is one example of this type of critical facility. Critical facilities are those facilities that are vital to the continued delivery of key government services or that may significantly impact the public’s ability to recover from the emergency. These facilities may include: buildings such as the county jail, law enforcement center, public services building, community corrections center, the courthouse, and juvenile services building and other public facilities such as schools.

Summary

Natural hazard mitigation strategies can reduce the impacts concentrated at large employment and industrial centers, public infrastructure, and critical facilities. Natural hazard mitigation for industries and employers may include developing relationships with emergency management services and their employees before disaster strikes, and establishing mitigation strategies together. Collaboration among the public and private sector to create mitigation plans and actions can reduce the impacts of natural hazards.

ⁱ 44 CFR Ch.1, Section 201.4(c)(2).

Section 4:

Mitigation Plan Mission, Goals and Action Items

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Introduction

This section provides information on the process used to develop the mission, goals and action items addressed in the mitigation plan. It also describes the framework that focuses the plan on developing successful mitigation strategies. The framework is made up of three parts— Mission, Goals and Action Items:

- *Mission*— The mission statement is a philosophical or value statement that answers the question “Why develop a plan?” The mission statement provides the overarching direction for the natural hazards mitigation plan. In short, the mission states the purpose and defines the primary function of the Yamhill County Natural Hazards Mitigation Plan. The mission is an action-oriented statement of the plan’s reason to exist. It should be broad enough that it need not change unless the community environment changes.
- *Goals*—Goals are designed to drive actions and they are intended to represent the general end toward which the county effort is directed. Goals identify how the area intends to work toward mitigating risk from natural hazards. They should not specify how the community is to achieve the level of performance. The goals provide direction and a framework for the specific recommendations that are outlined in the action items.
- *Action Items*—The action items are detailed recommendations for activities that local departments, residents and others could engage in to reduce risk (See Section 5 for information on the plan’s action items).

Mission

The mission of the Yamhill County Natural Hazards Mitigation Action Plan is: *to reduce risk, prevent loss and protect life, property and the environment from natural hazard events through coordination and cooperation among public and private partners. This can be achieved by increasing public awareness, documenting the resources for risk reduction and loss-prevention, and identifying activities that will guide the county towards building a safer community.*

Mitigation Plan Goals

Mitigation plan goals are broad statements of direction that Yamhill County residents and public and private partners can take while working to reduce the county’s risk from natural hazards. These statements of direction form a bridge between the broad mission statement and particular action items.

Meetings with the project steering committee, stakeholder interviews, and an open house all served as methods to obtain input and priorities in developing goals for reducing risk and preventing loss from natural hazards in Yamhill County.

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

The plan goals help to guide the direction of future activities aimed at reducing risk and preventing loss from natural hazards. The goals listed here serve as checkpoints as agencies and organization begin implementing mitigation action items.

Goal #1: EMERGENCY OPERATIONS

Goal Statement: Coordinate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures and with various other agencies, as appropriate.

Goal #2: EDUCATION AND OUTREACH

Goal Statement: Develop and implement education and outreach programs to increase public awareness of the risks associated with natural hazards.

Goal #3: PARTNERSHIPS

Goal Statement: Develop effective partnerships with public and private sector organizations and significant agencies and businesses for future natural hazard mitigation efforts.

Goal #4: PREVENTIVE

Goal Statements:

- Develop and implement activities to protect human life, commerce, and property from natural hazards.
- Reduce losses and repetitive damage for chronic hazard events while promoting insurance coverage for catastrophic hazards.

Goal #5: NATURAL RESOURCES UTILIZATION

Goal Statement: Link natural resources management, land use planning, and watershed planning with natural hazard mitigation activities to protect natural systems and allow them to serve natural hazard mitigation functions.

Goal #6: IMPLEMENTATION

Goal Statement: Implement strategies to mitigate the effects of natural hazards.

Natural Hazard Mitigation Plan Action Items

Action items are detailed recommendations for mitigation the impacts of natural hazard events in Yamhill County. Action items are measurable steps towards achieving the plan's mission. The action

items are both hazard specific (e.g., strategies for flood mitigation, wildfire mitigation, landslide mitigation, etc.) and multi-hazard (i.e., cuts across all specific hazards).

Steering committee meetings identified and refined natural hazards mitigation plan action items. Information from stakeholder interviews also identified and refined action items. The action items outline both short- and long-term strategies to reduce the risk to Yamhill County from natural hazards. The action items are both hazard specific (i.e., strategies only for floods, wildfires, landslides, etc.) and multi-hazard (i.e., cuts across all specified hazards).

To facilitate implementation, each action item includes information on timeframe during which the action should occur, coordinating and partner organizations, ideas for implementation, and plan goals addressed.

It is important to note that it is not a requirement to perform cost-benefit analyses on the action items defined in the plan. The “ideas for implementation” found below each action item primarily emphasizes incorporating the actions of the mitigation plan into existing programs and other planning mechanisms such as land use and capital improvement plans where appropriate.

The activities or action items may be considered for funding through federal and state grant programs, and through the Federal Emergency Management Agency’s Hazard Mitigation Grant Program and Pre-Disaster Mitigation Competitive Grant Program, as funds are made available. Each action item addresses the following five elements to help ensure implementation of the activities:

1. Coordinating Organization
2. Partner Organization(s)
3. Timeline
4. Notes and Implementation Ideas
5. Plan Goals Addressed

The sections of this plan that address the six chronic hazards and the one catastrophic hazard include the action items pertaining to that specific natural hazard.

Coordinating Organization

The coordinating organization is the public agency with regulatory responsibility to address natural hazards, or one willing and able to organize resources, find appropriate funding, or oversee activity implementation, monitoring, and evaluation. Coordinating organizations may include local, county or regional groups that are in relative proximity to the county to facilitate implementation of activities and programs.

Partner Organizations

Partner organizations are agencies or public/private sector organizations that will assist the coordinating organizations in implementing action items by providing relevant resources. Partner organizations may include regional, state and federal agencies, as well as local and county public and private sector organizations. Partner organizations are potential partners recommended by the project steering committee, but not necessarily contacted during plan development. Partner organizations should be contacted by the coordinating organization to establish commitment of time and resources to activities. This initial contact is also to gain a commitment of time and or resources towards completion of the action items.

Internal Partners:

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

External Partners:

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

Timeline

Action items include both short- and long-term activities. Each action item includes an estimate of the timeline for implementation. *Short-term action items* (ST) are activities that county agencies are capable of implementing with existing resources and authorities within one to two years. *Long-term action items* (LT) may require new or additional resources or authorities and may take between one and five years to implement.

Ideas for Implementation:

Almost all action items include ideas for implementation and potential resources. This information offers a transition from theory to practice. The ideas for implementation serve as a starting point for this plan. This component of the action items is dynamic as some ideas may be not feasible and new ideas can be added during the plan maintenance process. (For more information on how this plan will be implemented and evaluated, see Section 5).

The action items are suggestions for ways to implement the plan goals only. Some of these items may prove to be unrealistic and other, more refined ideas may be identified and added to the plan. Ideas for implementation include things such as collaboration with relevant organizations; grant programs, human resources, education and outreach, research, and physical manipulation of buildings and infrastructure. A list of potential resources outlines what organization or agency will be most qualified and capable to perform the

implementation strategy. Potential resources often include utility companies, non-profits, schools, and other community organizations.

Plan Goals Addressed:

Each action item includes a list of the plan goals that the activity will address. Action items should be fact based and tied directly to issues or needs identified throughout the planning process. Action items can be developed from a number of sources including participants of the planning process, noted deficiencies in local capability, or issues identified through the risk assessment.

Public Participation

In addition to the Steering Committee meetings, an open house was held on April 20, 2005, to inform the public on Yamhill County Natural Hazards. The purpose of the open house was to gather comments and ideas from the residents of Yamhill County about natural hazards mitigation planning, to inform the public about natural hazards that occur in Yamhill County, and identify community priorities, and potential strategies for achieving these priorities.

A complete listing of input methods and public comment is located in *Appendix B: Public Participation Process*.

Meetings with the project steering committee, stakeholder interviews and the public open house all served as methods to obtain input and priorities in developing goals for reducing risk and preventing loss for natural hazards in Yamhill County.

Multi-Hazard Action Items (MH)

Multi-hazard action items are those activities that pertain to all seven hazards in the mitigation plan: flood, landslide, wildfire, severe winter storm, windstorm, drought and earthquake.

Multi-Hazard Action Item 1: Provide assistance to incorporated communities and special districts in developing natural hazards mitigation plans.

Ideas for Implementation:

- Develop workshops and outreach materials with Oregon Natural Hazards Workgroup (ONHW), Yamhill County Emergency Management, and Yamhill County Planning Division to assist in developing Natural Hazard Mitigation Plans for incorporated communities in Yamhill County.
- Assist the Mid-Willamette Valley Council of Governments in developing Natural Hazard Mitigation Plans for smaller cities in Yamhill County.
- Incorporate completed, approved mitigation plans with the Yamhill County Natural Hazard Mitigation Plan as Addenda.

Coordinating Organization: Emergency Management

Internal Partner: Planning Division
External Partner: Mid-Willamette Valley Council of Governments, city emergency management agencies, Red Cross, emergency response agencies, OEM, FEMA

Timeline: 1 to 2 years; on-going
Plan Goals Addressed: Emergency Operations; Education & Outreach; Partnerships; Preventive; Implementation

Multi-Hazard Action Item 2: Consider the goals and action items from the Yamhill County Natural Hazards Mitigation Plan for implementation in other county documents and programs, where appropriate.

Ideas for Implementation:

- Review the Natural Hazard Mitigation Plan for opportunities to update the County's Comprehensive Plan. Statewide Planning Goal 7 is designed to protect life and property from natural disasters and hazards through planning strategies;
- Consider how components of the County's Natural Hazards Mitigation Plan might be used in updating current and future capital improvement plans.

Coordinating Organization: Natural Hazard Mitigation Plan Steering Committee
Timeline: Annually, on-going
Plan Goals Addressed: Emergency Operations; Education & Outreach; Partnerships; Preventive; Natural Resources Utilization; Implementation

Multi-Hazard Action Item 3: Evaluate the effectiveness of existing programs and identify shortcomings in natural hazard mitigation. Balance the objectives of program goals with natural hazards mitigation.

Coordinating Organization: Steering Committee
Internal Partners: Planning Division; Public Works Department
Timeline: 1 to 3 years; on-going
Plan Goals Addressed: Preventive; Implementation

Multi-Hazard Action Item 4: Identify funding opportunities for developing and implementing local and county mitigation activities.

Ideas for Implementation:

- Develop incentives that encourage local governments, residents, and businesses to consider hazard mitigation projects;
- Consider funding sources that assist in completing mitigation projects when possible;
- Develop partnerships amongst organizations and agencies in Yamhill County, which identify grant programs and foundations that support mitigation activities.

Coordinating Organization: Steering Committee
 Internal Partner: Planning Department
 External Partners: OEM, FEMA, IISOI
 Timeline: 1 to 2 years
 Plan Goals Addressed: Emergency Operations; Education & Outreach; Partnerships; Preventive; Implementation

Multi-Hazard Action Item 5: Develop a process for the Yamhill County Natural Hazards Mitigation Plan Steering Committee to assist in implementing, monitoring, and evaluating county-wide mitigation activities.

Ideas for Implementation:

- Oversee implementation of the mitigation plan;
- Provide a mechanism to update and revise the mitigation plan;
- Monitor hazard mitigation implementation;
- Update the Natural Hazard Mitigation Action Plan with new information in accordance with Section 1.
- Conduct a review of the Natural Hazard Mitigation Plan at least every 5 years, evaluating mitigation successes, and area that were not addressed.

Coordinating Organization: Steering Committee
 Timeline: 1 year – upon adoption of the plan
 Plan Goals Addressed: Education & Outreach; Partnerships; Preventive; Implementation

Multi-Hazard Action Item 6: Determine the impact that each natural hazard could have on the priority transportation routes to and from emergency facilities and first responder sites.

Ideas for Implementation:

- Establish action measures to ensure that priority routes are given priority in resource utilization to ensure open access during hazard events.

Coordinating Organization: Emergency Management
Internal Partner: Sheriff's Office
External Partners: Fire and police departments, and other first responders
Timeline: On-going (every 5 years)
Plan Goals Addressed: Emergency Operations; Partnerships; Preventive; Implementation

Multi-Hazard Action Item 7: Identify collaborative programs that recognize ways to decrease the risks of natural hazards.

Ideas for Implementation:

- Distribute information about flood, fire, earthquake, and other forms of natural hazards to property owners in areas identified as high risk through hazard mapping.
- Educate individuals and businesses on the benefit of mitigation activities.
- Encourage communication and dissemination of natural hazard mitigation information.

Coordinating Organization: Emergency Management
Internal Partner: Planning Division
External Partner: Chambers of Commerce
Timeline: 1 to 2 years
Plan Goals Addressed: Emergency Operations; Education & Outreach; Partnerships; Preventive; Natural Resources Utilization; Implementation

Multi-Hazard Action Item 8: Develop public and private partnerships to foster natural hazard mitigation program coordination and collaboration in Yamhill County.

Ideas for Implementation:

- Coordinate with cities in Yamhill County and the Mid-Willamette Valley Council of Governments on development of Natural Hazard Mitigation Plans that are consistent with the goals and framework of the county plan.
- Identify all organizations within Yamhill County that have programs or interests in natural hazards mitigation planning.

- Involve private businesses throughout the county in mitigation planning.

Coordinating Organization: Emergency Management
 Internal Partner: Planning Division
 Timeline: On-going
 Plan Goals Addressed: Education & Outreach; Partnerships; Preventive; Implementation

Multi-Hazard Action Item 9: Develop GIS inventories of essential facilities, at-risk buildings and infrastructure and prioritize mitigation projects.

Ideas for Implementation:

- Identify critical facilities at risk from natural hazards events.
- Develop strategies to mitigate risk to these facilities, or to utilize alternative facilities should natural hazard events cause damage to the facilities in question.
- Identify bridges at risk from flood or earthquake hazards.
- Enhance evacuation route system capacities.

Coordinating Organization: Emergency Management
 Internal Partner: GIS, Planning and Public Works
 External Partner: ODOT, city planning and public works departments, utility companies, emergency response agencies, MWVCOG, ODF, BLM, USFS
 Timeline: 1 to 2 years; on-going
 Plan Goals Addressed: Education and Outreach, Partnerships, Preventive, Implementation

Multi-Hazard Action Item 10: Strengthen emergency services' preparedness and response by linking emergency services with natural hazard mitigation programs, and enhance public education on a regional scale.

Ideas for Implementation:

- Educate private property owners on limitations of infrastructure in an emergency.
- Encourage private property owners to upgrade private roadways to support weight of fire trucks and emergency vehicles and provide clearance for emergency vehicles.
- Encourage individual and family preparedness through public education projects.
- Encourage coordination of emergency transportation routes between the Yamhill County Sheriff's Office, Emergency Management, Yamhill County Public Works, city jurisdictions, and the ODOT.

- Identify partnership opportunities amongst citizens, residents, private contractors, and other jurisdictions, which increase availability of equipment and staffing for response efforts.
- Continue coordination with public officials on requirements for disaster assistance.

Coordinating Organization: Emergency Management
 Internal Partners: Planning and Public Works
 External Partners: Cities, ODOT
 Timeline: 3 to 5 years
 Plan Goals Addressed: Emergency Operations; Education & Outreach; Preventive

Multi-Hazard Action Item 11: Develop, enhance, and implement education programs aimed at mitigating natural hazards, and reducing the risk to citizens, public agencies, private property owners, businesses, and schools.

Ideas for Implementation:

- Develop a web page to facilitate information sharing.
- Develop outreach programs to Yamhill County business organizations emphasizing the need to prepare for natural hazard events.
- Develop adult and child Public Service Announcements geared for the community to be used by local radio and cable stations.

Education

- Coordinate with school programs and adult education on reducing risk and preventing loss from natural hazards through education.
- Conduct natural hazard awareness program outreach in schools and community centers.
- Conduct workshops for public and private sector organizations to raise awareness of mitigation activities and programs.
- Develop outreach materials for mitigation, preparedness, response and recovery.

Coordinating Organization: School Districts, facility safety personnel
 Internal Partners: Emergency Management, Planning and Building, Health Department
 External Partners: Emergency response agencies, Red Cross, MWVCOG, OEM, FEMA, media
 Timeline: On-going
 Plan Goals Addressed: Education & Outreach; Partnerships; Preventive; Implementation

Multi-Hazard Action Item 12: Sustain a public awareness campaign about natural hazards.

Ideas for Implementation:

- Inform and educate the public about potential natural hazards in Yamhill County, personal preparedness, mitigation activities and opportunities, and options available when natural hazard events occur. The public awareness campaign may take many forms, including, but not limited to the following:
 - Present hazard-specific information at public workshops;
 - Distribute preparedness and mitigation information at community fairs and events;
 - Maintain a natural hazard display at the County Historical Museum;
 - Use public service announcements to educate people about emergency procedures;
 - Survey the public to determine their level of preparedness and find out what deters them from taking preventive actions; and
 - Include in the county’s hazard information website scientific facts about natural hazards, information on building codes, lists of companies that provide insurance for specific hazards, and educational information on damage prevention.

Coordinating Organization: Emergency Management
Internal Partners: Public Works, Planning
External Partners: Cities, ODOT, emergency response agencies, CERT, MWVCOG, school districts, utility companies, media, FEMA, OEM
Timeline: On-going
Plan Goals Addressed: Education & Outreach; Partnerships; Preventive; Implementation

Multi-Hazard Action Item 13: Sustain an education and outreach program for local jurisdictions and assist them in developing emergency operations, public information and hazard mitigation plans.

Ideas for Implementation:

- Train local jurisdictions on regional emergency management policies and procedures;
- Help coordinate countywide emergency management training and exercises;
- Help local jurisdictions develop resources and establish emergency facilities;
- Inform local jurisdictions about available resources, grant opportunities and other assistance;
- Disseminate information from Oregon Emergency Management and the Federal Emergency Management Agency.

Coordinating Organization: Emergency Management
Internal Partner: Planning Division
External Partners: City emergency management agencies, Red Cross, emergency response agencies, MWVCOG, OEM, FEMA
Timeline: 1 to 2 years; on-going
Plan Goals Addressed: Emergency Operations; Education & Outreach; Partnerships; Preventive; Implementation

Multi-Hazard Action Item 14: Review and update the Yamhill County Emergency Operations Plan and the Natural Hazards Mitigation Plan on an annual basis. Conduct a complete review of the plans and have them officially promulgated by the Board of Commissioners every five years.

Ideas for Implementation:

- Coordinate plan updates annually and complete reviews at least every five years.
- During complete reviews, the plans will be evaluated with respect to the county's zoning ordinance and Comprehensive Plan, mutual aid agreements, and any new statutory requirements.

Coordinating Organization: Emergency Management
Internal Partner: Steering Committee, County Departments
External Partner: City emergency management agencies, law enforcement agencies, NWS, utility companies, OSP, ODOT, ARES, emergency response agencies, MWVCOG
Timeline: 1 to 5 years, on-going
Plan Goals Addressed: Emergency Operations; Education & Outreach; Partnerships; Preventive; Natural Resources Utilization; Implementation

Multi-Hazard Action Item 15: Make the Yamhill County Emergency Operations Plan and the Natural Hazards Mitigation Plan, and other resources on hazard planning/mitigation available to the public electronically.

Note: The World Wide Web makes electronic publication and distribution of information simple. Electronic publishing can foster dissemination of hazards-related information and raise public awareness of natural hazards.

Coordinating Organizations: Emergency Management & Planning
Internal Partner: County Webmaster
Timeline: 1 to 2 years
Plan Goals Addressed: Emergency Operations; Education & Outreach

Multi-Hazard Action Item 16: Promote hazard-resistant utility construction and maintenance methods.

Ideas for Implementation:

- Support/encourage utility and telecommunications companies to use construction and maintenance methods that reduce power outages from various natural hazards.
- Maintenance plans that take age, construction and placement of poles into account may help alleviate risk of power outage during natural hazard events.

Coordinating Organization: MWVCOG
Internal Partner: Emergency Management
External Partner: City emergency management agencies, ARES, utility companies
Timeline: 3 to 5 years
Plan Goals Addressed: Education & Outreach; Preventive; Natural Resources Utilization; Implementation

Multi-Hazard Action Item 17: Develop a system for data collection for non-declared natural hazard events.

Ideas for Implementation:

- Collect and store the damage information locally, and report to the National Climate Data Center.
- Include with this information countywide damage totals for each event. Over time, this data will show the geographic patterns of occurrence and vulnerability.

Coordinating Organization: Emergency Management
Internal Partner: GIS, Building
External Partner: IISOI, farm services, insurance companies
Timeline: 3 to 5 years

Plan Goals Addressed: Emergency Operations, Education & Outreach, Partnerships, Preventive; Implementation

Multi-Hazard Action Item 18: Improve coordination and evaluate technical and engineering gaps in response service for natural hazard events, and develop a long-term recovery plan for Yamhill County from the effects of natural hazards.

Ideas for Implementation:

- Identify how Yamhill County can coordinate with other entities after a seismic event, and identify what limitations exist that prevents coordinated event response.
- Where possible, develop mutual aid agreements for assistance after catastrophic natural hazard events.
- Within the long-term recovery plan, identify how and where Yamhill County communities would rebuild after a catastrophic event.
- Identify likely scenarios for rebuilding structures, transportation routes, and infrastructure conduits.

Coordinating Organization: Emergency Management
External Partners: Neighboring counties' emergency management, USGS, DOGAMI, hospitals, Red Cross, Army National Guard
Timeline: 1 to 5 years
Plan Goals Addressed: Emergency Operations, Partnerships

Natural systems are in a constant state of flux, which creates unpredictability where unforeseen and unplanned natural hazard events happen. The Yamhill County Natural Hazard Mitigation Plan, through the use of the above multi-hazard action items, would like to address any natural hazard outside of the seven identified hazards in this document as a *force majeure* ("Act of God").

It is Yamhill County's belief that all of the action items contained in this document, both hazard specific and multi-hazard, complement each other making our communities more prepared to cope with Natural Hazard events.

Section 5:

**Plan Implementation,
Maintenance, and Public
Participation**

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Overview

The plan implementation and maintenance section of this document details the formal process that will ensure that the Yamhill County Natural Hazards Mitigation Plan remains an active and relevant document. The plan maintenance process includes a schedule for monitoring and evaluating the plan annually and producing an updated plan every five years. This section also describes how Yamhill County will integrate public participation throughout the plan maintenance and implementation process. Finally, this section includes an explanation of how the county intends to incorporate the mitigation strategies outlined in this plan into existing planning mechanisms and programs such as the county's comprehensive land use planning process, capital improvement planning process, and building codes enforcement and implementation.

The plan's format allows Yamhill County to review and update sections when new data becomes available. New data can be easily incorporated, resulting in a natural hazards mitigation plan that remains current and relevant to Yamhill County. The benefits of a current and relevant natural hazards mitigation plan include:

- Keeping the public informed of and involved in the county's natural hazards mitigation efforts;
- Building community partnerships and collaboration between local/state/federal governments, local businesses, and private landowners;
- Opening a variety of funding sources and opportunities to the county; and
- Protecting lives, property, and critical resources from natural hazards.

Implementing the Plan

The Yamhill County Natural Hazards Mitigation Plan (NHMP) was developed and will be implemented through a collaborative process. After the Yamhill County Board of Commissioners adopts the plan via ordinance, the county's Emergency Manager will be responsible for submitting it to the State Hazard Mitigation Officer at Oregon Emergency Management (OEM). Oregon Emergency Management will then submit the plan to the Federal Emergency Management Agency (FEMA–Region X) for review. This review will address the federal criteria outlined in FEMA Interim Final Rule 44 CFR Part 201. Upon acceptance by FEMA, the county will gain eligibility for the Pre-Disaster Mitigation Grant Program, the Hazard Mitigation Grant Program funds, and Flood Mitigation Assistance program funds.

The Yamhill County Natural Hazards Mitigation Plan Steering Committee will meet periodically to focus efforts on implementing and maintaining the plan. The steering committee, however, will be condensed to a core team that will be directed to assist with

implementation and monitor progress of the plan. This coordinating group's role is described in detail later in this section. Yamhill County Emergency Management will serve as the convener of the condensed steering committee.

The effectiveness of the county's non-regulatory Natural Hazards Mitigation Plan will be contingent on the implementation of the plan and incorporation of the outlined action items into existing county plans, policies, and programs. The Yamhill County Natural Hazards Mitigation Plan includes a range of action items that, if implemented, would reduce loss from hazard events in Yamhill County. Together, the action items in the Yamhill County Natural Hazards Mitigation Plan provide the framework for activities that county departments can choose to implement over the next five years. The Hazard Mitigation Steering Committee has prioritized the plan's goals and identified actions, which will be implemented, as resources permit, through existing plans, policies, and programs.

Coordinating Body

Yamhill County Emergency Management will be the coordinating body for the mitigation plan.

To make the coordination and review of the Yamhill County Natural Hazards Mitigation Plan as broad and useful as possible, Yamhill County Emergency Management will engage additional stakeholders and other relevant hazard mitigation organizations and agencies to implement the identified action items.

Convener

Following a disaster event, Yamhill County Emergency Management briefs the Board of Commissioners.

The county has designated Yamhill County Emergency Management as the responsible agency for the implementation and maintenance of the plan. Emergency Management's joint convener shall be the county's Planning & Development Department.

Implementation Through Existing Programs

The Natural Hazards Mitigation Plan includes a range of action items that, when implemented, will reduce loss from hazard events in Yamhill County. Within the framework of the plan, FEMA requires the identification of existing programs that might be used to implement these action items. Yamhill County currently addresses statewide planning goals and legislative requirements through its comprehensive land use plan, capital improvement plan, mandated standards and building codes. To the extent possible, Yamhill County will work to incorporate the recommended mitigation action items into existing programs and procedures.

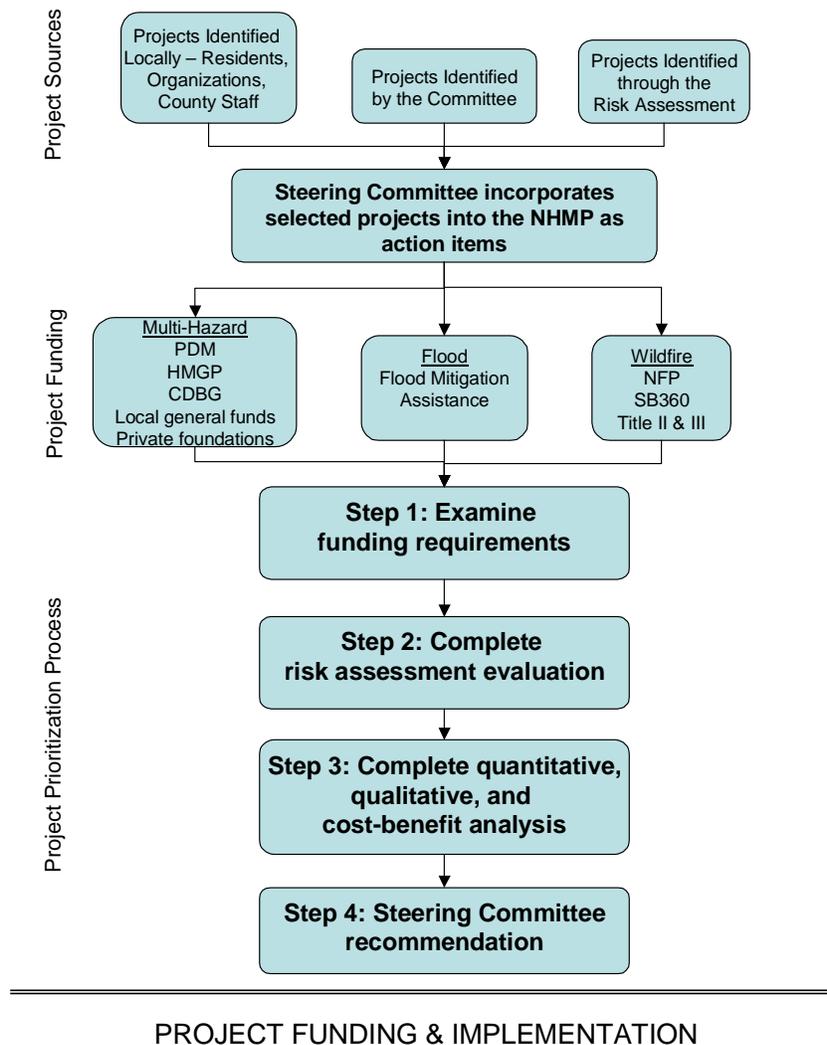
Project Prioritization Process

The requirements of the federal Disaster Mitigation Act of 2000 through FEMA's Pre-Disaster Mitigation Program state that the

natural hazards mitigation plan must identify a process for prioritizing potential actions. Potential mitigation activities often come from a variety of sources. Therefore, the project prioritization process requires flexibility. Examples of methods in which projects may be identified include: Natural Hazards Mitigation Plan Steering Committee members, local government staff, other planning documents, or the plan's Risk Assessment.

The Steering Committee will consider all proposed projects and select projects that align with the plan's goals. Such projects may then be incorporated into the plan as formal action items. Funding can then be considered for projects that have been formally incorporated into the plan. Depending on the potential project's intent and implementation methods, several funding sources may be appropriate. Examples of mitigation funding sources include but are not limited to: FEMA's Pre-Disaster Mitigation competitive grant program (PDM), Flood Mitigation Assistance (FMA) program, National Fire Plan (NFP), Title II and Title III funds, Community Development Block Grants (CDBG), local general funds, and private foundations, among others. The prioritization process utilizes a four-step process to prioritize activities to help ensure that mitigation dollars are used in a cost effective manner. Figure 5.1 illustrates the project prioritization process.

Figure 5.1: Project Prioritization Process Overview



Source: Community Service Center’s Oregon Natural Hazards Workgroup at the University of Oregon, 2005

Economic Analysis of Mitigation Projects

The Federal Emergency Management Agency’s methods of identifying the costs and benefits associated with natural hazard mitigation strategies, measures, or projects fall into two general categories: benefit/cost analysis and cost-effectiveness analysis. 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. Cost-effectiveness analysis evaluates how best to spend a given amount of money to achieve a specific goal. Determining the economic feasibility of mitigating natural hazards 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.

Yamhill County Emergency Management and the county's Planning & Development Department will use FEMA-approved benefit/cost methodology as a tool for identifying and prioritizing mitigation action items when applying for federal mitigation funding. For other projects and funding sources, Emergency Management and Planning will use other approaches to understand the costs and benefits of each action item and develop a prioritized list. For more information regarding economic analysis of mitigation action items, see Appendix C.

Methodology for Prioritizing Plan Action Items

To initially prioritize the plan's action items, Yamhill County prioritized the plan goals. The Natural Hazards Mitigation Plan Steering Committee decided to not prioritize the community hazards because of the belief that reprioritization would be an on-going exercise.

The county's prioritized list of action items serves simply as a starting point for the implementation of mitigation activities; it does not dictate the order of implementation.

The Natural Hazards Mitigation Plan Steering Committee and the Yamhill County Board of Commissioners have the option to implement any of the action items at any time, regardless of the prioritized order. This allows the committee to consider mitigation strategies as new opportunities arise, such as funding for action items that may not be of highest priority. This methodology used by the Natural Hazards Mitigation Plan Steering Committee to initially prioritize the plan's goals and action items will also be used by the Yamhill County Emergency Management Division of the county Sheriff's Office to maintain the list.

Yamhill County Emergency Management will convene a committee to review the issues surrounding grant applications and shared knowledge and/or resources. This process will afford greater coordination and less competition for limited funds.

Step 1: Prioritizing Plan Goals

To accomplish this task, the Natural Hazards Mitigation Plan Steering Committee examined and voted on the importance of each of the plan's seven goals. The steering committee determined the relative priority of each goal. Steering committee members prioritized the goals from highest to lowest, thereby ranking the importance of each goal in making Yamhill County more disaster resilient.

The steering committee was reminded that goals are designed to drive actions and that they are intended to represent the general end toward which the county's efforts are directed. They do not specify how the county is to achieve the level of performance. They are the guiding principles for the specific recommendations that are outlined in the action items. The steering committee ranked the goals regardless of how each goal would be accomplished. After the vote, their priorities were tallied and the results are as follows:

1. Develop and implement activities to protect human life, commerce, and property from natural hazards.
2. Coordinate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures and with various other agencies, as appropriate.
3. Develop and implement education and outreach programs to increase public awareness of the risks associated with natural hazards.
4. Develop effective partnerships with public and private sector organizations and significant agencies and businesses for future natural hazard mitigation efforts.
5. Reduce losses and repetitive damage for chronic hazard events while promoting insurance coverage for catastrophic hazards.
6. Link natural resources management, land use planning, and watershed planning with natural hazard mitigation activities to protect natural systems and allow them to serve natural hazard mitigation functions.
7. Implement strategies to mitigate the effects of natural hazards.

Each action item in the plan is associated with one or more of these goals.

Step 2: Prioritizing and Implementing Action Items

The Natural Hazards Mitigation Plan Steering Committee and Yamhill County Emergency Management will consider action items for implementation based on the following information:

1. The prioritized Natural Hazards Mitigation Plan goals. Does the action item address a highly prioritized goal? Does it address multiple goals?
2. The degree of risk from the hazard. Does the action item address a high-risk hazard? Does it address multiple hazards?

The Steering Committee will determine whether or not the plan's Risk Assessment supports the implementation of the action item i.e., mitigation activity. This determination will be based on the location of the potential activity and the proximity to known hazard areas, historic hazard occurrence, and the probability of future occurrence.

Yamhill County's Emergency Management will review, guide and promote the implementation of action items. In examining the feasibility of the plan's prioritized action items, benefit/cost analysis would be encouraged for all structural mitigation projects. For FEMA-funded, nonstructural projects or projects funded through entities other than FEMA, a qualitative assessment will be completed to determine the project's cost effectiveness. See Appendix C for more information on this process.

Step 3: Steering Committee Recommendation

Based on the steps above, the Steering Committee will recommend whether or not the mitigation activity should move forward. If the Steering Committee decides to sanction the action, Emergency Management would contact the coordinating organization designated for the activity to proceed and to document success upon project completion.

Plan Maintenance: Evaluating and Updating the Plan

Plan maintenance is a critical component of the natural hazards mitigation plan. Proper maintenance of the plan will ensure that this plan will benefit Yamhill County's efforts to reduce the risks posed by natural hazards. The University of Oregon's Oregon Natural Hazards Workgroup developed the following 'plan maintenance' section, which presents a process to ensure that a regular review and update of the plan occurs. The condensed Natural Hazards Mitigation Plan Steering Committee and local staff will be responsible implementing this process in addition to maintaining and updating the plan through a series of meetings outlined in the plan review meeting schedule shown in Table 5.2. As of September 23, 2005, the Steering Committee approved this process.

Table 5.2: Plan Review Meeting Schedule

Semi-Annual Meeting	Annual Review Meeting	Five-Year Review
Review Current Actions	Update Risk Assessment data and findings based on new data	Review plan update questions
Identify New Issues and Needs	Discussion of methods of continued public involvement	Update plan sections as necessary
Prioritize Potential Projects	Documenting successes and lessons learned	

Semi-Annual Meeting

The condensed Steering Committee will meet on a semi-annual basis to:

- Review existing action items to determine appropriateness for funding;
- Identify issues that may not have been identified when the plan was developed; and
- Prioritize potential mitigation projects using the methodology described below.

The convener will be responsible for documenting the outcome of the semi-annual meetings. The process the Steering Committee will use to

prioritize mitigation projects is detailed in the 'Project Prioritization Process' section, above.

Annual Review Meeting

The Steering Committee will meet annually to review updates of the Risk Assessment data and findings, discuss methods of continued public involvement, and document successes and lessons learned based on actions that were accomplished during the past year. The co-convenor will be responsible for documenting the outcomes of the annual meeting.

Five-Year Review of Plan

This plan will be updated every five years in accordance with the update schedule outlined in the Disaster Mitigation Act of 2000. During the five-year plan update, the following questions should be asked to determine what actions are necessary to update the plan. The co-conveners will be responsible for convening the Steering Committee to address the questions outlined below.

- Are the plan goals still applicable?
- Do the plan's priorities align with state priorities?
- Are there new partners that should be brought to the table?
- Are there new local, regional, state, or federal policies influencing natural hazards that should be addressed?
- Has the community successfully implemented any mitigation activities since the plan was last updated?
- Have new issues or problems related to hazards been identified in the community?
- Do existing actions need to be reprioritized for implementation?
- Are the actions still appropriate given current resources?
- Have there been any changes in development patterns that could influence the effects of hazards?
- Have there been any significant changes in the community's demographics that could influence the effects of hazards?
- Are there new studies or data available that would enhance the risk assessment?
- Has the community been affected by any disasters? Did the plan accurately address the impacts of this event?

These questions will help the Steering Committee determine what components of the mitigation plan need updating. The Yamhill County Emergency Management staff will be responsible for updating any deficiencies found in the plan based on the questions listed above.

Formal Review Process

Yamhill County has developed a method to ensure that a regular review and update of the Yamhill County Natural Hazards Mitigation Plan occurs. Yamhill County Emergency Management is responsible for monitoring and evaluating the progress of the mitigation strategy in the plan. Emergency Management will also organize plan review meetings on a regular basis. It is anticipated that Emergency Management would hold four to six meetings annually.

At the plan review meetings, the condensed steering committee would review the mission and goals to determine their relevance to changing situations in the community, as well as changes in state or federal policy, and to ensure they continue to address current and expected conditions. The plan review meetings would also include periodic review of the risk assessment portion of the plan to determine whether this information should be updated or modified. This review process would be conveyed to other interested parties via newsletters, presentations, and the media.

Emergency Management is the responsible party for incorporating the changes and updates to the plan. On an annual basis, Emergency Management will present to the county Board of Commissioners updated drafts of the plan ready for adoption or amendment to the existing plan. Upon adoption by the Board of Commissioners, the updated plan would then be submitted to the Oregon State Police – Office of Emergency Management (OEM) and to FEMA.

Following a disaster event, Yamhill County Emergency Management briefs the Board of Commissioners.

Continued Public Involvement

Yamhill County is dedicated to involving the public directly in the continual reshaping and updating of the Natural Hazards Mitigation Plan. Although members of the Natural Hazards Mitigation Plan Steering Committee represent the public to some extent, the public will have the opportunity to provide feedback about the plan.

During plan development, public participation was incorporated into every stage of the plan development process.

A public meeting will be held for each annual evaluation when deemed necessary by the Yamhill County Emergency Management Coordinator. The meetings will provide a public forum for expressing concerns, opinions, or ideas about the plan. The Emergency Management Division of the Yamhill County Sheriff's Office will be responsible for publicizing public meetings and maintaining public involvement.

Section 6:
Flood

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Why are Floods a Threat to Yamhill County?

In addition to the Willamette River, Yamhill County contains two other large rivers (North and South Yamhill Rivers) and smaller tributaries that are susceptible to annual flooding events. Flooding poses a threat to life and safety, and can cause severe damage to public and private property.

The county's most devastating floods of recent history occurred in 1996. In February 1996, prolonged precipitation accompanied by an early snowmelt caused many rivers and creeks throughout the Willamette River watershed to rise to 100-year flood levels. The Willamette River and many of its tributaries were filled beyond capacity, causing flooding in both rural and urban areas.

The 1996 floods caused a statewide loss of over \$280 million in damages, as 26 major rivers rose to flood stage. More than 100 Red Cross and Salvation Army shelters were opened, and 23,000 residents fled their homes. Seven casualties were reported, and 50 people were injured. An estimated 1,700 Oregonians lost their jobs due to flooding, and the Small Business Association (SBA) loaned Oregon businesses over \$40.5 million to assist with recovery efforts.¹

Although this flood was a large-scale disaster, it was not unprecedented. During the Christmas Flood of 1964, over \$157 million in damage was done, and 20 Oregonians lost their lives.²

Residents in Yamhill County share a statewide concern about flood issues. According to the NFIP, Oregon has 256 flood-prone communities within the 36 counties of the State. Although all of the counties in the State are vulnerable to flooding events, the risk of loss is much more pronounced in some counties than others.

History of Flooding in Yamhill County

The Willamette River basin has a long history of flooding. Many mid-Willamette Valley residents may be familiar with the legendary floods of the 19th Century. The largest flood on record on the Willamette occurred in 1861. It is difficult to know for sure because there were no measurements of volume taken at that time.

In January 1880, busy river port and site for the main shops and the turntables of the Willamette Valley Railroad Co.'s narrow-gauge Dayton-Sheridan track, was devastated by flood and fire.³ The January 1880 high water badly damaged the Yamhill River Bridge and washed out railroad tracks, and then fire destroyed the town's first flourmill, "a fine, eight-story structure."⁴

Since the 19th century, however, the construction of flood control dams in the 1940s and 1950s has changed the pattern of flooding significantly. Yamhill County has seen four major floods and three lesser floods during the last 40 years. The largest floods in the past century occurred in December 1955, December 1964, January 1965, January 1972, November

1973, January 1974, and January 1996. One of the most memorable floods during this time period, the “Christmas” flood of 1964, was rated “approximately a 100 year flood” by FEMA and was probably the most damaging in Oregon’s history.⁵

December 1964 - January 1965

The “Christmas” flood of 1964 was the largest flood to occur subsequent to major dam construction on the upper Willamette (1940s-50s). This flood occurred as a result of two storms, one on December 19, 1964 and the other on January 31, 1965. These storms brought record-breaking rainfall that exacerbated near record, early season low-elevation snow. The December 1964 flood peaked at 47,200 cubic feet per second (cfs) at Whiteson – 25 percent more than the previous highest recorded flow of January 1972. The 1996 flood was similar and peaked at about 47,000 cfs.⁶ The 1964 flood was equivalent to a 75-year event on the South Yamhill River near Whiteson.

The flooding caused ten deaths, \$5 million dollars of damage to State bridges and millions of dollars of damage in Yamhill County.⁷ There were hundreds of landslides, bridges and roads washed out, houses were damaged or destroyed, and thousands of people were forced to evacuate their homes. Governor Mark Hatfield declared the entire State an emergency disaster area, and called the flooding, “the worst disaster ever to hit the state.”⁸

January 1974

Heavy snow and freezing rain and a series of mild storms caused snowmelt and rapid runoff. The storms resulted in two fatalities and 13 injuries in Oregon.⁹ Nine counties in Oregon were declared disaster areas, and damages statewide exceeded \$65 million. Although not as hard hit as other counties, the Yamhill County Road Department applied a five-ton limit to all county and market roads.¹⁰

There were several county road closures due to slides and high water.¹¹ Some roads in the Sheridan/Willamina area were reported closed by slides, and the Wheatland ferry suspended operations due to high water.¹² Willamina and Grand Ronde schools were closed on January 15, 1974, because of high water and rain caused roads to be too soft to be safe for school buses.¹³

In several communities along the Willamette River, wastewater treatment plants exceeded capacity resulting in millions of gallons of raw sewage being discharged into the Willamette River.¹⁴

February 1986

This flood caused by a combination of heavy rains and snowmelt caused the Willamette River to crest at just over twenty-nine feet and within ten inches of flooding. Numerous homes flooded and highways closed.

February 1996

Residents of Yamhill County experienced more than one flood during 1996. During the period of February 5 through 9 of 1996, a combination of a deep snow pack, warm temperatures, and record-breaking rains caused streams

to rise to all-time flood record levels.¹⁵ River flood states were comparable in magnitude to the December 1964 flood, the largest in Oregon since flood control reservoirs were built in the 1940s and 1950s. The South Yamhill River at Whiteson crested at 47.5 feet on February 9th, three-tenths higher than the 1964 flood. Flood state for the South Yamhill River is 38 feet.¹⁶ Statewide there were seven flood related deaths¹⁷ and 150 people were evacuated from their homes.¹⁸

The City of Carlton's wastewater treatment facility overflowed into the North Yamhill River.¹⁹ The community of Grand Island was completely engulfed by the Willamette River's floodwaters.²⁰ Total damages within Yamhill County were approximately \$4.35 million.²¹

November 1996

Months after the flood of February 1996, Yamhill County experienced high water again. November 18-20, 1996, brought with it more flooding to county residents and added damage from the year's previous flood. Like February's storm, the "pineapple express," a weather system that draws large amounts of moisture from an area near Hawaii and deposits it on the West Coast, caused the heavy rain.²²

Damage from the 1996 flooding cost McMinnville's Park and Recreation Department \$57,000 to repair park roads, rebuild ball fields, and replace bleachers at Joe Dancer Park alone.

Rural areas of the county were also hit hard by November's deluge.

January 1997

This January storm was rooted in the last days of December 1996. Heavy rains once again caused flooding throughout the county. The Willamette River crested at twenty-nine feet, one foot above flood level. The South Yamhill River at McMinnville crested on January 1, 1997 at 55 feet – flood stage is 50 feet. Five thousand Mid-Willamette Valley residents lost power as high winds that accompanied the rain blew down power lines.

Repetitive Flood Losses in Yamhill County

The properties in and near the floodplains of Yamhill County are subject to flooding events almost annually. Since flooding is such a pervasive problem throughout the county, many residents have purchased flood insurance to help recover from losses incurred from flooding events. Flood insurance covers only the improved land, or the actual building structure. Although flood insurance assists in recovery, it can provide an inappropriate sense of protection from flooding. Many residents who have had flood damage rebuild in the same vulnerable areas, only to be flooded again. These properties are termed *repetitive loss* properties, and are very troublesome because they continue to expose lives and valuable property to the flooding hazard. Local governments as well as federal agencies such as FEMA recognize this pitfall in floodplain insurance, and attempt to remove the risk from repetitive loss of properties through projects such as acquiring land and relocating homes, or by elevating structures.

Continued repetitive loss claims from flood events lead to an increased amount of damage caused by floods, higher insurance rates, and contribute to the rising cost of taxpayer funded disaster relief for flood victims.²³

What Factors Create Flood Risk

Flooding occurs when climate (or weather patterns), geology, and hydrology combine to create conditions where water flows outside of its usual course. In Yamhill County, geography and climate combine to create seasonal flooding conditions.

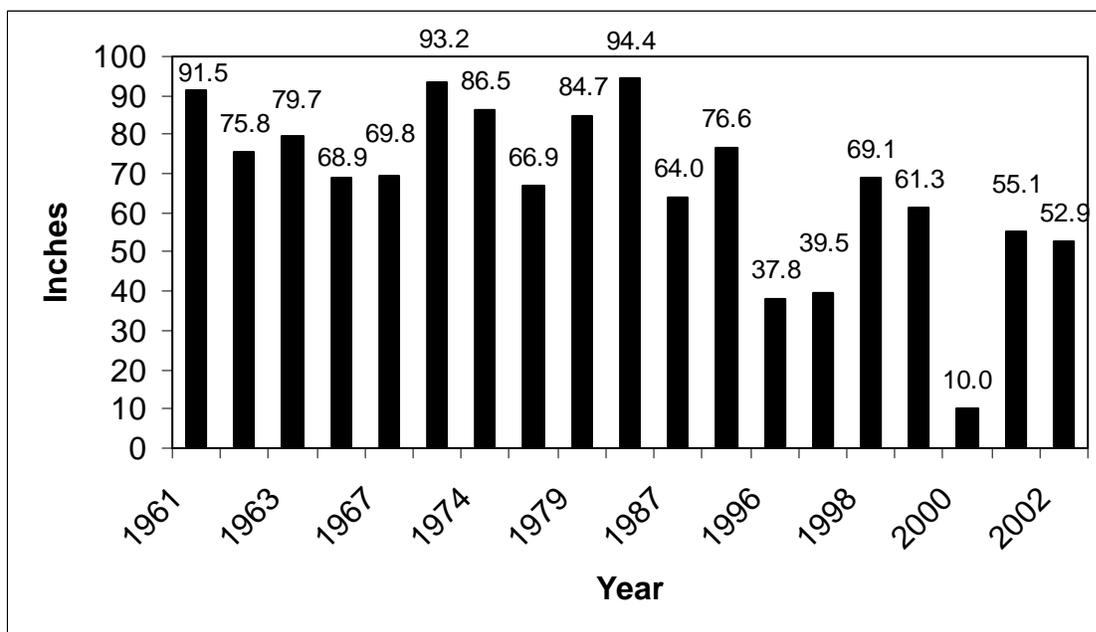
Precipitation

Because Yamhill County spans a wide range of climatic and geologic regions, there is considerable variation in precipitation, with elevation being the largest factor in precipitation totals. Elevation in Yamhill County ranges from approximately 3,423 feet at Trask Mountain in northwest Yamhill County to about 60 feet along the Willamette River in northeast Yamhill County. Correspondingly, the average monthly precipitation ranges from approximately fourteen inches in the highest elevations to approximately five inches in lower elevation areas of the County.²⁴

The amount of precipitation is not the only factor that influences peak flows. They are also influenced by withdrawals for irrigation and drinking water, stream and wetland modifications, changes in land use and water-related technology, and the removal of vegetation.²⁵ These factors not only affect the amount of water present in streams but also the rate of release of water into streams during a storm.

Flooding is most common from October through April, when storms from the Pacific Ocean, 60 miles away, bring intense rainfall to the area.²⁶ Yamhill County receives approximately 40.68 inches of rain on average each year²⁷ (see Figure 6.1). During winter months, rainfall totals average far higher than other months of the year. This results in high water, particularly in December and January. The larger floods are the result of heavy rains of two-day to five-day durations augmented by snowmelt at a time when the soil is near saturation from previous rains. Frozen topsoil also contributes to the frequency of floods.²⁸

Figure 6.1 Annual Precipitation, Yamhill County, Oregon, 1961-2002



Source: Oregon Climate Service

Data missing for the following incomplete years: 1964-1965, 1968-1971, 1973-1979, 1987, 1990, 1992-1994 – McMinnville station.

Geography

Yamhill County is within the Willamette River basin in the northwestern Willamette Valley. Yamhill County lies east of the Coast Range and west of the Willamette River. Generally, weather patterns move in a west to east direction. As such, most air masses that reach Yamhill County have moved for several days over the Pacific Ocean. When the air masses rise over the Coastal Range, they cool and become over saturated. The Coast Range and the Cascades to the east protect counties in the Willamette Valley. The Coast Range provides a buffer from eastward moving coastal storms and the Cascades shield the Willamette Valley from great masses of continental air moving westward that cause extreme temperatures east of the Cascades.²⁹

Soils

There are thirteen soil associations in Yamhill County ranging from well-drained silty loam soils to poorly drained silty clay loam soils and clay. In-depth information on the soils and their characteristics and locations can be found in the *Soil Survey of Yamhill County Area*.³⁰ In areas near the Willamette River, soils are often formed in alluvial and lacustrine materials that are prone to flooding in many places.³¹

Floodplain Terminology

Floodplain

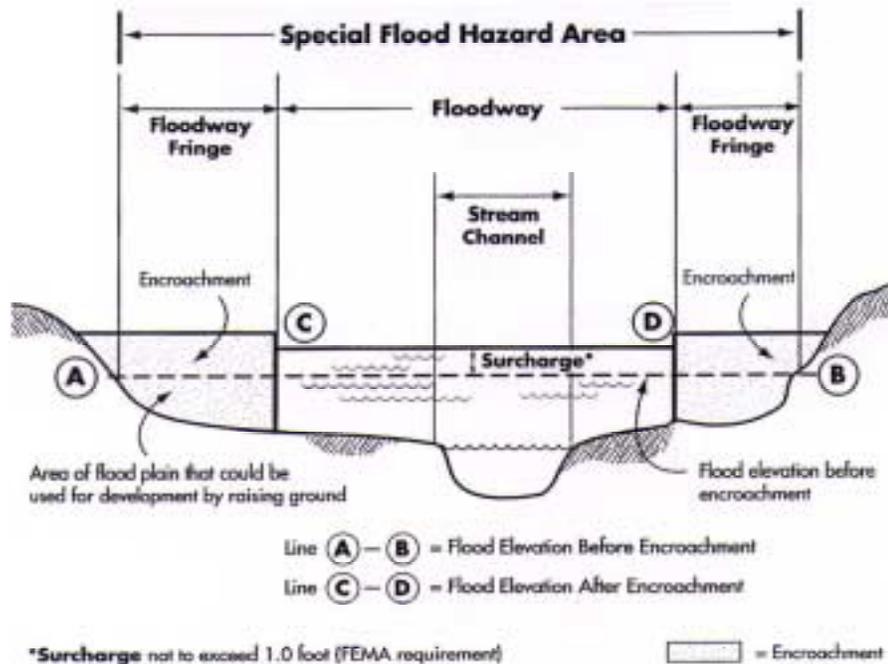
A floodplain is a land area adjacent to a stream, lake, tidal estuary or other water body that is subject to flooding. See Figure 6.2. This area, if left undisturbed, acts to store excess floodwater. The floodplain is made up of two sections: the floodway and the flood fringe.

Floodway

The floodway is one of two main sections that make up the floodplain. Unlike floodplains, floodways do not reflect a recognizable geologic feature and are defined for regulatory purposes by the National Flood Insurance Program, or NFIP, as “the channel of a river or other watercourse and adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot”.

The floodway carries the bulk of the floodwater downstream and is usually the area where water velocities and forces are the greatest. NFIP regulations require that the floodway be kept open and free from development or other structures that would obstruct or divert flood flows onto other properties. Floodways are not mapped for all rivers and streams but are generally mapped in developed areas.

Figure 6.2. Floodplain Schematic



Source: Floodplain Management in Missouri. (March 1999) Missouri Emergency Management Agency

Flood Fringe

The flood fringe refers to the outer portions of the floodplain, beginning at the edge of the floodway and continuing outward. The flood fringe is subject to periodic inundation from flooding. This is the area where development is most likely to occur, and where precautions to protect life and property need to be taken. The Yamhill County Zoning Ordinance Section 901 details procedures for development within the floodplain. Development may be permitted in the flood fringe if it satisfies certain conditions and requirements regarding the height of the structure's main floor above floodwaters, 'flood proofing' construction, displacement of floodwaters, and similar matters. Placement of dwellings in the floodway is prohibited in Yamhill County. (Zoning Ordinance Section 901.09).

Base Flood Elevation (BFE)

The term "Base Flood Elevation" refers to the height of the base flood, usually in feet, in relation to the National Geodetic Vertical Datum of 1929, the North American Vertical Datum of 1988, or other datum referenced in the Flood Insurance Study report, or average depth of the base flood, usually in feet, above the ground surface.³² The ten-year (or one-percent) flood is sometimes referred to as 'base flood' or the 'regional flood', however, base flood elevations can be set at levels other than the 100-year flood. Yamhill County defines its Base Flood Level as "the level of which [a flood] has a one percent change of being equaled or exceeded in any given year. Commonly referred to as a 100-year flood."³³

Some communities choose to use higher frequency flood events as their base flood elevation for certain activities, while using lower frequency events for others. For example, for the purpose of stormwater management, a 25-year flood event might serve as the base flood elevation, while the 500-year flood event may serve as base flood elevation for the tie down of manufactured homes. The regulations of the NFIP focus on development in the 100-year floodplain.³⁴

Characteristics of Flooding in Yamhill County

Two types of flooding primarily affect Yamhill County: *urban* flooding and *riverine* flooding (see descriptions below). In addition, any low-lying area has the potential to flood. The flooding of developed areas may occur when the amount of water generated from rainfall and runoff exceeds a stormwater system's (ditch or sewer) capability to remove it.³⁵

Urban Flooding

As land is converted from fields or woodlands to roads and parking lots, it loses its ability to absorb rainfall. Urbanization of the watershed changes the hydrologic systems of the basin. Heavy rainfall collects and flows faster on impervious concrete and asphalt surfaces. The water moves from the clouds, to the ground, and into streams at a much faster rate in urban areas than in rural or less developed areas. Adding these elements to the hydrological system can result in floodwaters that rise very rapidly and peak with violent force.

Most urban areas have a high concentration of impermeable surfaces that either collect water, or concentrate the flow of water into unnatural channels. During periods of urban flooding, streets can become swift moving rivers and basements can fill with water. Storm drains often back up with vegetative debris (i.e., yard waste), causing additional flooding.

Riverine Flooding

Riverine flooding is the over-bank flooding of rivers and streams, and is the most common flood hazard in Oregon. The natural processes of riverine flooding add sediment and nutrients to fertile floodplain areas. Flooding in large river systems typically results from large-scale weather systems that generate prolonged rainfall over a wide geographic area, causing flooding in hundreds of smaller streams, which then drain into the major rivers.³⁶

Examples of riverine flooding events are the flooding in February 1996 and December 1964 and January 1965.

Shallow area flooding is a special type of riverine flooding. FEMA defines shallow flood hazards as areas that are inundated by the 100-year flood with flood depths of only one to three feet. These areas are generally flooded by low velocity sheet flows of water.

What is the Effect of Development on Floods?

When structures or fill are placed in the floodway, water is displaced. Development raises the base flood elevation by forcing the river to compensate for the flow space obstructed by the inserted structures and/or fill. When structures or materials are added to the floodway, and no fill is removed to compensate, serious problems can arise. Floodwaters may expand beyond historic floodplain areas. As a result, other existing floodplain areas may experience floodwaters that rise above historic levels.

Local governments must manage development in floodplains and floodways to assure that any encroachments in the floodway or floodplain are minimized. This can be accomplished by cut-and-fill balance and other methods to prevent the rise of pre-development flood levels. Displacement of only a few inches of water can mean the difference between no structural damage occurring in a given flood event, and the inundation of many homes, businesses, and other facilities. Careful attention must be paid to development that occurs within the floodway to ensure that structures are prepared to withstand base flood events without exacerbating flood levels.

How Are Flood-Prone Areas Identified?

Flood maps and flood insurance studies are often used to identify flood-prone areas. The National Flood Insurance Program (NFIP) was established in 1968 as a means of providing low-cost flood insurance to the nation's flood-prone communities. The NFIP also reduces flood losses by requiring regulations that focus on building codes and "sound floodplain management."³⁷ In Yamhill County, the NFIP and related building code regulations are in effect. NFIP regulations (44 Code of Federal Regulations (CFR) Chapter 1, Section 60.3) require that all new construction in floodplains must be elevated at or above base flood level. The Oregon

Building Code requires new construction to be elevated to one foot above the base flood elevation.

Communities participating in the NFIP may adopt regulations that are more stringent than those contained in 44 CFR 60.3, but not less stringent.³⁸ In Yamhill County, all homes and other buildings legally constructed in the floodplain after January 1974 must be mitigated to NFIP standards with the first floor being elevated at least one foot above base flood level, or in the case of non-residential buildings, flood proofed to at least one foot above the base flood level.

FIRM Maps and Flood Insurance Studies

Floodplain maps are the basis for implementing floodplain regulations and for delineating flood insurance purchase requirements. A Flood Insurance Rate Map (FIRM) is the official map produced by the Federal Emergency Management Agency (FEMA), which delineates Special Flood Hazard Areas or floodplains where National Flood Insurance Program regulations apply. The FEMA map is a Flood Hazard boundary map that indicates flood-prone areas. A structure's risk is based on the elevation of its lowest floor. The maps are also used by insurance agents and mortgage lenders to determine if flood insurance is required and what insurance rates should apply.

Water surface elevations are combined with topographic data to develop FIRMs. These maps illustrate areas that would be inundated during a 100-year flood, floodway areas, and elevations marking the 100-year-flood level. In some cases, they also include base flood elevations (BFEs) and areas located within the 500-year floodplain.

Flood Insurance Studies and FIRMs produced for the National Flood Insurance Program (NFIP) provide assessments of the probability of flooding at a given location. FEMA conducted many Flood Insurance Studies in the late 1970s and early 1980s. FEMA flood maps are not entirely accurate. These studies and maps represent flood risk at the point in time when FEMA completed the studies, and do not incorporate planning for floodplain changes in the future due to new development. Although FEMA is considering changing that policy, it is optional for local communities. It should be noted that artificial and natural changes to the environment have changed the course of many of the streams and rivers in Yamhill County, as well as their associated floodplain boundaries.³⁹

Flood Mapping Methods and Techniques

Although many communities rely exclusively on FIRM's to characterize the risk of flooding in their area, there are some flood-prone areas that are not mapped but remain susceptible to flooding. These areas include locations next to small creeks, local drainage areas, and areas susceptible to artificial flooding.

By looking at historic stream flow records it is possible to estimate likely flood recurrence and frequency. This presents the probability of a given flood level occurring in a given year. It is not, however, a forecast. For example, a 100-year flood has a one in 100 chance of occurring in any given year.

Flow records are essential for establishing accurate local probabilities. Some flow records in Oregon date back about 100 years. Most areas have a much shorter record to examine, though. Models have been developed to examine the relationship between precipitation and various land uses to predict flood recurrence levels without actual flow data; however, they are not commonly used. Even in areas where flow records exist, predicting floods is difficult.

The state climatologic service examines weather trends for Oregon and believes the state has a 20-year wet and 20-year dry cycle. The significance of this for flood information is that data collected from a stream for the past 30-year period may contain 20 years of relatively dry conditions, and flood predictions would be different from data collected during a 20-year wet period.

Sources of error in determining flood levels:

1. The length of time records have been kept is significant because of long-term cycles and gradual changes over time. For a record-keeping period of 25 years, there is an 85 percent confidence level that the statistics will accurately represent expected flood levels.
2. Conditions in the watershed may change over time. For example, increasing urbanization tends to increase impervious surfaces and the intensity of flooding for the same amount of rain. This means the mapped 100-year floodplain may be out of date.

In order to address lack of data, many jurisdictions have taken efforts to develop more localized flood hazard maps. One method that has been employed includes using high-water marks from flood events or aerial photos, in conjunction with the FEMA maps, to better reflect the true flood risk.

The use of GIS (Geographic Information System) is becoming an important tool for flood hazard mapping. FIRM maps can be imported directly into GIS, which allows for GIS analysis of flood hazard areas. Communities find it particularly useful to overlay flood hazard areas on tax assessment parcel maps. This allows a community to evaluate the flood hazard risk for a specific parcel during review of a development request. Coordination between FEMA and local planning jurisdictions is the key to making a strong connection with GIS technology for the purpose of flood hazard mapping.

FEMA and the Environmental Systems Research Institute (ESRI), a private company, have formed a partnership to provide multi-hazard maps and information to the public via the Internet. ESRI produces GIS software, including ArcView® and ArcInfo®. The ESRI web site contains information on GIS technology and downloadable maps. The hazards maps provided on the ESRI site are intended to assist communities in evaluating geographic information about natural hazards. Flood information for most Oregon communities is available on the ESRI web site. Visit <http://www.esri.com> for more information.

Flood Hazard Assessment

Hazard Identification

Hazard identification is the first phase of flood-hazard assessment. Identification is the process of estimating: (1) the geographic extent of the floodplain i.e., the area at risk from flooding; (2) the intensity of the flooding that can be expected in specific areas of the floodplain; and (3) the probability of occurrence of flood events. This process usually results in the creation of a floodplain map. Floodplain maps provide detailed information that can assist jurisdictions in making policies and land-use decisions. Map 4 shows 100-year floodplains within Yamhill County. Map 5 shows the hydrologic subbasins within the county.

Vulnerability Assessment

Vulnerability assessment is the second phase of flood hazard assessment. It combines the floodplain boundary, generated through hazard identification, with an inventory of the property within the floodplain. It identifies the number of properties at risk from flooding, and the dollar value of the property at risk. Floodplain data for Yamhill County can be used to conduct a preliminary vulnerability assessment for flood and drainage hazard areas.

Risk Analysis

Risk analysis is the third and most advanced phase of a hazard assessment. It builds upon the hazard identification and vulnerability assessment.

A flood risk analysis for Yamhill County should include two components:

- (1) The amount of loss to both property and life that may result from a flood event (defined through the vulnerability assessment); and,
- (2) The number of flood events expected to occur over time.

Within the broad components of a risk analysis, it is possible to predict the severity of damage from a range of events. For example, a risk analysis can be conducted for both 25-year (smaller storm) floodplains (Drainage Hazard Areas), and 100-year (larger storm) floodplains. Over time, the Drainage Hazard Areas will flood more often than areas within a 100-year floodplain, exposing properties in Drainage Hazard Areas to a greater risk of flood damage. Depending on the impacts resulting from a 25-year flood event versus a 100-year flood event, however, and the amount of life and property exposed to the different hazard events, the level of risk may vary.

Flow velocity models can assist in predicting the amount of damage expected from different magnitudes of flood events. The data used to develop these models is based on hydrological analysis of landscape features. Changes in the landscape, often associated with human development, can alter the flow velocity and the severity of damage that can be expected from a flood event. GIS technology and flow velocity models make it possible to map the damage that can be expected from both flood events over time. It is also possible to pinpoint the effects of certain flood events on individual properties.

Community Flood Issues

What is Susceptible to Damage During a Flood Event?

The largest impact on communities from flood events is the loss of life and property. During certain years, property losses resulting from flood damage are extensive. Development in the floodplains of Yamhill County will continue to be at risk from flooding because flood damage occurs on a regular basis throughout the county.

Property loss from floods strikes both private and public property. Public sector impacts (e.g., impacts to water and sewer systems, roads, etc.) statewide resulted in approximately two-thirds of the estimated damage from the 1996 flood events.⁴⁰

Property Loss Resulting from Flooding Events

The type of property damage caused by flood events depends on the depth and velocity of the floodwaters. Faster moving floodwaters can wash buildings off their foundations and sweep cars downstream. Pipelines, bridges, and other infrastructure can be damaged when high waters combine with flood debris. Extensive damage can be caused by basement flooding and landslide damage related to soil saturation from flood events. Seepage into basements or daylight basements is common during flood events, not only in or near floodplains, but also on hillsides and other areas that are far removed from floodplains.⁴¹ Most flood damage is caused by water saturating materials susceptible to loss (e.g., wood, insulation, wallboard, fabric, furnishings, floor coverings, and appliances).

Homes

Homes in frequently flooding areas can also suffer damage to septic systems and drain fields. Homes in rural floodplain areas often depend on private sewage treatment systems, and inundation of these systems may result in leakage of wastewater into surrounding areas. In many cases, flood damage to homes renders them unlivable. The federal government provides disaster funding for people who cannot, or should not, live in their homes because of damage or other disaster-related reasons.⁴²

Manufactured Homes

Statewide, the 1996 floods destroyed 156 housing units. Of those units, 61 percent were manufactured homes and trailers.⁴³ Many older manufactured home parks are located in floodplain areas. Manufactured homes have a lower level of structural stability than site-built homes. A site-built home's foundation and building frame are put together on site as opposed to manufactured homes, which are prefabricated off site. Manufactured homes in floodplain zones must be anchored to provide additional structural stability during flood events. Due to confusion in the late 1980's resulting from multiple changes in NFIP regulations, there are some communities that do not actively enforce anchoring requirements. Lack of enforcement of manufactured home construction standards in floodplains can contribute to severe damages from flood events.

Business/Industry

Flood events impact businesses by damaging property and by interrupting business. Flood events can cut off customer access to a business as well as close down a business for repairs. A quick response to the needs of businesses affected by flood events can help a community maintain economic vitality in the face of flood damage. Responses to business damages may include funding to assist owners in elevating or relocating flood-prone business structures.⁴⁴

Public Infrastructure

Publicly owned facilities are a key component of daily life for all citizens of the county. Damage to public water and sewer systems, transportation networks, flood control facilities, emergency facilities, and offices can hinder the ability of the government to deliver services. Government can take action to reduce risk to public infrastructure from flood events, as well as adopt public policy that reduces risk to private property from flood events.

There are a variety of drinking water, surface water, and wastewater service providers throughout the county. During flooding events, the infrastructure that supports the water service providers in the county can be damaged and sometimes destroyed.

Buildings and Roads

In the wake of the 1996 flood events, damage to public buildings statewide represented 34 percent of total public losses.⁴⁵ Of particular importance during flood events are facilities located in flood hazard areas that are critical to government response and recovery activities.

During natural hazard events, or any type of emergency or disaster, dependable road connections are critical for providing emergency services. Road systems in Yamhill County are maintained by multiple jurisdictions. Federal, state, county, and city governments all have a stake in protecting roads from flood damage. Road networks often traverse floodplain and floodway areas. Transportation agencies responsible for road maintenance are typically aware of the roads at risk from flooding.

Bridges

Bridges in Yamhill County are key points of concern during flood events for two primary reasons:

- (1) They are often important links in road networks, crossing water courses or other significant natural features; and,
- (2) They can be obstructions in watercourses, inhibiting the flow of water during flood events.

The bridges in Yamhill County are state, county, city, or privately owned. A state-designated inspector must inspect all state, county and city bridges every two years, but private bridges are not inspected, and can be very dangerous. The inspections are rigorous, looking at everything from seismic capability to erosion and scour. The smaller, more economically feasible repairs to county bridges are the responsibility of the Yamhill County Public Works Roads Division. The larger projects require funding through the

Highway Bridge Replacement and Rehabilitation program (HBRR). HBRR provides 80 percent of funding, and the county is responsible for twenty percent.

There are 133 bridges maintained by Yamhill County. Of these, 46 bridges have been appraised as being deficient by the Oregon Department of Transportation (ODOT) and in need of repair or replacement

Structurally deficient bridges are rated for deck, superstructure, substructure, culvert, retaining wall, structural condition and waterway adequacy. Functionally obsolete bridges are rated for deck geometry, under clearance, approach roadway alignment, structural condition and waterway adequacy. If a bridge is both structurally deficient and functionally obsolete, it is classified only as structurally deficient.

Structurally Deficient Bridges in Yamhill County:⁴⁶

- Willamina Creek Road, Willamina Creek, #01751A
- Dukes Landing Road, Mosquito Creek, #11794
- Greenfell County Park Road, Baker Creek, #11503
- Stone Road, Bryan Creek, #11650
- Rex Brown Road, Panther Creek, #11605 (planned for replacement in 2003)
- Old Railroad Grade, North Yamhill River, #11526
- Deer Creek Park Road, Deer Creek, #11501

Yamhill County lists 22 ‘functionally obsolete bridges’, and nine ‘concrete shear-cracked bridges.’ The county conducts routine maintenance on its bridges, which includes but is not limited to rebuilding approaches, partial deck replacements, and patch concrete spalling.⁴⁷

Stormwater System

Local drainage problems are common throughout the region. Some communities have drainage master plans, and local public works departments are often aware of local drainage threats. Problems are often present where open ditches enter culverts or go underground into storm sewers. In addition, high water tables in some areas can mean wet crawl spaces, yards, and basements after storms pass because the accumulated water does not drain quickly into a stream or storm sewer. Filled ditches and swales near buildings can inhibit or prevent the flow of water and compound these problems. Inadequate maintenance, especially following leaf accumulation in the fall, can also contribute to the flood hazard in urban areas.⁴⁸

Floods and Natural Systems

Maintaining and restoring natural systems help mitigate the impact of flood events on the built environment. High water can be beneficial to the natural processes within a floodplain, and can benefit riparian areas.

Natural Systems

Maintaining and restoring natural systems help to mitigate the impact of flood events on the built environment. Flooding changes the natural environment and hydrology of an affected area. High water can be beneficial to the natural processes within a floodplain, and can benefit riparian areas. The best flood control techniques work to control water using the natural features such as wetlands that assist in water storage and bank stability.

Riparian Areas

Riparian areas are important transitional areas that link water and land ecosystems. Vegetation in riparian areas is dependent on stream processes, such as flooding, and often is composed of plants that require large amount of water, such as willows and cottonwood trees. Healthy vegetation in riparian buffers can reduce streamside erosion. During flood events, high water can cause significant erosion. Well-managed riparian areas can reduce the amount of erosion and help protect water quality during flood events.

Existing Flood Mitigation Activities

Flood mitigation activities listed here include current mitigation programs and activities that are being implemented by Yamhill County agencies or organizations.

County Programs

Yamhill County Codes. Yamhill County uses building codes, zoning codes, and various planning strategies to address the Oregon Land Use

Planning Goal 7, which aims at restricting development in areas of known hazards, and applying the appropriate safeguards.

- **Mitigation Requirements:** All habitable floors must be one foot above floodplain, and developers must complete a Floodplain Development Permit Application as outlined in Subsection 6.070 (Flood Management District) of the Zoning Ordinance.
- **Affected Properties:** All development in the floodplain.
- **Mitigation Requirements:** Subsections of Section 6.070 of the Land Division Ordinance prohibits this type of development in identified hazard areas.
- **Affected Properties:** Development in areas that could be prone to flooding, inadequate drainage, steep slopes, rock formations, earthquake activity, landmass instability, pollutants or other factors or conditions likely to be harmful to the safety, and general health of future residents or the general public.
- **Mitigation Requirements:** Protection of Water Resources (Comprehensive Land Use Plan Section II, Subsection C(k): Land use management practices and nonstructural solutions to problems of erosion and flooding are preferred to structural solutions.).
- **Affected Properties:** All development in riparian areas.

Yamhill County works to mitigate problems regarding flood issues when they arise. Funding, time and labor are often unavailable, causing the problems to go unresolved. Some areas in the county are more susceptible to flooding issues, and have incurred repetitive losses.

City of McMinnville Program: City of McMinnville allows nothing but parks and open space in the city's floodplains.⁴⁹ The city bars development in the floodplains of the North and South Yamhill Rivers, Cozine Creek, Baker Creek and their tributaries. McMinnville is on the "cutting edge" in managing floodplain development, according to Mark Eberlein, mitigation programs specialist with FEMA responsible for Oregon communities.⁵⁰ The city's ordinance helps lower costs to the federal agency of cleaning up after disasters, and reduces costs to the federal National Flood Insurance Program (NFIP). Since 1978, the flood insurance program has paid claims of \$223 for damage in McMinnville, compared to \$234,000 for Yamhill County as a whole and \$42.2 million statewide. McMinnville also has substantial uplands, compared to Sheridan, where significant parts of the city are in the floodplain.

Keeping development out of the floodplain means that the areas are available for floodwater storage, minimizing the impact of flooding on neighbors. Protecting the river's floodplain can also benefit wildlife, something that is becoming increasingly important with potential federal Endangered Species Act protections for steelhead in the Yamhill River system. Letting the river flow naturally through its floodplain increases fish habitat.

Regional Programs

Flood Management Projects. Flood management structures can assist in regulating flood levels by adjusting water flows upstream of flood-prone areas. There are over 49 dams in Yamhill County holding millions of gallons of water in reservoirs. Releases of water from major reservoirs are designed to protect Yamhill County from high floodwaters. The largest reservoirs in Yamhill County include the following, none of which are primarily used for flood management:

- McGuire Dam (McMinnville Water & Light) – 3,760 acre feet (Nestucca River)
- McMinnville’s Haskins Creek Impounding Reservoir – 325 acre-feet (Haskins Creek)
- Baker, E.R. Reservoir (Private) – 225 acre-feet (tributary to Chehalem Creek)
- Hawn Creek District Improvement Corporation’s Hawn Creek Reservoir – 153 acre-feet (Hawn Creek)
- Bailey Nurseries’ [private] Walker Dam – 145 acre-feet (Bryan Creek)

State Programs

Goal 7: Areas Subject to Natural Disasters and Hazards.

Goal 7 of the Statewide Planning Goals, administered by the Department of Land Conservation and Development, requires local governments to adopt flood protection policies and controls. Goal 7 requires local governments to identify hazards and adopt appropriate safeguards for land use and development.

State of Oregon Floodplain and Floodway Removal/Fill Law

The Oregon Removal/Fill Law,⁵¹ which is administered by the Oregon Department of State Lands, requires a permit for activities that would remove or fill 50 cubic yards or more of material in waters of the state (e.g., streams, lakes, wetlands). The purpose of the law, enacted in 1967, is to protect public navigation, fishery and recreational uses of the waters of the state. “Waters of the state” are defined as “natural waterways including all tidal and non-tidal bays, intermittent streams, constantly flowing streams, lakes, wetlands and other bodies of water in this state, navigable and non-navigable, including that portion of the Pacific Ocean that is in the boundaries of this state.”⁵² The law applies to all landowners, whether private individuals or public agencies.

Yamhill County complies with the removal/fill laws when designing and building facilities, and has related responsibilities when dealing with private development and other construction projects. Any permittee who has graded or filled or proposes to grade or fill more than 50 cubic yards in a wetland is referred to DSL, the USACE, and Oregon Department of Fish and Wildlife (ODFW) for permitting and consultation.

State Building Codes Division (BCD)

The Building Codes Division administers state building codes for one and two-family dwellings and manufactured dwellings. The BCD requires that the lowest living space in a dwelling be elevated at least one foot above the base flood elevation. Other buildings are also regulated and required to be elevated a minimum one foot above base flood elevation or flood proofed.

Wetlands

Many floodplain and stream-associated wetlands absorb and store stormwater flows, which reduces flood velocities and stream bank erosion. Preserving these wetlands reduces flood damage and the need for expensive flood control devices such as levees. When the storms are over, many wetlands augment summer stream flows by slowly releasing the stored water back to the stream system.⁵³ Wetlands are highly effective at removing nitrogen, phosphorous, heavy metals, and other pollutants from water. For this reason, artificial wetlands are often constructed for cleaning stormwater runoff and for tertiary treatment (polishing) of wastewater. Wetlands bordering streams and rivers and those that intercept runoff from fields and roads provide this valuable service free of charge.⁵⁴

Oregon's Wetlands Protection Program

Oregon's Wetlands Program was created in 1989 to integrate federal and state rules concerning wetlands protection with the Oregon Land Use Planning Program. The Wetlands Program follows a mandate to work closely with local governments and the Department of State Lands (DSL) to improve land use planning approaches to wetlands conservation. A Local Wetlands Inventory (LWI) is one component of that program. DSL also develops technical manuals, conducts wetlands workshops for planners, and works directly with local governments on wetlands planning tasks.

Oregon Wetlands Joint Venture

The Oregon Wetlands Joint Venture is a coalition of private conservation, waterfowl, fisheries, and agriculture organizations working with government agencies to protect and restore important wetland habitats.⁵⁵

Federal Programs

National Weather Service

The National Weather Service provides flood watches, warnings, and informational statements for rivers throughout Yamhill County.⁵⁶

National Resources Conservation Service (NRCS), US Department of Agriculture

NRCS provides a suite of federal programs designed to assist state and local governments and landowners in mitigating the impacts of flood events. The Watershed Surveys and Planning Program and the Small Watershed Program provide technical and financial assistance to help participants solve natural resource and related economic problems on a watershed basis. The Wetlands Reserve Program and the Flood Risk Reduction Program provide financial incentives to landowners to put aside land that is either a wetland resource, or that experiences frequent flooding. The Emergency Watershed Protection Program (EWP) provides technical and financial assistance to clearing debris from clogged waterways, restoring vegetation, and stabilizing riverbanks. The measures taken under EWP must be environmentally and economically sound and generally benefit more than one property.

Federal Emergency Management Agency (FEMA) Programs

The Federal Emergency Management Agency (FEMA) resulted from the consolidation of five federal agencies that were dealing with different types of emergencies. Since then, many states and local jurisdictions have accepted this approach and changed the names of their organizations to include the words "emergency management." FEMA provides maps of flood hazard areas, various publications related to flood mitigation, funding for flood mitigation projects, and technical assistance.⁵⁷

According to FEMA, breaking the disaster-rebuild-disaster cycle in the United States is the agency's top priority.⁵⁸ FEMA sometimes tries to find permanent ways to avoid paying for damages by, for example, purchasing homes and removing them from floodplains.

National Flood Insurance Program (NFIP)

Every community with identified flood hazards is a member of the program. Thus, these local governments are required to adopt the NFIP's minimum requirements. Flood insurance is available to citizens in communities that adopt and implement NFIP siting and building standards. The standards are applied to development that occurs within a delineated floodplain, a drainage hazard area, and areas subject to inundation during a base flood event, and properties within 250 feet of a floodplain boundary. These areas are depicted on federal Flood Insurance Rate Maps (FIRMs) that are available through FEMA. Oregon's Department of Land Conservation and Development (DLCD) is the state's NFIP-coordinating agency.

The Community Rating System (CRS)

The Community Rating System (CRS) recognizes community floodplain management efforts that go beyond the minimum requirements of the NFIP. Property owners within cities could receive reduced NFIP flood insurance premiums if their city implements floodplain management practices that qualify it for a CRS rating. As of 2003, the City of Sheridan is the only community in Yamhill County that participates in the Community Rating System, thereby receiving lower flood insurance rates.⁵⁹ For further information on the CRS, visit FEMA's website at <http://www.fema.gov/nfip/crs.htm>.

Mitigation Plan Goals

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

The plan goals help to guide the direction of future activities aimed at reducing risk and preventing loss from natural hazards. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Goal #1: EMERGENCY OPERATIONS

Goal Statement: Coordinate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures and with various other agencies, as appropriate.

Goal #2: EDUCATION & OUTREACH

Goal Statement: Develop and implement education and outreach programs to increase public awareness of the risks associated with natural hazards.

Goal #3: PARTNERSHIPS

Goal Statement: Develop effective partnerships with public and private sector organizations and significant agencies and businesses for future natural hazard mitigation efforts.

Goal #4: PREVENTIVE

Goal Statements:

- Develop and implement activities to protect human life, commerce, and property from natural hazards.
- Reduce losses and repetitive damage for chronic hazard events while promoting insurance coverage for catastrophic hazards.

Goal #5: NATURAL RESOURCES UTILIZATION

Goal Statement: Link natural resources management, land use planning, and watershed planning with natural hazard mitigation activities to protect natural systems and allow them to serve natural hazard mitigation functions.

Goal #6: IMPLEMENTATION

Goal Statement: Implement strategies to mitigate the effects of natural hazards.

Flood Mitigation Action Items

The following mitigation action items were formulated through researching regional and national mitigation plans and natural hazards planning literature, and interviews with local stakeholders. Refinement of the Plan's action items occurred through discussions with the mitigation plan steering committee and through an open house that presented the proposed items to the public.

The flood mitigation action items provide direction on specific activities that organizations and residents in Yamhill County can undertake to reduce risk and prevent loss from flood events. Each action item is followed by ideas for implementation, which can be used by the steering committee and local decision makers in pursuing strategies for implementation.

This section lists action items identified to reduce the risk from flood impacts in Yamhill County. These action items are designed to meet the Yamhill County Natural Hazards Mitigation Plan Goals.

Short-term (ST) Flood Action Items

Short-term flood action items include general mitigation activities that agencies are capable of implementing during the next two years, given their existing resources and authorities.

- **ST-FL #1: Develop better flood warning systems.**

- *Ideas for Implementation*

- Coordinate with appropriate organizations to evaluate the need for more stream gauges that are tied into National Weather Service flood forecasting activities; and;
- Distribute information regarding flooding to the general public efficiently.

Coordinating Organization:	Emergency Management, Public Works
Internal Partner:	Planning
External Partners:	Yamhill Basin Council, Yamhill SWCD, cities, OSU Extension Service, USGS, WRD, DSL, OEM, USACE, private river gauges
Timeline:	1 to 2 years
Plan Goals Addressed:	Emergency Operations; Partnerships; Preventive; Implementation

ST-FL #2: Maintain an inventory of all permitted dams built for flood control purposes in the county.

- *Ideas for Implementation*
- Update appropriate seismic criteria and procedures for evaluating performance of existing dams (varies with each permitted dam Emergency Action Plan);
 - Susceptibility to damage from flood events and/or earthquakes
 - Amount of water impounded
 - Type of construction
 - Year completed
 - Repair work performed

Coordinating Organization: Emergency Management
 External Partner: Yamhill Basin Council, USACE, WRD, DEQ, ODFW, NRCS
 Timeline: 1 to 2 years
 Plan Goals Addressed: Emergency Operations; Partnerships; Natural Resources Utilization

ST-FL #3: Implement the steps needed for Yamhill County to become a participant in the NFIP’s Community Rating System.

- *Ideas for Implementation*
- County officials should review the requirements for CRS participation and assess the steps needed to obtain certification; and
- County officials should pursue certification under the CRS program.

Coordinating Organization: Yamhill County
 Internal Partners: Planning, Emergency Management
 External Partner: Cities, DLCD, FEMA, OEM, OECDD
 Timeline: 1 to 3 years
 Plan Goals Addressed: Partnerships; Preventive; Natural Resources Utilization; Implementation

Long-term (LT) Flood Action Items

Long-term flood action items include general mitigation activities that are likely to take more than two years to implement and may require new or additional resources and/or authorities.

LT-FL #1: Update and improve the Flood Insurance Rate (FIRM) Maps for Yamhill County as funding becomes available.

- *Ideas for Implementation*

- Work with FEMA on specific areas to update as funding becomes available.

Coordinating Organization: Community Development/Planning
 Internal Partner: GIS
 External Partner: DLCD, FEMA
 Timeline: 3 to 5 years
 Plan Goals Addressed: Partnerships; Preventive; Natural Resources Utilization; Implementation

LT-FL #2: Enhance data and mapping for floodplain information in the county, and identify and map flood-prone areas outside of designated floodplains.

Ideas for Implementation

- Apply for FEMA’s cooperative technical partnership using two-foot contour interval floodplain mapping data;
- Encourage the development of floodplain maps for all local streams not currently mapped on Flood Insurance Rate Maps or county maps, with special attention focused on mapping rural and unincorporated areas. The maps can be used for planning, risk analysis, and emergency management. The maps should show:
 1. The expected frequency of flooding,
 2. The level of flooding, and
 3. The areas subject to inundation.
- Pursue certification under the CRS program;
- Maintain maps of covered streams and creeks, including digitizing and creating a set of aerial maps of Yamhill County to more easily ‘ground truth’ collected data;
- Identify mapped culverts that historically create flooding problems and target them for retrofitting;
- Prepare an inventory of rural drainage problems;
- Coordinate with local agencies and organizations to obtain flood data and mapping resources;
- Build databases for HAZUS programs;
- Integrate the Capital Improvement Plan process with GIS;
- Include a map layer with arrows to indicate direction of stream/creek flow; and
- Add creek names that are missing and coordinate the naming of unnamed creeks.

Coordinating Organization: Outside UGB: GIS, Planning & Building Divisions, Public Works, Cities

Inside UGB: Cities
Internal Partners: Emergency Management
External Partners: NRCS, Yamhill SWCD, FEMA
Timeline: 3 to 5 years (as funding allows)
Plan Goals Addressed: Partnerships; Preventive; Natural Resources Utilization

LT-FL #3 Seek funding to train elected officials and recorders in small towns who have no emergency management background.

Such training should include:

- Why every emergency operations center is important;
- What needs to be done in a natural hazards emergency;
- Who responds to natural hazards emergencies;
- Public safety roles i.e., fire versus police public safety.

Coordinating Organization: Emergency Management
External Partner: Yamhill Fire Defense Board, OEM, FEMA
Timeline: On-going
Plan Goals Addressed: Education & Outreach; Partnerships

LT-FL #4 Provide flood event education and outreach to households and businesses.

Ideas for Implementation

- Identify and map vulnerable populations;
- Create a flood education curriculum, a speaker-training program, and outreach aimed at specific populations i.e., schools, households, businesses, etc;
- Collaborate with existing program managers to develop a flood education component that supports fish habitat and water quality education curricula;
- Identify existing watershed education programs and determine which programs would support a flood education component;
- Identify and provide mitigation guidance to owners of properties at risk from flooding;
- Develop a contact list of households and/or businesses that may have an interest in flood mitigation or flood response issues;
- Recruit individuals to speak to households and businesses/employees about flood issues;
- Encourage development of outreach programs to business organizations that must manage for flood protection;
- Raise awareness level of property owners and developers that impacts upstream result in impacts downstream, and lack of stormwater best management practices can result in an increase in flooding events;

- Educate the public on the need for them to maintain their private water quality and water detention facilities;
- Consider implementing tax incentives for property owner maintaining their private facilities;
- Educate private property owners on restoring natural systems within the floodplain to manage riparian areas and wetlands for flood abatement;
- Erect “monuments” over piped creeks throughout the county and floodplain elevation markers to bring flood awareness to home and business owners who live near them;
- Develop a “Clean Stream” sponsorship program, using the “Friends of Fanno Creek” model. Erect signage recognizing individuals, households, businesses, and organizations committed to the ongoing care of a waterway section. Develop a brochure as an educational tool;
- Pursue certification under the CRS program.

Coordinating Organization: Yamhill County
 Internal Partner: Planning, GIS, Assessor’s Office, Emergency Management
 External Partner: IISOI, Yamhill Basin Council, Yamhill SWCD, DLCD, OEM, cities, OECDD
 Timeline: On-going
 Plan Goals Addressed: Education & Outreach; Partnerships; Natural Resources Utilization; Implementation

LT-FL #5: Seek funding to retrofit culverts in Yamhill County with pipes designed for 50 to 100-year flood intervals.

Ideas for Implementation

- Work with Local, State and Federal agencies involved with riparian habitat restoration, as larger culverts tend to be ‘fish friendly’; and
- County officials should pursue certification under the CRS program.

Coordinating Organization: Public Works
 Internal Partner: Planning, Emergency Management
 External Partners: Cities, DSL, ODFW, USFWS, Yamhill SWCD, Yamhill Basin Council, OSU Extension
 Timeline: 1 to 3 years
 Plan Goals Addressed: Partnerships; Preventive; Natural Resources Utilization; Implementation

LT-FL #6: Coordinate with Yamhill SWCD, Oregon Department of Geology and Mineral Industries (DOGAMI), and National Oceanic and Atmospheric Administration (NOAA) to identify funding sources for further study of the gravel accumulations in the Willamette River at Lambert Bend.

Note:

- Gravel accumulations near Lambert Bend have altered the stream flow and continue to erode the riverbank in this area. Approximately 200 acres of land and two gravel operations are at risk of significant losses unless some type of solution is developed. The Willamette River floodplain is vital to both the agricultural and aggregate industries.

Ideas for Implementation

- Identify funding sources to assist with restoring floodplain function in the Lambert Bend area (RM 65) of the Willamette River

Coordinating Organizations: Yamhill SWCD, DOGAMI, NOAA
 Internal Partners: Planning, Emergency Management
 External Partners: DSL, ODFW, DEQ, Yamhill Basin Council, OSU Extension
 Timeline: 1 to 3 years
 Plan Goals Addressed: Partnerships; Preventive; Natural Resources Utilization; Implementation

LT-FL #7: Mitigate repetitive flood loss properties.

Ideas for Implementation

- Elevate dwellings on repetitive flood-loss properties above the mean base flood elevation;
- Acquire the property when purchasing the property from the property owner is more feasible than repetitive reparations following flood loss;
- Relocate dwellings and other affected structures outside of the flood plain.

Coordinating Partners: Cities in Yamhill County, Yamhill County
 Internal Partner: Tax Assessor
 External Partners: FEMA, OEM
 Timeline: On-going
 Plan Goals Addressed: Partnerships; Preventive; Implementation

Flood Mitigation Resources

County Resources

Yamhill Basin Council

Contact: Jamie Sheahan, Coordinator

2200 SW 2nd Street

McMinnville, OR 97128

Phone: 503-434-7447

Facsimile: 503-472-2459

Email: sheahanj@co.yamhill.or.us

Web site: www.co.yamhill.or.us/ybc

Yamhill Soil & Water Conservation District

Contact: Tim Stieber, District Manager

2200 SW 2nd Street

McMinnville, OR 97128

Phone: 503-472-6403

Facsimile: 503-472-2459

Web site: www.yamhillswcd.org

State Resources

Oregon's Wetlands Protection Program

Oregon's Wetlands Program was created in 1989 to integrate federal and state rules concerning wetlands protection with the Oregon Land Use Planning Program. The Wetlands Program has a mandate to work closely with local governments and the Department of State Lands (DSL) to improve the land use planning approaches to wetlands conservation. A Local Wetlands Inventory (LWI) is one component of that program. DSL also develops technical manuals and works directly with local governments on wetlands planning tasks.

Contact: Department of State Lands

Website: <http://statelands.dsl.state.or.us/>

Oregon Wetlands Joint Venture

The Oregon Wetlands Joint Venture is a coalition of private conservation, waterfowl, fisheries, and agriculture organizations working with government agencies to protect and restore important wetland habitats.

Contact: Oregon Wetlands Joint Venture

Website: <http://wetlands.dfw.state.or.us/>

Department of Land Conservation and Development (DLCD)

DLCD administers the state's Land Use Planning Program. The program is based on 19 Statewide Planning Goals, including Goal 7, Areas Subject to Natural Disasters and Hazards, with stream flooding as one of its major focus. DLCD serves as the federally designated agency to coordinate floodplain management in Oregon. DLCD also conducts various landslide related mitigation activities. In order to help local governments address natural hazards effectively, DLCD provides technical assistance such as conducting workshops, reviewing local land use plan amendments, and working interactively with other agencies.

Contact: Natural Hazards Program Manager, DLCD

Address: 635 Capitol St. NE, Suite 200, Salem, OR 97301-2540

Phone: 503-373-0050

Fax: 503-378-6033

Website: <http://www.lcd.state.or.us/hazards.html>

Oregon Floodplain Coordinator: 503-373-0050 ext. 255

Oregon State Police (OSP) – Office of Emergency Management (OEM)

OEM administers FEMA's Hazard Mitigation Grant Program, which provides post-disaster monies for acquisition, elevation, relocation, and demolition of structures located in the floodplain. OEM also administers FEMA's Flood Mitigation Assistance Program. This program provides assistance for NFIP-insured structures only. OEM also helps local jurisdictions to develop hazard mitigation plans. OEM is heavily involved in flood damage assessment and works mainly with disaster recovery and hazard mitigation programs. OEM provides training for local governments through workshops on recovery and mitigation. OEM also helps implement and manage federal disaster recovery programs.

Contact: Office of Emergency Management
Address: 3225 State Street, Salem, OR 97301
Phone: 503-378-2911
Fax: 503-373-7833
Website: <http://www.osp.state.or.us/oem/>
OEM Hazard Mitigation Officer: 503-378-2911 ext. 22247
Recovery and Mitigation Specialist: 503-378-2911 ext. 22240

Oregon Department of Fish and Wildlife (ODFW)

ODFW's mission is to protect and enhance Oregon's fish and wildlife and their habitats for use and enjoyment by present and future generations. ODFW regulates stream activity and engages in stream enhancement activities.

Contact: ODFW
Address: 3406 Cherry Avenue NE, Salem, OR 97303
Phone: 503-947-6000
Website: <http://www.dfw.state.or.us/>
Email: ODFW.Info@state.or.us

Oregon Department of State Lands (DSL)

DSL is a regulatory agency, responsible for administration of Oregon's Removal-Fill Law. This law is intended to protect, conserve, and make the best use of the state's water resources. It generally requires a permit from DSL to remove, fill, or alter more than 50 cubic yards of material within the bed or banks of waters of the state. Exceptions are in-state scenic waterways and areas designated essential salmon habitat, where a permit is required for all in-stream activity, regardless of size. DSL and the US Army Corps of Engineers may issue these permits jointly.

Contact: Department of State Lands
Address: 775 Summer Street NE, Suite 100, Salem, OR 97301-1279
Phone: 503-378-3805
Fax: 503-378-4844
Website: <http://statelands.dsl.state.or.us/>
Assistant Director: 503-378-3805, ext. 279
Western Region Manager: 503-378-3805, ext. 244

Oregon Water Resources Department (WRD)

The WRD's mission is to serve the public by practicing and promoting wise long-term water management. The WRD provides services through 19 water master offices throughout the state. In addition, five regional offices

provide services based on geographic regions. The Department's main administration is performed from the central office in Salem.

Contact: WRD
Address: 725 Summer Street SE, Salem, OR 97301-1271
Phone: 503-986-0900
Website: <http://www.wrd.state.or.us/index.shtml>

OSU Watershed Extension Program

The OSU Watershed Extension Program's mission is to increase the capacity of Oregon watershed groups and communities for conserving, improving, protecting and sustaining watershed functions and values. Increasing capacity is achieved through research-based education, skill-building projects, and new partnerships among residents, local organizations, businesses, agencies, and educational institutions.

Contact: Watershed Extension Program, Central Staff
Tara Nierenberg, Statewide Program Coordinator
Address: Oregon State University, Watershed Extension
307 Ballard Hall, Corvallis, OR 97331-3604
Phone: 541-737-8715
Email: Tara.Nierenberg@oregonstate.edu
Website: <http://seagrant.oregonstate.edu/wsep>

Regional Resources

Northwest Regional Floodplain Managers Association (NORFMA)

NORFMA is a nonprofit organization for regional networking and support on issues of environmental quality, economic sustainability, and scientific discovery on a watershed basis. The Association provides a channel for regional communication and cooperation in Oregon, Washington, Idaho, British Columbia and Alaska. NORFMA promotes educational programs on floodplain and watershed management topics, increases public awareness of the value and function of floodplains, and encourages government involvement in programs to reduce flood damages and to protect, manage, and restore floodplains.

The NORFMA website is a resource for floodplains, fisheries, and river engineering information for the Northwest. This site provides technical information, articles, and Internet links in the field of floodplain and fisheries management.

Contact: Christine Valentine, MFIP Coordinator – Oregon Regional Rep.
Address: Department of Land Conservation and Development (DLCD)
635 Capitol Street NE, Suite 150, Salem, OR 97301
Phone: 503-373-0050 ext. 250
Fax: 503-378-5518
Website: <http://www.norfma.org>

Federal Resources

Federal Emergency Management Agency (FEMA)

FEMA provides maps of flood hazard areas, various publications related to flood mitigation, funding for flood mitigation projects, and technical assistance. FEMA also operates the National Flood Insurance Program. The mission of FEMA is “to reduce loss of life and property and protect the

nation's critical infrastructure from all types of hazards through a comprehensive, risk-based, emergency management program of mitigation, preparedness, response and recovery." FEMA Region X serves the northwestern states of Alaska, Idaho, Oregon, and Washington.

Contact: FEMA, Federal Regional Center, Region 10
Address: 228th St. SW, Bothell, WA 98021-9796
Phone: 425-487-4678
Website: <http://www.fema.gov>

To obtain FEMA publications:
Phone: 800-480-2520

To obtain FEMA maps:
Contact: Map Service Center
Address: P.O. Box 1038, Jessup, Maryland 20794-1038
Phone: 800-358-9616
Fax: 800-358-9620

The National Flood Insurance Program

The National Flood Insurance Program (NFIP) Website is a subsection of the Federal Emergency Management Agency (FEMA) site (<http://www.fema.gov>). The NFIP information is intended for both the general public and the many organizations and agencies participating in the program. It includes information about the NFIP and other flood disaster assistance available from the Federal Government. It also provides access to the newly revised NFIP booklet: *Answers to Questions about the National Flood Insurance Program*.

Contact: The National Flood Insurance Program
Phone: 888-FLOOD29 or 800-427-5593
Website: <http://www.fema.gov/nfip>

United States Geological Survey (USGS)

The USGS website provides current stream flow conditions at USGS gauging stations in Oregon and throughout the Pacific Northwest. The Oregon USGS office is responsible for water resources investigations for Oregon and part of southern Washington. Their office cooperates with more than 40 local, state, and federal agencies in Oregon. Cooperative activities include water resources data collection and interpretive water availability and water quality studies.

Contact: USGS Oregon District Office
Address: 10615 S.E. Cherry Blossom Dr., Portland, OR 97216
Phone: 503-251-3200
Fax: 503-251-3470
Website: <http://oregon.usgs.gov>
Email: info-or@usgs.gov

USGS Water Resources

This web page offers current US water news; extensive current (including real-time) and historical water data; numerous fact sheets and other publications; various technical resources; descriptions of ongoing water survey programs; local water information; and connections to other sources of water information.

Contact: USGS Water Resources
Phone: 503-251-3200
Website: <http://water.usgs.gov> or <http://water.usgs.gov/public/realtime.html>
Email: info-or@usgs.gov

Bureau of Reclamation

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public. The closest dam to Yamhill County owned by the Bureau of Reclamation is Scoggins Dam in Washington County. The Bureau prepares emergency action plans for events at the dam.

Contact: Bureau of Reclamation, Pacific Northwest Region
Address: 1150 N. Curtis Road, Boise, ID 83706-1234
Phone: 208-378-5021
Website: <http://www.pn.usbr.gov/contact/index.shtml>

Army Corps of Engineers

The Corps of Engineers administers a permit program to ensure that the nation's waterways are used in the public interest. Any person, firm, or agency planning to work in waters of the United States must first obtain a permit from the Army Corps of Engineers. In Oregon, joint permits may be issued with the Department of State Lands. The Corps is responsible for the protection and development of the nation's water resources, including navigation, flood control, energy production through hydropower management, water supply storage and recreation.

Contact: US Army Corps of Engineers-Portland District, Floodplain Information Branch

Address: P.O. Box 2946, Portland, OR 97208-2946 (mail)
Robert Duncan Plaza (in person)
333 SW First Avenue, Portland, OR 97204
Phone: 503-808-5150
Fax: 503-808-4875
Website: <http://www.nwp.usace.army.mil/>

National Resources Conservation Service (NRCS), US Department of Agriculture (USDA)

NRCS provides a suite of federal programs designed to assist state and local governments, and landowners in mitigating the impacts of flood events. NRCS assists owners of America's private land with conserving their soil, water, and other natural resources. NRCS delivers technical assistance based on sound science and suited to a customer's specific needs. NRCS partners with local conservation districts and serves almost every county in the nation, and the Caribbean and Pacific Basin. Participation in their programs is voluntary.

The Watershed Surveys and Planning Program and the Small Watershed Program provide technical and financial assistance to help participants solve natural resource and related economic problems on a watershed basis. The Wetlands Reserve Program and the Flood Risk Reduction Program provide financial incentives to landowners to put aside land that is either a wetland resource or experiences frequent flooding. The Emergency Watershed Protection Program (EWP) provides technical and financial assistance for clearing debris from clogged waterways, restoring vegetation, and stabilizing riverbanks. The measures taken under the EWP must be environmentally and economically sound and generally benefit more than one property.

Contact: USDA-NRCS, McMinnville Service Center
(Farm Service Agency, NRCS, Conservation District)
Address: 2200 SW Second Street, McMinnville, OR 97128-5444
Phone: 503-472-1474
Fax: 503-472-2459
Website: <http://www.nrcs.usda.gov/>

National Weather Service, Portland Bureau

The National Weather Service provides flood watches, warnings, and informational statements for rivers in Yamhill County. The NWS is the sole U.S. official voice for issuing warnings during life threatening weather situations. The NWS Portland Bureau provides river level information online and by phone.

Contact: National Weather Service, Portland Bureau
Address: 5241 NE 122nd Avenue, Portland, OR 97230-1089
Phone: 503-326-2340
Fax: 503-808-4875
Website: http://www.wrh.noaa.gov/Portland/public_hydro/

StormReady, National Weather Service

StormReady is a nationwide community preparedness program that uses a grassroots approach to help communities develop plans to handle all types of severe weather – from tornadoes to tsunamis. The program encourages communities to take a new, proactive approach to improving local hazards operations by providing emergency managers with clear-cut guidelines on how to improve their weather operations.

Contact: StormReady, National Weather Service
Phone: 503-261-9247
Email: Tyree.Wilde@noaa.gov
Website: <http://www.stormready.noaa.gov/>

Office of Hydrology, National Weather Service

The National Weather Service's Office of Hydrology (OH) and its Hydrological Information Center offer information on floods and other aquatic disasters. This site offers current and historical data including an archive of past flood summaries, information on current hydrologic conditions, water supply outlooks, an Automated Local Flood Warning Systems Handbook, Natural Disaster Survey Reports, and other scientific publications on hydrology and flooding.

Contact: Office of Hydrology, National Weather Service
Website: <http://www.nws.noaa.gov/oh> or <http://www.nws.noaa.gov/oh/hic/>

Additional Resources

The Association of State Floodplain Managers

The Association of State Floodplain Managers is an organization of professionals involved in floodplain management, flood hazard mitigation, the National Flood Insurance Program, and flood preparedness, warning, and recovery. ASFPM fosters communication among those responsible for flood hazard activities, provides technical advice to governments and other entities about proposed actions or policies that will affect flood hazards, and encourages flood hazard research, education, and training. The ASFPM web site includes information on how to become a member, the organization's constitution and bylaws, directories of officers and committees, a publications list, information on upcoming conferences, a history of the association, and other useful information and Internet links.

Contact: The Association of State Floodplain Managers
Address: 2809 Fish Hatchery Road, Madison, WI 53713
Phone: (608) 274-0123
Fax: 608-274-0696
Website: <http://www.floods.org>

The Floodplain Management Association

The Floodplain Management website was established by the Floodplain Management Association (FMA) to serve the entire floodplain management community. It includes full-text articles, a calendar of up-coming events, a list of positions available, an index of publications available free or at

nominal cost, a list of associations, a list of firms and consultants in floodplain management, an index of newsletters dealing with flood issues (with hypertext links if available), a section on the basics of floodplain management, a list of frequently asked questions (FAQs) about the Website, and, of course, a copious catalog of Web links.

Contact: Floodplain Management Association
Website: <http://www.floodplain.org>
Email: admin@floodplain.org

FEMA's List of Flood Related Websites

This site contains a long list of flood related Internet sites from "American Heritage Rivers" to "The Weather Channel," and is a good starting point for flood information on the Internet.

Contact: Federal Emergency Management Agency.
Phone: 800-480-2520
Website: <http://www.fema.gov/nfip/related.htm>

Insurance Services Offices, Inc. (ISO)

The Building Codes Effectiveness Grading Schedule (BCEGS), developed and operated by ISO assesses the building codes in effect in a community and how the community enforces them, with special emphasis on mitigation of losses from natural disasters. In BCEGS, each community is assigned a grade of 1 (best) to 10 (no recognized program), with two ratings for each jurisdiction, commercial and residential. Coordinating floodplain management with local building codes has advantages with regard to permits, inspections, other developments such as grading, post-flood inspections, application of floodplain management requirements, special certifications, construction quality and modifications to existing buildings.

Contact: Insurance Services Offices, Inc. (ISO)
Government Relations Office
Address: 388 Market Street, Suite 750, San Francisco, CA 94111-5314
Phone: 415-434-4599 or 1-800-888-4476
Fax: 415-398-8064
Website: <http://www.iso.com/>
Email: info.sanfrancisco@iso.com

Publications

Planning for Natural Hazards: The Oregon Technical Resource Guide, Department of Land Conservation and Development (July 2000).

Produced by the Community Planning Workshop for the Department of Land Conservation and Development, this is a natural hazards planning and mitigation resource for Oregon cities and counties. It provides hazard-specific resources and plan evaluation tools. The document was written for local government employees and officials. The Technical Resource Guide includes a natural hazards comprehensive plan review, a hazard mitigation legal issues guide, and five hazard-specific technical

resource guides, including: flooding, wildfires, landslides, coastal hazards, and earthquakes. This document is available online. You can also write, call, or fax to obtain this document:

Contact: Natural Hazards Program Manager, Department of Land Conservation and Development
Address: 635 Capitol St. NE, Suite 200, Salem, OR 97301-2540
Phone: (503) 373-0050
Fax: (503) 378-6033
Website: <http://www.lcd.state.or.us/hazards.html>

NFIP Community Rating System Coordinator's Manual. FEMA/NFIP. Indianapolis, IN.

This informative brochure explains how the Community Rating System works and what the benefits are to communities. It explains in detail the CRS point system, and what activities communities can pursue to earn points. These points then add up to the "rating" for the community, and flood insurance premium discounts are calculated based upon that "rating." The brochure also provides a table on the percent discount realized for each rating (1-10). Instructions on how to apply to be a CRS community are also included.

Contact: NFIP Community Rating System
Phone: 800-480-2520 or 317-848-2898
Website: <http://www.fema.gov/nfip/crs.htm>

Floodplain Management: A Local Floodplain Administrator's Guide to the NFIP. FEMA-Region 10. Bothell, WA.

This document discusses floodplain processes and terminology. It contains floodplain management and mitigation strategies, as well as information on the NFIP, CRS, Community Assistance Visits, and floodplain development standards.

Contact: National Flood Insurance Program
Phone: 800-480-2520
Website: <http://www.fema.gov/nfip/>

Morris, Marya. *Subdivision Design in Flood Hazard Areas.* PAS 473. Chicago, IL: APA. 1997.

This report explains planning techniques that minimize problems in a flood hazard area. Includes selected ordinances and policies.

Contact: American Planning Association, Planners Book Service
Address: 122 S. Michigan Ave., Suite 1600, Chicago, IL 60603
Phone: 312-786-6344
Fax: 312-431-9985
Website: www.planning.org

Flood Hazard Mitigation Planning: A Community Guide, (June 1997), Massachusetts Department of Environmental Management.

This informative guide offers a ten-step process for successful flood hazard mitigation. Steps include: map hazards, determine potential

damage areas, take an inventory of facilities in the flood zone, determine what is or is not being done about flooding, identify gaps in protection, brainstorm alternatives and actions, determine feasible actions, coordinate with others, prioritize actions, develop strategies for implementation, and adopt and monitor the plan.

Contact: Massachusetts Flood Hazard Management Program
Phone: 617-626-1250
Website: <http://www.magnet.state.ma.us/dem/programs/mitigate>

Reducing Losses in High Risk Flood Hazard Areas: A Guidebook for Local Officials, (February 1987), FEMA-116.

This guidebook offers a table on actions that communities can take to reduce flood losses. It also offers a table with sources for floodplain mapping assistance for the various types of flooding hazards. There is information on various types of flood hazards with regard to existing mitigation efforts and options for action (policy and programs, mapping, regulatory, non-regulatory). Types of flooding that are covered include alluvial fan, areas behind levees, areas below unsafe dams, coastal flooding, flash floods, fluctuating lake level floods, ground failure triggered by earthquakes, ice jam flooding, and mudslides.

Contact: Federal Emergency Management Agency
Phone: 800-480-2520
Website: <http://www.fema.gov>

Oregon Model Flood Damage Prevention Ordinance, (January 1999), FEMA/DLCD.

This is an example of how to write an ordinance that complies with NFIP/FEMA standards. Communities can simply adopt this ordinance, word for word, filling in the blanks specific to their community or jurisdiction.

Contact: Department of Land Conservation and Development (DLCD)
Phone: 503-373-0050
Website: <http://www.lcd.state.or.us/hazards.html>

Flood – Endnotes

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- ³⁰ *Id.*
- ³¹ *Id.*

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- ³² Federal Emergency Management Agency. June 2003. Available on the World Wide Web (http://www.fema.gov/fhm/fq_term.shtm#frequent4).
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Section 7: Landslide

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Why are Landslides a Threat to Yamhill County?

Landslides are a serious geologic hazard in almost every state in America. Nationally, landslides cause 25 to 50 deaths each year.¹ The best estimates of the direct and indirect costs of landslide damage in the United States range between \$1 billion to \$2 billion annually.² In Oregon, a significant number of locations are at risk to dangerous landslides. While not all landslides result in private property damage, many landslides impact transportation corridors, fuel and energy conduits, and communication facilities.³ They can also pose a serious threat to human life.

A 1998 study completed by the Oregon Department of Geology and Mineral Industries (DOGAMI) states that although few landslides develop in the Willamette Valley as compared to more mountainous parts of the state, the marine sedimentary rock units in southern Yamhill County and the edges of the valley are susceptible to large slides.⁴

Landslides can be broken down into two categories: (1) rapidly moving; and (2) slow moving. Rapidly-moving landslides (debris flows and earth flows) present the greatest risk to human life, and persons living in or traveling through areas prone to rapidly moving landslides are at increased risk of serious injury. Rapidly moving landslides have also caused most of the recent landslide-related injuries and deaths in Oregon. A rapidly moving debris flow in Douglas County killed five people during the storms of 1996. Slow moving landslides can cause significant property damage, but are less likely to result in serious human injuries.

History of Landslide Events

Currently there is no comprehensive list of landslide events and/or dates for Yamhill County. Landslides probably accompany every major storm system that impacts western Oregon. In recent events, particularly noteworthy landslides accompanied storms in 1964, 1982, 1966 and 1996. Two major landslide-producing winter storms occurred in Oregon during November 1996. Intense rainfall on recently and past logged land as well as previously un-logged areas triggered over 9,500 landslides and debris flows that resulted directly or indirectly in eight fatalities.⁵ The storms of 1996 produced thousands of landslides in the Cascade and Oregon Coast mountain ranges.⁶

A DOGAMI study of the western portion of the Salem Hills indicated that slopes nearest to the Willamette River contain the greatest risk of landslide.⁷ The study further states, "the rock types within the Salem Hills include weak and low-permeability marine sediments overlain by high-strength basalts with prominent and pervasive discontinuities. These rock types, along with clay-rich residual soils overlying the basalts, provide a setting that is susceptible to water-induced landsliding where slopes are relatively steep and within existing slide masses."⁸

Many prominent features that help identify ancient landslide terrain are hummocky topography, disrupted drainage patterns, sag ponds, springs, back-tilted bedrock blocks, and subdued head scarps.⁹

Landslide Characteristics

What is a Landslide?

Landslides are downhill or lateral movements of rock, debris, or soil mass. The size of a landslide usually depends on the geology and the landslide triggering mechanism. Landslides initiated by rainfall tend to be smaller, while those initiated by earthquakes may be very large. Slides associated with volcanic eruptions can include as much as one cubic mile of material.

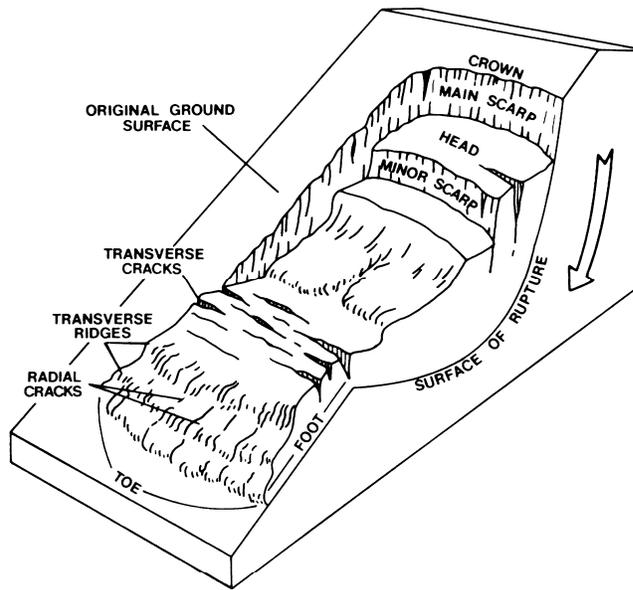
Landslides vary greatly in the volumes of rock and soil involved, the length, width, and depth of the area affected, frequency of occurrence, and speed of movement. With few exceptions, the primary ingredients for landslides are steep slopes, water (moisture content), and weak soils or rocks. Vegetation influences landslides both by binding soil with the roots and by using soil moisture that would otherwise tend to saturate the soil profile. Tree harvesting, fire, and roads are thought to increase the frequency of landslides.

Landslides are given different names depending on the type of failure and their composition and characteristics. Types of landslides include slides, rock falls, and flows.

Slides move in contact with the underlying surface. These movements include rotational slides where sliding material moves along a curved surface, and translational slides where movement occurs along a flat surface. These slides are generally slow moving and can be deep. Slumps are small rotational slides that are generally shallow (See Figure 5.1). Slow-moving landslides can occur on relatively gentle slopes and can cause significant property damage, but are far less likely to result in serious injuries than rapidly moving landslides.¹⁰

Erosion occurs when ditches or culverts beneath hillside roads become blocked with debris. If the ditches are blocked, run-off from the slopes is inhibited during periods of precipitation. This causes the run-off water to collect in soil, and in some cases, cause a slide. Usually the slides are small (100 to 1,000 cubic yards), but they can be quite large.

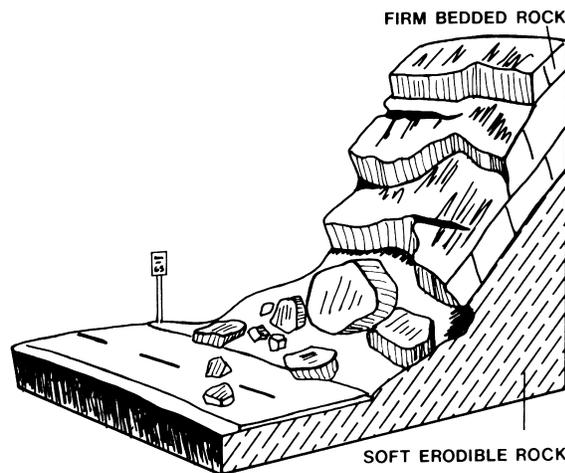
Figure 5.1. Rotational Slide



Source: *Planning for Natural Hazards: The Oregon Technical Resource Guide*, Oregon Department of Land Conservation and Development

Rock falls (see Figure 5.2) occur when blocks of material come loose on steep slopes. Weathering, erosion, or excavations, such as those along highways, can cause falls where the road has been cut through bedrock. They are fast moving with the materials free falling or bouncing down the slope. In falls, material is detached from a steep slope or cliff. The volume of material involved is generally small, but large boulders or blocks of rock can cause significant damage.

Figure 5.2. Rock Fall

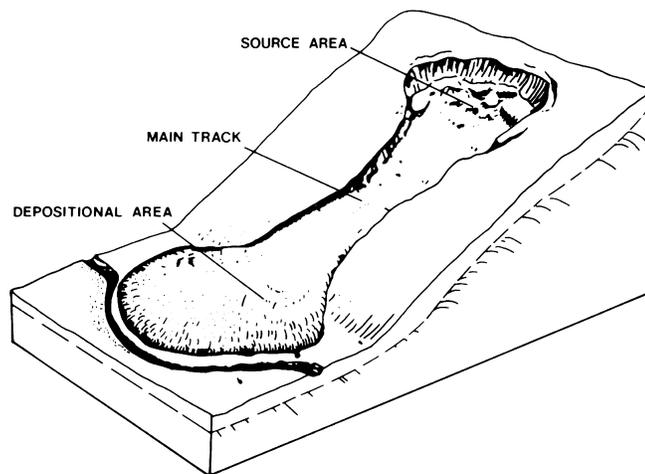


Source: *Planning for Natural Hazards: The Oregon Technical Resource Guide*, Oregon Department of Land Conservation and Development

Flows (see Figure 5.3) are plastic or liquid movements in which land mass (e.g. soil and rock) breaks up and flows during movement. They occur throughout Oregon, but are especially noteworthy in the Cascade and Coast Ranges.

Earthquakes often trigger flows.¹¹ Debris flows normally occur when a landslide moves downslope as a semi-fluid mass scouring, or partially scouring soils from the slope along its path. Flows are typically rapidly moving and also tend to increase in volume as they scour out the channel.¹² Flows often occur during heavy rainfall, can occur on gentle slopes, and can move rapidly for large distances. One example of a flow in Oregon is the Dodson debris flow that occurred in 1996. This debris flow started high on the Columbia Gorge cliffs, and traveled far down steep canyons to form debris fans at Dodson.¹³

Figure 5.3. Earthflow



Source: *Planning for Natural Hazards: The Oregon Technical Resource Guide*, Oregon Department of Land Conservation and Development

Landslides are typically triggered by periods of heavy rainfall or rapid snowmelt. Earthquakes, volcanic activity, and excavations may also trigger landslides. Certain geologic formations are more susceptible to landslides than others. Human activities, including locating development near steep slopes, can increase susceptibility to landslide events. Landslides on steep slopes are more dangerous because movements can be rapid.

Although landslides are a natural geologic process, the incidence of landslides and their impacts on people can be exacerbated by human activities. Grading for road construction and development can increase slope steepness. Grading and construction can decrease the stability of a hillslope by adding weight to the top of the slope, removing support at the base of the slope, and increasing water content. Other human activities affecting landslides include: excavation, drainage and groundwater alterations, and changes in vegetation.¹⁴

Landslide Conditions

Natural Conditions

Natural processes can cause landslides or reactivate historical landslide sites. Rainfall-initiated landslides tend to be smaller, while earthquake-induced landslides may be very large, but less frequent. The removal of shoreline supporting material along bodies of water by currents and waves, or undercutting during construction at the base of a slope produces countless small slides each year. Seismic tremors can trigger landslides on slopes historically known to have landslide movement. Earthquakes can also cause additional failure (lateral spreading) that can occur on gentle slopes above steep streams and riverbanks. Landslides are particularly common along stream banks, reservoir shorelines, large lakes, and seacoasts. Steep, concave-shaped slopes with larger drainage areas appear to be more susceptible to landslides than other landforms. Landslides associated with volcanic eruptions can include volumes of over one cubic mile of material. All soil types can be affected by natural landslide triggering conditions.

Excavation and Grading

Slope excavation is common in the development of home sites or roads on sloping terrain. Grading these slopes can result in some slopes that are steeper than the pre-existing natural slopes. Since slope steepness is a major factor in landslides, these steeper slopes can be at an increased risk for landslides. The added weight of fill placed on slopes can also result in an increased landslide hazard. Small landslides can be fairly common along roads, in either the road cut or the road fill. Landslides occurring below

new construction sites are indicators of the potential impacts stemming from excavation.

What locations are at risk from landslides and debris flows?

Locations at risk from landslides or debris flows include areas with one or more of the following conditions:

- On or close to steep hills;
- Steep road-cuts or excavations into steep slopes;
- Existing landslides or places of known historic landslides (such sites often have tilted power lines, trees tilted in various directions, cracks in the ground, and irregular-surfaced ground);
- Steep areas where surface runoff is channeled, such as below culverts, V-shaped valleys, canyon bottoms, and steep stream channels;
- Fan-shaped areas of sediment and boulder accumulation at the outlets of canyons, large boulders (2 to 20 feet diameter) perched on soil near fans or adjacent to creeks; and
- Occurrences of logjams in streams.¹

Drainage and Groundwater Alterations

Water flowing through or over the ground is often the trigger for a landslide. Any activity that increases the amount of water flowing into landslide-prone slopes can increase landslide hazards. Broken or leaking water or sewer lines can be especially problematic, as can water retention facilities that direct water onto slopes. Even lawn irrigation and minor alterations to small streams in landslide prone locations can result in damaging landslides. Ineffective stormwater

management and excess runoff can also cause erosion and increase the risk of landslide hazards. Drainage can be affected naturally by the geology and topography of an area. Development that results in an increase in impervious surface impairs the ability of the land to absorb water and may redirect water to other areas. As a result, more landslides could occur.

Channels, streams, ponding, and erosion on slopes all indicate potential slope problems. Road and driveway drains, gutters, downspouts, and other constructed drainage facilities can concentrate and accelerate flow. Ground saturation and concentrated velocity flow are major causes of slope problems and may trigger landslides.¹⁵

Changes in Vegetation

Removing vegetation from very steep slopes can increase landslide hazards. The *Storm Impacts Study* conducted by the Oregon Department of Forestry found that landslide hazards in three out of four steeply sloped areas were highest for a period of ten years after timber harvesting.¹⁶ Areas that have experienced wildfire and land clearing for development may have long periods of increased landslide hazard. In addition, woody debris in stream channels (both natural and as a result from logging) may cause the impacts from debris flows to be more severe.¹⁷

Development

Development sites at the greatest risk from landslides are against the base of very steep slopes, in confined stream channels (small canyons), and on fans (rises) at the mouth of these confined channels. While home development sites do not cause landslides, they put residents and property at risk of landslide impacts. The simplest mitigation measure for this situation is to locate the home out of the impact area, or construct debris flow diversions for homes at risk. Three development-related actions that can put people at risk include:¹⁸

1. **Creating Steeper Slopes.** Excavation practices, sometimes aggravated by drainage, can reduce the stability of otherwise stable slopes. These failures commonly affect only a small number of homes. Without these excavation practices, there is little risk of landslides in areas not prone to landslide movement.
2. **Development on or Adjacent to Existing Landslides.** Existing landslides are generally at risk of future movement regardless of excavation practices. Excavation and drainage practices can further increase risk of landslides. In many cases, there are no development practices that can completely assure stability. Homeowners and communities in these situations accept some risk of future landslide movement.
3. **Development on Gentle Slopes.** Development on gentle slopes can be subject to landslides that begin a long distance from the development.

Informing new residents, long-time homeowners, and developers about the risks associated with landslides is an important issue related to landslide location and occurrence. Developers that are uninformed about geological

materials and processes may contribute to conditions that trigger landslide activity or increase susceptibility to landslide hazards.¹⁹

Landslide Hazard Assessment

Hazard Identification

Hazard identification is the first phase of a hazard assessment, and is the process of estimating the geographic extent of the hazard, its intensity, and its probability of occurrence.²⁰ This process usually results in a hazard map. Hazard maps can provide detailed information in a clear format and can assist in making policy and land use decisions.

Debris flows generally occur during intense periods of rainfall on previously saturated soil. They generally start on steep slopes and accelerate to speeds as great as 35 mph. These rapidly moving landslides have caused most of the recent landslide related injuries and deaths in Oregon.²¹ The previous damage and deaths associated with rapidly moving landslides in Oregon have been the catalyst for agencies to map these types of landslides. Currently, two state agencies are involved in mapping debris flows: (1) the Oregon Department of Forestry (ODF); and (2) the Department of Geology and Mineral Industries (DOGAMI).

Vulnerability Assessment

Vulnerability assessment is the second phase of a hazard assessment. It combines the information generated through debris flow identification with an inventory of the existing development exposed to landslide hazards. Vulnerability assessments assist in predicting how different types of property and population groups will be affected by a hazard.²² The optimum method for doing this analysis at the county or jurisdiction level is to use parcel-specific assessment data on land use and structures.²³ Data that includes specific landslide-prone and debris flow locations in the county can be used to assess the population and total value of property at risk from future landslide occurrences.

While a quantitative vulnerability assessment (an assessment that describes number of lives or amount of property exposed to the hazard) has not yet been conducted for Yamhill County landslide events, there are many qualitative factors (issues relating to what is in danger within a community) that point to potential vulnerability. Landslides can impact major transportation arteries, blocking residents from essential services and businesses. While past landslide events have not caused major property damage or significantly impacted county residents, continuing to map county landslide and debris flow areas will help in preventing future loss.

Risk Analysis

Risk analysis is the third, and most advanced phase of a hazard assessment. It builds upon hazard identification and vulnerability assessments.

Factors included in assessing landslide risk include population and property distribution in the hazard area, the frequency of landslide or debris flow

occurrences, slope steepness, soil characteristics, and precipitation intensity. This type of analysis could generate estimates of the damages to the county due to a landslide or debris flow event in a specific location. Current data is insufficient to conduct a risk analysis and the software needed to conduct this type of analysis was not available.

The Oregon Department of Forestry (ODF) and the Department of Geology and Mineral Industries (DOGAMI) are active in developing maps and collecting data on hazard risk. Developing partnerships with these agencies and other state and federal organizations can facilitate future strides in doing risk analysis for landslide hazards.

Community Landslide Issues

Landslides can affect utility services, transportation systems, and critical lifelines. Communities may suffer immediate damages and loss of service. Disruption of infrastructure, roads, and critical facilities may also have a long-term effect on the economy. Utilities, including potable water, wastewater, telecommunications, natural gas, and electric power are all essential to service community needs. Loss of electricity has the most widespread impact on other utilities and on the whole community. Natural gas pipes may also be at risk of breakage from landslide movements as small as an inch or two.²⁴

Lifelines and critical facilities should remain accessible if possible during a natural hazard event. The impact of closed transportation arteries may be increased if the closed road or bridge is a critical lifeline to hospitals or other emergency facilities. Therefore, inspection and repair of critical transportation facilities and routes is essential and should receive high priority. Losses of power and phone service are also potential consequences of landslide events. Due to heavy rains, soil erosion in hillside areas can be accelerated, resulting in loss of soil support beneath high voltage transmission towers in hillsides and remote areas.²⁵ Flood events can also cause landslides, which can have serious impacts on gas lines.

Mitigation Plan Goals and Existing Activities

Mitigation Plan Goals Addressed

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

The plan goals help to guide the direction of future activities aimed at reducing risk and preventing loss from natural hazards. The goals listed here serve as checkpoints as agencies and organization begin implementing mitigation action items.

Goal #1: EMERGENCY OPERATIONS

Goal Statement: Coordinate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures and with various other agencies, as appropriate.

Goal #2: EDUCATION AND OUTREACH

Goal Statement: Develop and implement education and outreach programs to increase public awareness of the risks associated with natural hazards.

Goal #3: PARTNERSHIPS

Goal Statement: Develop effective partnerships with public and private sector organizations and significant agencies and businesses for future natural hazard mitigation efforts.

Goal #4: PREVENTIVE

Goal Statements:

- Develop and implement activities to protect human life, commerce, and property from natural hazards.
- Reduce losses and repetitive damage for chronic hazard events while promoting insurance coverage for catastrophic hazards.

Goal #5: NATURAL RESOURCES UTILIZATION

Goal Statement: Link natural resources management, land use planning, and watershed planning with natural hazard mitigation activities to protect natural systems and allow them to serve natural hazard mitigation functions.

Goal #6: IMPLEMENTATION

Goal Statement: Implement strategies to mitigate the effects of natural hazards.

Existing Mitigation Activities

County

County Zoning Ordinance

Yamhill County mapped its steep slope (hazardous) areas and adopted steep slope ordinances.

State

Oregon State Senate Bill 12

The fatalities and losses resulting from the 1996 landslide events brought about the passage of Oregon Senate Bill 12, which set site development standards, authorized the mapping of areas subject to rapidly moving landslides and the development of model landslide (steep slope) ordinances. Provisions include:

- Allowing the Oregon State Forester to prevent timber harvest or road construction in or below areas identified by the Department of Forestry as “high risk sites” and where homes or highways are in precarious locations.
- Allowing road officials to close roads that pose risk to human life because of landslides.
- Requiring State agencies to develop, and local officials to distribute, information about hazards of construction on sites that are vulnerable to landslides.

- Establishing a ten-member Task Force on Landslides and Public Safety to assess the problem and develop a solution. It includes legislators and representatives from state natural resource agencies, boards of commissions, local government, and the public.

Debris Flow Mapping

Currently, two state agencies are involved in mapping debris flows: (1) the Oregon Department of Forestry (ODF) and (2) the Department of Geology and Mineral Industries (DOGAMI). Senate Bill 12 requires that the DOGAMI, with cooperation from local governments and the ODF, identify and map landslide-prone areas, or “further review areas.” Senate Bill 12 defines a further review area as “an area of land in which further site specific review should occur before land management or building activities begin.”²⁶ ODF is responsible for forecasting and measuring rainfall from storms that may trigger debris flows.

Oregon Department of Forestry (ODF)

The Oregon Department of Forestry has provided a preliminary indication of debris flow (rapidly moving landslides) in western Oregon. Their debris flow maps include the general locations subject to naturally occurring debris flows and include the initiation sites and locations along the paths of potential debris flows (confined stream channels and locations below steep slopes). These maps do not consider the effects of management-related slope alterations (drainage and excavation) that can increase the hazard, nor do they consider very large landslides that could possibly be triggered by volcanic or earthquake activity. Areas identified in these maps are not to be considered “further review areas” as defined by Senate Bill 12 (1999).²⁷

Information used to develop the ODF Debris Flow maps include:

- Digital elevation models at 30-meter resolution based on US Geological Survey data, to derive slope steepness and then to develop polygons for assigned hazards. Note that actual slopes are steeper than the digitally elevated models.
- Mapped locations of Tyee soil formation and similar sedimentary geologic units.
- Oregon Department of Forestry *Storm Impacts and Landslides of 1996* study; debris flow initiation and path location data.
- Stream channel confinement near steep hill slopes based on US Geological Survey Digital Raster Graphics.
- Historical information on debris flow occurrence in western Oregon (from Oregon Department of Forestry, US Forest Service, DOGAMI, Bureau of Land Management (BLM), and the Oregon Department of Transportation (ODOT)).
- Fan-shaped land formations below long, steep slopes.

Areas of highest intensity precipitation do not appear to be correlated with known areas of high and extreme debris flow hazard, so precipitation intensity was *not* used to develop risk (hazard) ratings.²⁸

Prohibition of Certain Forest Operations

As part of the requirements of Senate Bill 12, ODF is currently administering the deferral of certain forest operations on landslide-prone sites above homes and roads. The Department's policy is that timber harvesting or road construction operations will be prohibited on land where landslides or debris flows pose a significant threat to human safety. Exceptions for salvage or other purposes are considered on an individual basis, but have been infrequent in keeping with the intent of preventing significant risks to human life.²⁹

Debris Flow Warning System

Oregon initiated a debris flow warning system in 1997, which involves collaboration between ODF, DOGAMI, ODOT, local law enforcement, NOAA Weather Radio, and local media.

ODF meteorologists are responsible for forecasting storms that may trigger debris flows. Information is broadcast over NOAA Weather Radio and on the Law Enforcement Data System. DOGAMI provides additional information on debris flows to the media. ODOT provides information concerning the location of landslides/debris flows, and alternate transportation routes.³⁰ ODOT also provides warning signs to motorists in landslide-prone areas during high-risk periods.³¹

Landslide Brochure

DOGAMI developed a landslide public outreach brochure in cooperation with several other state agencies. Forty thousand copies were printed in November 1997 and were distributed widely to building codes officials, county planners, local emergency managers, field offices of natural resource agencies, banks, real estate companies, insurance companies, and other outlets. Landslide brochures are available from DOGAMI, OEM, ODF, and the Department of Land Conservation and Development (DLCD).³²

Oregon State Building Code Standards

The Oregon Building Codes Division adopts statewide standards for building construction that are administered by state and local municipalities throughout Oregon. The One- and Two-Family Dwelling Code and the Structural Specialty Code contain provisions for lot grading and site preparation for the construction of building foundations.

Both codes contain requirements for cut, fill, and sloping of the lot in relationship to the location of the foundation. There are also building setback requirements from the top and bottom of slopes. The codes specify foundation design requirements to accommodate the type of soils, the soil bearing pressure, and the compaction and lateral loads from soil and groundwater on sloped lots. The building official has the authority to require a soils analysis for any project where it appears the site conditions do not meet the requirements of the codes, or that special design considerations must be taken. ORS 455.447 and the Structural Code require a seismic site hazard report for projects that include essential facilities such as hospitals, fire and police stations, emergency response facilities, and special occupancy structures, such as large schools and prisons.³³

Case Study: Salem Landslide Ordinance

The 1996 flood events contributed to two major landslide events, which forced the City of Salem into litigation. Through FEMA's Hazard Mitigation Grant Program, the City of Salem, Marion County, and DOGAMI received \$250,000 to map landslide areas and develop a landslide ordinance.

The ordinance requires the preparation and approval of geological assessments before development occurs in areas identified with a moderate degree of hazard. Those areas then undergo a preliminary review of geologic conditions. The ordinance requires staff to determine if a geotechnical report requiring more information and detail than the geological assessment is necessary. This approach ensures adequate review of proposed development on private property where potentially greater risk requires detailed information to fully identify and address the hazard. Additionally, prior to development, a declaratory statement indicating that the property is within an identified hazard area must be recorded on the property deed. Compliance with the ordinance is required as part of any land use permit and building permit for regulated activities within identified hazard areas.³⁴

The Salem ordinance identified four key elements:

- 1) Identify the hazard.** DOGAMI produced water-induced and earthquake-induced landslide maps for South Salem and Eola Hills. The ordinance incorporates slope steepness and hazard areas. The slope steepness criteria were formulated to address hillside development, which was not included in the mapping process. Salem's Building and Safety Division created a kiosk where people can print out landslide maps of site-specific areas.
- 2) Determine when to regulate.** The city developed a graduated response table to determine the level of site investigation for various types of regulated activities on property within the mapped area. Landslides with moderate or high susceptibility may be subject to regulation (this is determined by the regulated activity).
- 3) Establish an assessment process for hazard areas.** The city adopted its assessment process as a procedural ordinance that documents when to require a geological assessment prepared by a Certified Engineering Geologist or a geotechnical report prepared by both a Certified Engineering Geologist and a registered Geotechnical Engineer. When development is in a high-risk area, the city requires the geological assessment and the geotechnical report.
- 4) Share the responsibility of hillside development.** Partnerships with state and local officials, residents, and businesses can reduce risk and prevent loss by bringing all their concerns to the table.

Why is the Salem landslide ordinance useful?

Because there is vacant land in landslide areas, it is important to develop landslide hazard mitigation activities. The potential for future development

necessitates strong regulation to reduce risk from potential landslide events.

Salem's landslide ordinance requires that an appropriate level of *study* occur before development occurs. While the process of developing a new ordinance was not without controversy, it was a collaborative project. Collaborative partnerships assist in future implementation. DOGAMI, OEM, DLCDC, Marion County, the Board of Examiners, State Engineering Board, and the City of Salem played a role in developing the ordinance.

For more information, contact:

City of Salem

555 Liberty St. SE/Room 305, Salem, OR 97301-3503

Phone: (503) 588-6211

Fax: (503) 588-6005

http://www.open.org/~naturalr/Landslides/landslide_Ord.htm

Landslide Mitigation Action Items

The following mitigation action items were formulated through research of regional mitigation plans, natural hazards planning literature, and interviews with local stakeholders. Plan actions items were refined through discussions with the mitigation plan steering committee and through an open house at which the county received comments from the public.

The landslide mitigation action items provide direction on specific activities that organizations and residents in Yamhill County can undertake to reduce risk and prevent loss from landslides. Each action item is followed by ideas for implementation, which can be used by the steering committee and local decision makers in pursuing strategies for implementation.

This section lists action items identified to reduce the risk from landslides in Yamhill County. These action items are designed to meet the mitigation plan goals.

Short-term (ST) Landslide Action Items

Short-term landslide action items include general mitigation activities that agencies are capable of implementing during the next two years, given their existing resources and authorities.

ST-LS #1: Improve knowledge of landslide hazard areas and understanding of vulnerability and risk to life and property in hazard-prone areas.

Ideas for Implementation

- Incorporate the results of the DOGAMI mapping effort when available into the County Natural Hazards Mitigation Plan Risk Assessment, and other county planning documents;
- Continue mapping county landslide and debris flow areas;
- Identify the location and extent of hazard areas and establish a factual base to support implementation of future measures;
- Analyze the risk of these areas to life, property, and infrastructure; and
- Develop public information to emphasize economic risk when building on potential or historical landslide areas.

Coordinating Organization:	Emergency Management
Internal Partner:	GIS, Public Works, Planning
External Partner:	DOGAMI, ODF, cities
Timeline:	2 years, On-going
Plan Goals Addressed:	Education & Outreach; Partnerships; Preventive; Implementation

ST-LS #2: Encourage construction, site location and design that can be applied to steep slopes to reduce the potential threat of landslides.

Ideas for Implementation

- Reduce driveway cuts into the hillside;
- Adjust the building setback from property lines to minimize building site cuts and fills;
- Require erosion control techniques, such as the temporary use of hay bales, diversion dams, or other physical changes to control stormwater runoff during road and site construction;
- Suggest to property owners to reduce water input into slopes from building roof drains, storm drains, and surface runoff;
- Develop a 'how-to' development and construction guide for homeowners in potential landslide hazard areas; and
- Develop public information to emphasize economic risk when building on potential or historical landslide areas.
- Where appropriate, reduce the number of building sites and corresponding disruption of the natural contour and vegetation; and
- Increase communication and coordination between Yamhill County Public Works and Building Departments.

Coordinating Organization: Emergency Management, Building and Public Works
Internal Partner: Planning
External Partners: DLCD, cities, IBHS
Timeline: 1 to 3 years
Plan Goals Addressed: Education & Outreach; Partnerships; Preventive; Natural Resources Utilization; Implementation

ST-LS #3: Identify safe evacuation routes in high-risk debris flow and landslide areas.

Ideas for Implementation

- Identify potential debris removal resources;
- Make available in GIS for access to the public;
- Increase participation in regional committee planning for emergency transportation routes; and
- Identify and publicize information regarding emergency transportation routes.

Coordinating Organization: Public Works
Internal Partner: Emergency Management, GIS
External Partner: ODOT, adjacent counties, DOGAMI
Timeline: 2 years
Plan Goals Addressed: Emergency Operations; Partnerships; Preventive

ST-LS #4: Compile Relative Landslide Risk maps for Yamhill County.

Note: DOGAMI will make the final determination of “further review areas” for rapidly moving landslides as required by Oregon Senate Bill 12.

Ideas for Implementation

- Once “further review areas” are established by DOGAMI, overlay those areas with utility system maps and tax assessor information to identify potential risk.

Coordinating Organization: GIS
Internal Partners: Emergency Management, Planning, Public Works, Assessor’s Office
External Partners: USFS, BLM, water systems, utilities, forest industries, DOGAMI
Timeline: Depending on DOGAMI funding in this biennium
Plan Goals Addressed: Emergency Operations; Education & Outreach; Partnerships; Preventive

ST-LS #5: Increase public education related to landslide hazards by distributing DOGAMI landslide informational brochure.

NOTE: DOGAMI produced an information brochure on landslide hazards.

Ideas for Implementation

- Distribute the DOGAMI landslide informational brochure.

Coordinating Organization: Emergency Management
Internal Partner: Planning, Public Works
External Partners: City emergency managers, DOGAMI, OEM, DLCD
Timeline: 1 to 2 years
Plan Goals Addressed: Education & Outreach; Partnerships

Long-term (LT) Landslide Action Items

Long-term landslide action items include general mitigation activities that are likely to take more than two years to implement and may require new or additional resources and/or authorities.

LT-LS #1: Evaluate current landslide warning systems to ensure effectiveness and efficiency and increase coordination between local jurisdictions and ODF for landslide warning systems.

Ideas for Implementation

- Educate high-risk populations about climatic and soil conditions that are conducive to landslides.

Coordinating Organization: Emergency Management
Internal Partner: Planning
External Partner: Builders, developers, property owners, ODF, BLM
Timeline: On-going
Plan Goals Addressed: Emergency Operations; Education & Outreach; Preventive

LT-LS #2: Mitigate activities in identified potential and historical landslide areas through public outreach.

Ideas for Implementation

- Coordinate with property owners to reduce risk in landslide hazard areas;
- Provide information on hazard location to future residents;
- Encourage information about hazard susceptibility on deeds;
- Distribute landslide educational materials to the public; and
- Identify and use existing mechanisms for public outreach (e.g., SWCD, NRCS, watershed councils, OSU Extension, etc.).

Coordinating Organization: Planning, Emergency Management
Internal Partners: Public Works
External Partners: ODF, cities, mortgage companies
Timeline: 3 to 5 years; on-going
Plan Goals Addressed: Education & Outreach; Partnerships; Preventive; Implementation

LT-LS #3: Increase coordination between local jurisdictions, emergency responders, homeowners and ODF for landslide warning systems.

Ideas for Implementation

- Educate at-risk home sites about climatic and soil conditions that are conducive to landslides; and
- Develop mitigation and evacuation information and procedures for at-risk home sites.

Coordinating Organization: Emergency Management
Internal Partner: Planning, Building
External Partner: City planning departments
Timeline: 3 to 5 years
Plan Goals Addressed: Emergency Operations; Education & Outreach; Preventive; Natural Resources Utilization; Implementation

LT-LS #4: Investigate the development and implementation of a county landslide ordinance.

Ideas for Implementation

- Use financial incentives or disincentives to promote development outside the identified risk areas; and
- Utilize the *Salem Steep Slope/Landslide* ordinance as an example of key components.

Coordinating Organization: Planning
 Internal Partner: Emergency Management, GIS, Public Works
 External Partner: DOGAMI, ODF
 Timeline: 3 to 5 years
 Plan Goals Addressed: Preventive; Natural Resources Utilization.

LT-LS #5: Protect existing development in landslide-prone areas.

Ideas for Implementation

- Provide information to residents on landslide prevention. Publications such as FEMA's *Homeowners Landslide Guide for Hillside Flooding, Debris Flows, Erosion, and Landslide Control* and FEMA's *Hillside Drainage* flier have some ideas about reducing landslide susceptibility;
- Encourage easements to restrict certain activities on landslide-prone properties. Easements foregoing the right to develop a property can be either sold or granted to the county or other organizations by property owners;
- Investigate land purchasing programs;
- Use Transfer of Development Rights to transfer development rights of a landslide hazard area by deed, easement, or other legal instrument authorized by local law to another parcel of land that is not prone to landslides;
- Construct debris flow diversions to protect existing properties; and
- Use and publicize the Oregon Department of Forestry's debris flow warning system.

Coordinating Organization: Emergency Management
 Internal Partner: Planning
 External Partner: DLCD, OEM, FEMA, ODF, cities
 Timeline: On-going
 Plan Goals Addressed: Partnerships; Education & Outreach; Preventive; Natural Resources Utilization; Implementation

LT-LS #6: Maintain public and private drainage systems.

Ideas for Implementation

- Ensure that ditches, stormwater facilities, and culverts are inspected and cleared prior to the wet season each year; and
- Encourage the placement of culverts built for 50 to 100-year flood events.

Coordinating Organization: Public Works
Internal Partner: GIS, Planning
External Partner: Cities, BLM
Timeline: On-going
Plan Goals Addressed: Education & Outreach; Partnerships; Preventive; Natural Resources Utilization; Implementation

Landslide Resource Directory

Regional Resources

Yamhill Soil & Water Conservation District (Yamhill SWCD)

The Yamhill SWCD is a subdivision of the state government, led by a locally elected board of directors who serve without pay. The district's charge is to help conserve the land, water, plants, and wildlife resources in Yamhill County. Associated directors, staff, and volunteers to carry out the district activities join the Yamhill SWCD directors. Much of the district's work involves matching governmental assistance with local conservation needs and encouraging land managers to use conservation practices.

Contact: Yamhill Soil & Water Conservation District; Tim Stieber, District Manager
Address: 2200 SW 2nd Street, McMinnville, OR 97128
Phone: 503-472-6403
Fax: 503-472-2459
Website: www.yamhillswcd.org

Yamhill Basin Council

The Yamhill Basin Council formed in 1995 and is a 27-member local advisory group for the Yamhill River and Chehalem Creek watersheds dedicated to addressing local resource management issues. The Council seeks to:

- Conduct and coordinate education, outreach and promotion of watershed information.
- Coordinate monitoring, assessment, and action plan projects.
- Obtain funding for watershed projects.
- Act as a forum for bringing stakeholders together.

Contact: Yamhill Basin Council, Jamie Sheahan, Watershed Coordinator
Address: 636 NE 7th St., McMinnville, OR 97128
Phone: 503-434-7447

State Resources

Department of Land Conservation and Development (DLCD)

Oregon's Department of Land Conservation and Development administers a natural hazards program to assist local governments in meeting statewide Planning Goal 7: Areas Subject to Natural Disasters and Hazards.

Activities relating to landslide mitigation include:

- Distribution of model ordinances through which hazards can be mitigated. DLCD advises local governments on which ordinance best meets their needs;
- Reviewing local land use plan amendments for consistency with state landslide programs and regulations and providing direct technical assistance;
- Providing a liaison between pertinent local, state, and federal agencies. DLCD representatives serve on a variety of commissions and ad hoc committees which deal with natural hazards;
- Adopting and amending statewide planning goals and administrative rules relating to natural hazards.

Contact: State Floodplain Manager, Natural Hazards Program Manager
Address: 635 Capitol Street NE, Suite 150
Phone: 503-373-0050
Fax: 503-378-6033
Website: <http://www.lcd.state.or.us/hazards.html>

Oregon Department of Forestry (ODF)

The mission of the Oregon Department of Forestry is to serve the people of Oregon through the protection, management, and promotion of a healthy forest environment, which will enhance Oregon's livability and economy for today and tomorrow. ODF regulates forest operations to reduce the risk of serious injury or death from rapidly moving landslides related to forest operations, and assists local governments in the siting review of permanent dwellings on and adjacent to forestlands in further review areas.

Contact: Oregon Department of Forestry (Salem Headquarters)
Address: 2600 State Street, Salem, Oregon 97310
Phone: 503-945-7200
Website: <http://www.odf.state.or.us>

Oregon Department of Forestry Debris Flow Warning Page

The ODF debris flow warning page provides communities with up-to-date access to information regarding potential debris flows. As the lead agency, ODF is responsible for forecasting and measuring rainfall from storms that may trigger debris flows. Advisories and warnings are issued as appropriate. Information is broadcast over NOAA weather radio and on the Law Enforcement Data System. DOGAMI provides additional information on debris flows to the media that convey the information to the public. ODOT also provides warnings to motorists during periods determined to be of highest risk for rapidly moving landslides along areas on state highways

with a history of being most vulnerable. Information is available on the ODF website at www.odf.state.or.us.

Oregon Department of Geology and Mineral Industries (DOGAMI)

DOGAMI is an important agency for landslide mitigation activities in Oregon. Some key functions of DOGAMI are development of geologic data, producing maps, and acting as lead regulator for mining and drilling for geological resources. The agency also provides technical resources for communities and provides public education on geologic hazards. DOGAMI provides data and geologic information to local, state, and federal natural resource agencies, industry, and private groups.

Contact: Department of Geology and Mineral Industries (DOGAMI)
Address: 800 NE Oregon Street, Suite 965, Portland, Oregon 97232
Phone: 503-731-4100
Fax: 503-731-4066
Website: <http://sarvis.dogami.state.or.us>
Email: info@naturenw.org

Nature of the Northwest

Oregon Department of Geology and Mineral Industries and the USDA Forest Service jointly operate the Nature of the Northwest Information Center. The Center offers a selection of maps and publications from state, federal, and private agencies.

Contact: The Nature of the Northwest Information Center
Address: 800 NE Oregon Street #5, Suite 177, Portland, Oregon 97232
Phone: 503-872- 2750
Fax: 503-731-4066
Website: <http://www.naturenw.org>
Email: Nature.of.Northwest@state.or.us

Oregon Department of Transportation (ODOT)

ODOT provides warnings to motorists during periods determined to be of highest risk of rapidly moving landslides along areas on state highways with a history of being most vulnerable to rapidly moving landslides. ODOT also monitors for landslide activity and responds to slide events on state highways.

Contact: ODOT Transportation Building
Address: 355 Capitol St. NE, Salem, OR 97310
Phone: 888-275-6368
Website: <http://www.odot.state.or.us>

Oregon State Police (OSP)-Office of Emergency Management (OEM)

OEM coordinates state resources for rapid and effective response to rapidly moving landslide and other landslide-related emergencies. The Oregon Emergency Response System (OERS) of OEM is a key player in the dissemination of debris flow advisories and warnings. OEM chairs a group that develops and measures landslide hazard mitigation strategies. OEM also administers the FEMA Hazard Mitigation Grant Program, which provides a source of funding for implementing hazard mitigation projects.

OEM also works with other state agencies to develop information for local governments and the public on landslide hazards.

Contact: Oregon Emergency Management
Address: 3225 State Street, Salem, Oregon, 97301
Phone: 503-378-2911
Fax: 503-373-7833
Website: <http://www.osp.state.or.us/oem>

Portland State University, Department of Geology

Portland State University conducts research and prepares inventories and reports for communities throughout Oregon. Research and projects conducted through the Department of Geology at Portland State University include an inventory of landslides for the Portland metropolitan region after the 1996 and 1997 floods and a subsequent susceptibility report and planning document for Metro.

Contact: Portland State University, Department of Geology
Address: 17 Cramer Hall; 1721 SW Broadway, Box 751, Portland, OR 97201
Phone: 503-725-3022
Website: <http://www.geol.pdx.edu>
Email: geology@pdx.edu

Federal Resources and Programs

Federal Emergency Management Agency, landslide fact sheet

FEMA's website contains information on strategies to reduce risk and prevent loss from landslides and debris flows.

Contact: Federal Regional Center, Region 10
Address: 130-228th St. SW, Bothell, WA 98021-9796
Phone: 425-487-4600
Website: <http://www.fema.gov/library/landslif.htm>

Natural Resource Conservation Service (NRCS)

The NRCS produces soil surveys. These may be useful to local governments that are assessing areas with potential development limitations including steep slopes and soil types. They operate many programs dealing with the protection of natural resources.

Contact: NRCS, Oregon Branch
Address: 101 SW Main Street, Suite 1300, Portland, OR 97204
Phone: 503-414-3200
Fax: 503-414-3103
Website: <http://www.or.nrcs.usda.gov>

US Geological Survey, National Landslide Information Center (NLIC)

The NLIC website provides good information on the programs and resources regarding landslides. The website includes information on the National Landslide Hazards Program Information Center, a bibliography, publications, and current projects. USGS scientists are working to reduce long-term losses and casualties from landslide hazards through better

understanding of the causes and mechanisms of ground failure both nationally and worldwide.

Contact: National Landslide Information Center
Phone: 800-654-4966
Website: <http://landslide.usgs.gov>

Additional Resources

American Planning Association (APA)

The APA's research department embarked on a program to bring together solutions from multiple disciplines into a single source. The APA Landslides Project will help serve local planning efforts in identifying landslide hazards during the planning process so as to minimize exposure to landslide risks. The APA's website highlights planning efforts to reduce risk and loss from landslides.

Contact: Principal Investigator, Landslides Project
Address: Research Department, American Planning Association
122 S. Michigan Ave., Suite 1600
Chicago, Illinois 60603-6107
Phone: 312-431-9100
Fax: 312-431-9985
Website: <http://www.planning.org/landslides>
Email: landslides@planning.org

Institute for Business & Home Safety (IBHS)

IBHS was created as an initiative of the insurance industry to reduce damage and losses caused by natural disasters. Their website provides educational resources and on-line publications for insurers, businesses, and homeowners who are interested in taking the initiative to minimize future damages and losses.

Contact: Institute for Business and Home Safety
Address: 1408 North Westshore Boulevard, Suite 208, Tampa, FL 33607
Phone: 813-286-3400
Fax: 813-286-9960
E-mail: info@ibhs.org
Website: <http://www.ibhs.org/ibhs2>

State of Washington, Department of Ecology

The Washington State Department of Ecology manages a landslide website with tips for reducing risk, warning signs, and maps.

Contact: Department of Ecology
Address: PO Box 47600, Olympia, WA 98504-7600
Website: <http://www.ecy.wa.gov/programs/sea/landslides>
Email: hshi461@ecy.wa.gov

Publications

Planning for Natural Hazards: The Oregon Technical Resource Guide, Department of Land Conservation and Development (July 2000).

Produced by the Community Planning Workshop for the Department of Land Conservation and Development, this is a natural hazards planning and mitigation resource for Oregon cities and counties. The document provides hazard-specific resources and plan evaluation tools. The document was written for local government employees and officials. The Technical Resource Guide includes a natural hazards comprehensive plan review, a hazard mitigation legal issues guide, and five hazard-specific technical resource guides, including: flooding, wildfires, landslides, coastal hazards, and earthquakes. You can write, call, fax, or go on-line to obtain this document.

Contact: Natural Hazards Program Manager, DLCD
Address: 635 Capitol St. NE, Suite 200, Salem, OR 97301-2540
Phone: 503-373-0050
Fax: 503-378-6033
Website: <http://www.lcd.state.or.us/hazards.html>

Mileti, Dennis, *Disasters by Design: A Reassessment of Natural Hazards in the United States (1999)* Joseph Henry Press.

This book offers a way to view, study, and manage hazards in the United States that will help foster disaster-resilient communities, higher environmental quality, inter- and intragenerational equity, economic sustainability, and an improved quality of life. The volume provides an overview of what is known about natural hazards, recovery, and mitigation; reveals how research findings have been translated into policies and programs; and advances a sustainable hazard mitigation research agenda.

Olshansky, Robert B., *Planning for Hillside Development* (1996) American Planning Association.

This document describes the history, purpose, and functions of hillside development and regulation and the role of planning, and provides excerpts from hillside plans, ordinances, and guidelines from communities throughout the US.

Olshansky, Robert B. & Rogers, J. David, *Unstable Ground: Landslide Policy in the United States* (1987) Ecology Law Quarterly.

This is about the history and policy of landslide mitigation in the US.

Public Assistance Debris Management Guide (July 2000) Federal Emergency Management Agency.

FEMA developed the Debris Management Guide to assist local officials in planning, mobilizing, organizing, and controlling large-scale debris clearance, removal, and disposal operations. Debris management is generally associated with post-disaster recovery. While it should be compliant with local and county emergency operations plans, developing strategies to ensure strong debris management is a way to integrate debris management within mitigation activities. The Guide is available in hard copy or on the FEMA website.

Contact: FEMA Distribution Center
Address: 130 - 228th Street, SW, Bothell, WA 98021-9796
Phone: 800-480-2520

Website: <http://www.fema.gov/r-n-r/pa/dmgtoc.htm>

USGS Landslide Program Brochure. National Landslide Information Center (NLIC), United States Geologic Survey.

The brochure provides good, general information in simple terminology on the importance of landslide studies and a list of databases, outreach, and exhibits maintained by the NLIC. The brochure also includes information on the types and causes of landslides, rockfalls, and flows.

Contact: USGS- MS 966, Box 25046

Address: Denver, Federal Center, Denver, CO 80225

Phone: 800654-4966

Web: <http://geohazards.cr.usgs.gov/>

Landslides - Endnotes

¹ Mileti, Dennis. 1999. *Disasters by Design: A Reassessment of Natural Hazards in the United States*. Washington D.C.: Joseph Henry Press.

² Brabb, E.E., and B.L Harrod, eds. 1989. *Landslides: Extent and Economic Significance. Proceedings of the 28th International Geological Congress Symposium on Landslides*. Washington D.C., Rotterdam: Balkema.

³ *USGS Landslide Program Brochure*, National Landslide Information Center, United States Geologic Survey.

⁴ Harvey, Andrew F.. and Gary L. Peterson. 1998. *Water-Induced Landslide Hazards, Western Portion of the Salem Hills, Marion County, Oregon*.

⁵ Region 3 Mid/Southern Willamette Valley Hazards Assessment.

⁶ <http://www.fs.fed.us/r6/nr/fid/cr96/cond96.shtml#winter>. Accessed August 19, 2004.

⁷ Harvey and Peterson. *Water-Induced Landslide Hazards, Western Portion of the Salem Hills, Marion County, Oregon*.

⁸ Id.

⁹ Id.

¹⁰ Interagency Hazard Mitigation Team. 2000. *State Hazard Mitigation Plan*. Oregon State Police – Office of Emergency Management.

¹¹ Robert Olson Associates. June 1999. *Metro Regional Hazard Mitigation Policy and Planning Guide*. Portland, OR: Metro.

¹² Id.

¹³ Department of Land Conservation and Development. July 2000. *Planning for Natural Hazards: The Oregon Technical Resource Guide*. Ch. 5.

¹⁴ Id.

¹⁵ FEMA. March 1997. *Homeowner's Guide for landslide control, hillside flooding, debris flows, soil erosion*.

¹⁶ Oregon Department of Forestry. 1999. *Storm Impacts and Landslides of 1996 Final Report*.

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- ¹⁷ Department of Land Conservation and Development. July 2000. *Planning for Natural Hazards: The Oregon Technical Resource Guide*. Ch. 5.
- ¹⁸ Id.
- ¹⁹ American Institute of Professional Geologists. 1993. *The Citizens' Guide to Geologic Hazard*. American Institute of Professional Geologists.
- ²⁰ Burby, R., ed. 1998. *Cooperating with Nature*. Washington D.C.: Joseph Henry Press.
- ²¹ Interagency Hazard Mitigation Team. 2000. *State Hazard Mitigation Plan*. Oregon State Police – Office of Emergency Management.
- ²² Burby, R., ed. 1998. *Cooperating with Nature*. Washington D.C.: Joseph Henry Press.
- ²³ Id.
- ²⁴ Goettel & Associates. February 1998. *Regional All Hazard Mitigation Master Plan for Clackamas County*.
- ²⁵ Id.
- ²⁶ Interagency Hazard Mitigation Team. 2000. *State Hazard Mitigation Plan*. Oregon State Police – Office of Emergency Management.
- ²⁷ Department of Geology and Mineral Industries/Oregon Department of Forestry. 1999. *Western Oregon Debris Flow Hazard Maps: Methodology and Guidance for Map Use*.
- ²⁸ Id.
- ²⁹ Id.
- ³⁰ Region 3 Mid/Southern Willamette Valley Hazards Assessment. November 2003.
- ³¹ Department of Geology and Mineral Industries/Oregon Department of Forestry. 1999. *Western Oregon Debris Flow Hazard Maps: Methodology and Guidance for Map Use*.
- ³² Id.
- ³³ Department of Land Conservation and Development. July 2000. *Planning for Natural Hazards: The Oregon Technical Resource Guide*, Chapter 5.
- ³⁴ Id.

Section 8: Wildfire

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Why are Wildfires a threat to Yamhill County?

Wildfires are an uncontrolled burning of forest, brush, or grassland. Wildfire has been a natural part of these ecosystems in Oregon and is widespread throughout the State. Oregon has over 41 million acres (more than 64,000 square miles) of forest and rangeland that are susceptible to wildfire. In addition, significant agricultural areas of the Willamette Valley and north and central Oregon contain crops, such as wheat, are prone to wildfire damage. Communities are also at risk from wildfires, and substantial hazards exist for communities at the wildland/urban interface. According to the 2001 Federal Register, 367 Oregon communities are at risk of damage from wildfire. Yamhill County contains such communities.¹

The majority of wildfires occur in the summer between June and October. Wildfires can occur at other times of the year, however, when weather and fuel conditions combine to allow ignition and spread. Seventy percent of Oregon's wildland fires result from human activity. The remaining thirty percent result from lightning, occurring most frequently in eastern and southern Oregon.

Residential development in forested areas will likely experience fires at some point. A lack of firebreaks surrounding buildings, limited water availability during the high-risk summer months, and fire suppression over the last 100 years contribute to a fire hazard in the forested hillsides of Yamhill County. Suppression of fire has contributed as much to the current vegetation pattern as historically intentional burning. The Yamhill region has significantly more acres of Douglas fir and much less oak savanna and prairie since the end of intentional burning in the middle of the 19th century.²

History of Oregon Wildfires

Wildfires have been a feature of the Oregon landscape for thousands of years. These fires resulted from lightning and from the practices of Native Americans. For at least the past four thousand years and possibly as long as ten thousand years prior to Euro-American settlement, humans have systematically burned large sections of the Willamette Valley including the greater Yamhill County area.

Fires in southwestern Yamhill County have resulted from both natural and human-induced causes. Natural fires were mostly the products of lightning strikes "but the frequency of thunderstorms in the Willamette Valley ranks among the lowest in North America."³ Thus, the relative frequency of these natural fires is thought to be extremely low.

The indigenous Che-ahm-ill people of the "Yam Hills" area were a subgroup of the Kalapuyan culture. They occupied the Yamhill River basin valley at the time of Euro-American contact.⁴ The Kalapuyans intentionally torched large portions of the landscape annually for a number of practical reasons including agriculture, hunting, communication, warfare, visibility, safety and sanitation.⁵ Many of these areas otherwise would have supported the Douglas fir forests that

have grown up in these areas over the past 150 years. Native uses of fire, which included trail building, amusement, agriculture, camping and hunting, and logging slash,⁶ were replaced with those of Euro-American settlers.

Natural and human-caused wildfires continued to shape the landscape after Euro-American settlement, but in different ways. Between 1840 and 1900, wild land fires burned at least two million acres of forestland in western Oregon. Settlers caused most, if not all of these fires.⁷ In the 1850s, the Coast Range forests burned more than they had in previous decades while valley prairies and savannas began to experience less fire and were either turned into field and pasture or began growing into forests. Settlers and their descendants have viewed fire control as necessary to protect timber and property in the region, an approach that continues to this day.

There were many fires in 1902 and 1910.⁸ In 1933, the infamous Tillamook burn covered nearly a quarter of a million acres. The Tillamook fire is thought to have caused several localized burns in the Willamina watershed.⁹ Since the 1930s, fire suppression crews have become better trained and organized. The largest, well-documented forest fire in Yamhill County history occurred in 1949. On September 29, the *Telephone Register* (now the *News Register*) reported that “18,000 acres of slash and second growth timber” was burned. The fire started in Peavine Canyon and spread to East Creek area, six miles north of Willamina.¹⁰ In the 1950s, a public education campaign through area newspapers urged residents to prevent forest fires. Through the later decades of the 20th century and currently, large fires continue to burn most years in various parts of the West.

In the early 1970s, an increasing number of wildland fires affected or involved homes. Suburban growth continued through the 1980s, and by the early 1990s frequent and destructive wildland interface fires had become a major concern of the State Forester, the State Fire Marshal and the State Legislature. In the 1990s, more than 100 structures burned in wildland fires, thousands more were threatened, and losses and suppression costs skyrocketed. In 1997, the Legislature passed Senate Bill 360, the Oregon Forestland-Urban Interface Fire Protection Act, “to provide a complete and coordinated fire protection system,” and recognized that “forestland-urban interface property owners have a basic responsibility to share in a complete and coordinated protection system...”

Fires in 2002 underscored the need for urgent action. Sparked by intense mid-summer dry lightning storms, wildfires burned hundreds of thousands of acres of Oregon forestland. There were ten, Governor-declared conflagrations, with as many as five events running concurrently. More than 50 structures burned and thousands more were threatened; at one point, the entire Illinois Valley in southwestern Oregon, the home of approximately 17,000 people, was under imminent evacuation alert due to the vast Florence/Biscuit Fire. Table 8-1 summarizes major fire events in Oregon between 1848 and 2002.

Table 8-1. Historic Fires in Oregon (1848-2003)

Year	Name of Fire	Counties	Acres burned
1848	Nestucca	Tillamook/Yamhill	290,000
1849	Siletz	Lincoln/Polk	800,000
1853	Yaquina	Lincoln	482,000
1865	Silverton	Marion	988,000
1868	Coos Bay	Coos	296,000
1933	Tillamook	Tillamook/Yamhill	240,000
1936	Bandon	Coos	143,000
1939	Saddle Mountain	Tillamook/Yamhill	190,000
1945	Wilson River/Salmonberry	Tillamook	182,000
1951	North Fork & Elkhorn	Tillamook, Yamhill	33,000
1966	Oxbow	Lane	44,000
1987	Silver	Josephine	97,000
1992	Lone Pine	Klamath	31,000
1996	Skelton	Deschutes	17,700
2002	Biscuit	Josephine/Curry	500,000
2003	B&B Complex	Jefferson/Linn/Deschutes/Marion	80,000

Sources: Atlas of Oregon, William G. Loy, et al, University of Oregon Books, 1976.
Oregon Department of Forestry (ODF), Tillamook Burn to Tillamook State Forest, August 1993.
Oregon Emergency Management, State Hazard Risk Assessment, 2003.
ODF,
http://www.odf.state.or.us/DIVISIONS/protection/fire_protection/stats/histfire.asp?id+3070105

During the 2000 fire season, more than 7.5 million acres of public and private lands burned in the US, resulting in loss of property, damage to resources, and disruption of community services. Taxpayers spent more than \$1.6 billion to combat 90,000 fires nationwide.¹¹ Many of these fires burned in wildland/urban interface areas and exceeded the fire suppression capabilities of those areas. The magnitude of wildfires is dependent on two primary factors: (1) severe drought, accompanied by a series of storms that produce thousands of lightning strikes and windy conditions; and (2) the effects of wildfire suppression over the past century that has led to buildup of brush and small diameter trees in the nation's forests and rangelands.¹² Table 8-2 illustrates the fire suppression costs for state, private, and federal lands protected by the Oregon Department of Forestry between 1985 and 2004.

Table 8-2. History of Fire Suppression Costs in Oregon 1985-2004

Year	Suppression Costs in \$*
1985	3,268,644
1986	5,847,018
1987	32,080,746
1988	13,192,596

1989	6,394,593
1990	8,279,974
1991	5,381,192
1992	17,000,000
1993	4,023,033
1994	21,100,000
1995	4,360,349
1996	5,066,227
1997	1,210,692
1998	2,056,343
1999	5,320,555
2000	5,750,862
2001	33,792,483
2002	65,255,154
2003	17,352,717
2004	10,493,951

Source: Oregon Department of Forestry

*Costs include District costs, extra costs, private costs, and other costs.

2002 Wildfires

Apple (Umpqua National Forest)

This fire was 21 miles east of Glide, and encompassed 9,800 acres. Twenty residences were threatened.

Tiller Complex (Umpqua National Forest)

This 65,824-acre fire consisted of eight large and numerous small fires, on the Tiller Ranger District and in the Rogue-Umpqua Divide Wilderness Area, 25 miles east of Canyonville. Sixty-seven residences were threatened.

Biscuit Fire (Siskiyou National Forest)

This fire cost more than \$160 million to fight, and was located in southern Oregon and northern California. The fire began on July 13, 2002 and reached 500,023 acres in August 2002. Estimated to be one of Oregon's largest wildfires in recorded history, the Biscuit Fire encompassed most of the Kalmiopsis Wilderness. The boundary of the Biscuit Fire stretched from ten miles east of the coastal community of Brookings, Oregon; south into northern California; east to the Illinois Valley; and north to within a few miles of the Rogue River. There were 274 structures threatened by this fire. Four residences and nine outbuildings were lost.¹³

2003 Wildfires

B&B Complex (Deschutes National Forest)

This fire, characterized by extreme plume-dominated behavior, grew to 80,000 acres in September 2003 as the Booth and Bear Butte fires

merged. The entire community of Camp Sherman, approximately 300 residents, was twice evacuated to avoid the fire's danger and Highway 20 was temporarily closed.¹⁴ A total of 2,205 personnel, 82 fire engines and 10 helicopters were employed to battle the fire. Governor Kulongoski invoked the Conflagration Act for the east side of the B&B Complex.¹⁵ The B & B Complex fire burned into a portion of Marion County.

Herman Creek Fire (USDA Forest Service & ODF lands)

The 370-acre Herman Creek Fire near Cascade Locks in the Columbia Gorge closed a 47-mile stretch between Hood River and Troutdale and caused traffic problems as far away as Portland. Union Pacific Railroad delayed its trains on the south side of the Columbia River as railroad ties caught fire. Sixty people were evacuated to temporary shelters in Stevens Point, WA as the fire burned within feet of dozens of homes. A bed and breakfast business and an abandoned house and barn burned to the ground.¹⁶

“With more Oregonians than ever living in forests that have grown thicker than ever through decades of strict fire suppression, even modest fires can quickly consume lives, homes, and the millions of dollars it costs to fight them.”

The Oregonian,
Feb. 26, 2001

Wildfire Characteristics

The characteristics of fire are important to understand when trying to mitigate its negative effects on humans and structures. In order for fire to exist, the three components of the fire triangle must be present. The triangle consists of fuel, heat, and oxygen.¹⁷ Most naturally caused fires are initiated by lightning strikes. Human-caused fires, both accidental and deliberate, are produced in many ways, including campfires, chimneys, torches, matches, fireworks, cigarettes, vehicle fires, military ordnance, and smoldering slash piles.¹⁸ In either instance, natural or human-caused, the ignition is started because the fire triangle exists. Fire occurring in natural ecosystems begins as a point of ignition, burns outward into circles and spreads in the direction toward which the wind is blowing.¹⁹ Additionally, when burning occurs on uneven terrain, the fire spreads upslope to eventually form itself into broad ellipses.²⁰

Effects of fire on ecosystem resources can represent damages, benefits, or some combination of both, depending largely on the characteristics of the fire site, the severity of the fire, the time period of valuation, and the values placed on the resources affected by the fire.²¹ The ecosystems of most forests depend upon fire to maintain various functions. The use of fire for beneficial purposes is considered, where appropriate, in terms of reducing fuel loads, disposing of slash, preparing seedbeds, thinning overstocked stands, increasing forage plant production, improving wildlife habitats, changing hydrologic processes, and improving aesthetic environments.²² However, despite its beneficial values to ecosystems, fire has been suppressed for years because of its perceived effects on timber harvest and threat to human life. In addition, new

development continues to push its way into what is termed as the “wildland-urban interface.”

The Interface

There are three categories of interface fire:²³

- The classic wildland-urban interface exists where well-defined urban and suburban development presses up against open expanses of wild land areas;
- The mixed wildland-urban interface is characterized by isolated homes, subdivisions, and small communities situated predominantly in wildland settings; and
- The occluded wildland-urban interface exists where islands of wildland vegetation occur inside a largely urbanized area.

Unlike most other natural hazards, the wildland-interface is not designated by geography alone. Certain conditions must be present for significant interface fires to occur. The most common are 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).²⁴ Once a fire has started, several conditions influence its behavior, including fuel, topography, weather, drought, and development. These combined conditions are the key elements that add to increased wildfire risk. The severity of the wildfire is ultimately affected by the severity of these conditions. For example, if a steep slope (topography) is combined with extremely low humidity, high winds, and highly flammable vegetation, then a high-intensity wildfire may develop.

Since the 1970s, Oregon's growing population has expanded further and further into traditional resource lands such as forestland. The “interface” between urban and suburban areas and the resource lands created by this expansion has produced a significant increase in threats to life and property from fires, and has pushed existing fire protection systems beyond original or current design or capability.²⁵ Property owners in the interface are often unaware of the problems and threats they face. Therefore, many owners have done very little to manage or offset fire hazards or risks on their own property. Furthermore, human activities increase the incidence of fire ignition and potential damage.

Fuel²⁶

Fuel is the material that feeds a fire, and is a key factor in wildfire behavior. Fuel is classified by volume and by type. Volume is described in terms of “fuel loading,” or the amount of available vegetative fuel. The type of fuel refers to the species of trees, shrubs, and grass that are present. Oregon, as a western state with prevalent conifer, brush, and rangeland fuel types, is subject to more frequent wildfires than other regions of the nation.

An important element in understanding the danger of wildfire is the availability of diverse fuels in the landscape, such as natural

vegetation, manmade structures, and combustible materials. A house surrounded by brushy growth rather than cleared space allows for greater continuity of fuel and increases the fire's ability to spread. After decades of fire suppression, "dog-hair" thickets have accumulated. These enable high intensity fires to flare and spread rapidly. Structures that are made of combustible material such as shake roofs and wood siding are especially susceptible to fire. Untrimmed bushes near these structures often serve as "ladder fuels" – enabling a slow moving ground fire to climb onto rooftops and into the crowns of trees. A crown fire is significantly more difficult to suppress than a ground fire, and are much more threatening to structures in the interface. Wildfire at the upper end of the wildfire intensity spectrum is likely to spread into the tops of the tallest trees in violent and discontinuous surges.²⁷ Fire that occurs at this severe end of the spectrum responds to its own convective winds, spreading rapidly as sparks from exploding trees ignite other fires many meters away.²⁸

Because of the many different possible "fuels" found in the interface landscape, firefighters have a difficult time predicting how fires will react or spread.

Topography²⁹

Topography influences the movement of air, thereby directing a fire's course. For example, if the percentage of uphill slope doubles, the rate of spread in wildfire will likely double. Gulches and canyons can funnel air and act as chimneys, which intensify fire behavior and cause the fire to spread faster. Solar heating of dry, south-facing slopes produces upslope drafts that can complicate fire behavior. Unfortunately, hillsides with hazardous topographic characteristics are also desirable residential areas in many communities. This underscores the need for wildfire hazard mitigation and increased education and outreach to homeowners living in interface areas.

Weather³⁰

Weather patterns combined with certain geographic locations can create a favorable climate for wildfire activity. Areas where annual precipitation is less than 30 inches per year are extremely fire susceptible.³¹ High-risk areas in Oregon share a hot, dry season in late summer and early fall when high temperatures and low humidity favor fire activity. Predominant wind directions may guide a fire's path. In addition, many high intensity fires produce their own wind, which aids in the spread of fire.

Drought

Recent concerns about the effects of climate change, particularly drought, are contributing to concerns about wildfire vulnerability. The term *drought* is applied to a period in which an unusual scarcity of rain causes a serious hydrological imbalance. Unusually dry winters, or significantly, less rainfall than normal, can lead to relatively drier conditions, and leave reservoirs and water tables lower. Drought leads to problems with irrigation, and may contribute to additional fires, or

additional difficulties in fighting fires. Most fuel types (not including grasses), however, require two or three years of drought before the fuel becomes dangerously dry. Drought contributes to the frequency and intensity of fires. A February 2001 *Oregonian* article reported: “Favorable weather last year helped the Northwest emerge largely unscathed from a fire season that scorched other parts of the West. But the forests remain thick with timber and with homes. And this winter has brought the Northwest far less snow and rain than usual, which could give a greater foothold to the flames that are sure to come.”³²

The last statewide drought emergency in Oregon was in September 1992.³³

Most fuel types (not including grasses), however, require two or three years of drought before the fuel becomes dangerously dry. Drought contributes to the frequency and intensity of fires. A February 2001 *Oregonian* article reported: “Favorable weather last year helped the Northwest emerge largely unscathed from a fire season that scorched other parts of the West. But the forests remain thick with timber and with homes. And this winter has brought the Northwest far less snow and rain than usual, which could give a greater foothold to the flames that are sure to come.”³⁴

On average over the last several years, Yamhill County has received less precipitation i.e., snow and rain than what is considered normal. A March 2005 *Oregonian* article reported: “Weather experts see problems this summer with fires, power rates, recreation, farming and fish unless spring brings rain.”³⁵ The article continues: “Barring a spring soaking, Oregon and Washington face a drought that could ravage forests, raise power rates and leave fish high and dry.”³⁶

The following information is from Oregon Governor Ted Kulongoski’s “2005 Oregon Drought and Fire Conditions” Website:

Water conditions in Oregon are close to those experienced in the 1977 drought. Snow conditions are approximately 44 percent of normal statewide, very close to that experienced before the 1977 drought and well below the levels seen in 2001 at this time of year. Precipitation records indicate Northwest Oregon is experiencing the second driest water year on record and accumulated stream flow conditions statewide range in the 35 to 75-percentile level. As of March 1, the Columbia system is projected at 66 percent of normal stream flow, down ten percent from a month earlier. Reservoirs used for irrigation throughout the state are well below normal, and many are not expected to fill. Even if we have a significantly wet March, conditions are not expected to approach normal for this time of year.³⁷

Development

Growth and development in forested areas is increasing the number of human-caused structures in the interface in Oregon. Wildfire has an effect on development, yet development can also influence wildfire.

While wildfires have always been a historic part of the ecosystem in Oregon, homes in the interface often lead to human ignition of fire. The combined increase in human development and activity in the interface, with the high content of fuels from years of fire suppression, can create a lethal combination.

Homeowners often prefer lots that are private and have scenic views nestled in vegetation. A private setting may be far from public roads, or hidden behind a narrow, curving driveway. These conditions, however, make evacuation and firefighting difficult. The scenic views found along mountain ridges can also mean areas of dangerous topography. Natural vegetation contributes to scenic beauty, but it may also provide a ready trail of fuel leading a fire directly to the combustible fuels of the home itself.³⁸

Wildfire Hazard Assessment

Wildfire Hazard Identification

Hazard identification is the first phase of a hazard assessment, and is the process of estimating the geographic extent of the hazard, its intensity, and its probability of occurrence.³⁹ This process usually results in a hazard map. Hazard maps can provide detailed information in a clear format that provides public information and can assist in making policy and land use decisions.

Wildfire hazard areas are commonly identified in regions of the wildland/urban interface. Ranges of the wildfire hazard are further determined by the ease of fire ignition due to natural or human conditions and the difficulty of fire suppression. The wildfire hazard is also magnified by several factors related to fire suppression/control, such as the surrounding fuel load, weather, topography, and property characteristics. Generally, hazard identification rating systems are based on weighted factors of fuels, weather, and topography. Indicators of least dangerous to most dangerous, illustrate each category. For example:

Roads and Signage

Steep; narrow; poorly signed	3
One or two of the above	2
Meets all requirements	1

Water Supply

None, except domestic	3
Hydrant, tank, or pool over 500 feet away	2
Hydrant, tank, or pool within 500 feet	1

Location of the Structure

Top of steep slope with brush/grass below	3
Mid-slope with clearance	2
Level with lawn, or watered groundcover	1

In order to determine the “base hazard factor” of specific wildfire hazard sites and interface regions, several factors must be taken into account. Categories used to assess the base hazard factor include:

- Topographic location, characteristics, and fuels;
- Site/building construction and design;
- Site/region fuel profile (landscaping);
- Defensible space;
- Accessibility;
- Fire protection response; and
- Water availability.

The use of Geographic Information System (GIS) technology in recent years has been a great asset to fire hazard assessment, allowing further integration of fuels, weather, and topography data for such ends as fire behavior prediction, watershed evaluation, mitigation strategies, and hazard mapping. As stated in the wildfire characteristics section of this chapter, the interface is not geographic in nature, but is associated with certain characteristics such as slope and vegetation.

Map 6 shows the coverage area for fire districts within Yamhill County.

Vulnerability Assessment

Vulnerability assessment is the second phase of a hazard assessment. It combines the information generated through hazard identification with an inventory of the existing development exposed to wildfire. Vulnerability assessments assist in predicting how different types of property and population groups will be affected by a hazard.⁴⁰ Data that includes the location of interface areas in Yamhill County can be used to assess the population and total value of property at risk from wildfire.

Risk Analysis

Risk analysis is the third, and most advanced phase of a hazard assessment. It builds upon hazard identification and vulnerability assessments.

Key factors included in assessing wildfire risk include ignition sources, building materials and design, community design, structural density, slope, vegetative fuel, fire occurrence, and weather, as well as occurrences of drought. The National Wildland/Urban Fire Protection Program has developed a Wildland/Urban Fire Hazard Assessment Methodology tool for communities to assess their risk to wildfire. For more information on wildfire hazard assessment, refer to www.Firewise.org.

Community Wildfire Issues

Characteristics of Growth and Development in the Interface

Residents in rural areas and unincorporated communities in Yamhill County are part of the wildland/urban interface characterized by a diverse mixture of varying housing structures, development patterns, ornamental and natural vegetation, and natural fuels. In the event of a wildfire, vegetation, structures, and other flammables can merge into unwieldy and unpredictable events. Factors germane to the fighting of such fires include access, firebreaks, and proximity of water sources, distance from a fire station, and available firefighting personnel and equipment. Reviewing past wildland/urban interface fires shows that many structures are destroyed or damaged for one or more of the following reasons:⁴¹

- Combustible roofing material;
- Wood construction;
- Structures with no defensible space;
- Fire department with poor access to structures;
- Subdivisions located in heavy natural fuel types;
- Structures located on steep slopes covered with flammable vegetation;
- Limited water supply; and
- Winds over 30 miles per hour.

Road Access

Of particular concern to firefighters are developments with narrow roadways and few routes of egress, or routes with very limited accessibility. Many new subdivisions are constructed with cul-de-sacs, which contribute to the problem of road access. Most cul-de-sacs do not allow rear access to homes, which can be a significant problem for firefighters and emergency services in defending the structure and ensuring the safety of its inhabitants.

Water Supply

Water supply is a critical factor in the ability to fight wildland fires. Developments lacking an adequate water supply and hydrant taps create extra challenges for firefighting personnel. Another water supply issue is that of small diameter pipe water systems, which are inadequate to provide sustained fire-fighting flows.

Mitigation Plan Goals and Existing Activities

Mitigation Plan Goals

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

The plan goals help to guide the direction of future activities aimed at reducing risk and preventing loss from natural hazards. The goals listed here serve as checkpoints as agencies and organization begin implementing mitigation action items.

Goal #1: EMERGENCY OPERATIONS

Goal Statement: Coordinate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures and with various other agencies, as appropriate.

Goal #2: EDUCATION AND OUTREACH

Goal Statement: Develop and implement education and outreach programs to increase public awareness of the risks associated with natural hazards.

Goal #3: PARTNERSHIPS

Goal Statement: Develop effective partnerships with public and private sector organizations and significant agencies and businesses for future natural hazard mitigation efforts.

Goal #4: PREVENTIVE

Goal Statements:

- Develop and implement activities to protect human life, commerce, and property from natural hazards.
- Reduce losses and repetitive damage for chronic hazard events while promoting insurance coverage for catastrophic hazards.

Goal #5: NATURAL RESOURCES UTILIZATION

Goal Statement: Link natural resources management, land use planning, and watershed planning with natural hazard mitigation activities to protect natural systems and allow them to serve natural hazard mitigation functions.

Goal #6: IMPLEMENTATION

Goal Statement: Implement strategies to mitigate the effects of natural hazards.

Existing Mitigation Activities

When assessing the risks from natural hazards, established mitigation practices already provide benefits in reduced disaster losses.

Local Programs

Fire Districts Within Yamhill County

Issue public press releases when fire danger is high.

Burning bans go into effect countywide when Oregon Department of Forestry officially establishes the year's fire season. Burning bans include no backyard burning, but excludes agriculturally related burns, which are enforced through state statute.

Yamhill County Land Division Ordinance

With the increase of home sites in the rural areas of Yamhill County, the county found there was a critical need for adequate fire department access. The risk of wildfire and other emergency incidents increase with home density. The county found that many existing driveways do not provide the needed access for emergency apparatus. New homes are expected to fully meet current driveway construction requirements set forth in Section 6.010(8) of the Land Division Ordinance. The county's "Driveway Construction Checklist/Inspection Form" is presented in Appendix D.

State Programs

Oregon Revised Statute 215.730:

ORS 215.730, Additional Criteria for Forestland Dwellings, provides criteria for approving dwellings located on lands zoned for forest and mixed agriculture/forest use. Under its provisions, county governments must require, as a condition of approval, that single-family dwellings on lands zoned as forestland meet the following requirements:

1. Dwelling has a fire retardant roof;

2. Dwelling will not be sited on a slope of greater than 40 percent;
3. Evidence is provided that the domestic water supply is from a source authorized by the Water Resources Department and not from a Class II stream as designated by the State Board of Forestry;
4. Dwelling is located upon a parcel within a fire protection district or is provided with residential fire protection by contract;
5. If dwelling is not within a fire protection district, the applicant

For more information on forestland zones consult the Oregon Department of Land Conservation and Development; Statewide Goal 4 – Forestlands and Oregon Administrative Rules 660-006.

provides evidence that the applicant has asked to be included in the nearest such district;

6. If dwelling has a chimney or chimneys, each chimney has a spark arrester; and
7. Dwelling owner provides and maintains a primary fuel-free break and secondary break areas on land surrounding the dwelling that is owned or controlled by the owner.

If a governing body determines that meeting the fourth requirement is impractical, local officials can approve an alternative means for protecting the dwelling from fire hazards.

Oregon Revised Statute 477.015-061

Provisions in ORS 477.015-061, Urban Interface Fire Protection, were established through efforts of the Oregon Department of Forestry, the Office of the State Fire Marshal, fire service agencies from across the state, and the Commissioners of Deschutes, Jefferson, and Jackson Counties. It is innovative legislation designed to address the expanding interface wildfire problem within Oregon Department of Forestry Fire Protection Districts. Full implementation of the statute will occur on or after January 1, 2002. The statute does the following:

1. Directs the State Forester to establish a system of classifying forestland-urban interface areas;
2. Defines forestland-urban interface areas;
3. Provides education to property owners about fire hazards in forestland-urban interface areas. Allows for a forestland-urban interface county committee to establish classification standards;
4. Requires maps identifying classified areas to be made public;
5. Requires public hearings and mailings to affected property owners on proposed classifications;
6. Allows property owners appeal rights;

7. Directs the Board of Forestry to promulgate rules that set minimum acceptable standards to minimize and mitigate fire hazards within forestland-urban interface areas; and
8. Creates a certification system for property owners meeting acceptable standards. Establishes a \$100,000 liability limit for cost of suppressing fires, if certification requirements are not met.

478.120 Inclusion of forestland in district.

The authority to include forestland within a rural fire protection district pursuant to ORS 478.010 (2)(c) applies to forestland within the exterior boundaries of an existing district and to forestland on which structures subject to damage by fire have been added after July 20, 1973.

478.140 Procedure for adding land to district by consent of owner.

Any owner consenting to add the forestland of the owner to the district under ORS 478.010 (2)(c) shall do so on forms supplied by the Department of Revenue. The owner shall file the original with the district. The district shall forward a copy to the assessor of each county in which the land is located, within 20 days of receipt.

478.910 Adoption of fire prevention code.

A district board may, in accordance with ORS 198.510 to 198.600, adopt a fire prevention code.

478.920 Scope of fire prevention code.

The fire prevention code may provide reasonable regulations relating to:

- (1) Prevention and suppression of fires.
- (2) Mobile fire apparatus means of approach to buildings and structures.
- (3) Providing fire-fighting water supplies and fire detection and suppression apparatus adequate for the protection of buildings and structures.
- (4) Storage and use of combustibles and explosives.
- (5) Construction, maintenance and regulation of fire escapes.
- (6) Means and adequacy of exit in case of fires and the regulation and maintenance of fire and life safety features in factories, asylums, hospitals, churches, schools, halls, theaters, amphitheatres, all buildings, except private residences, which are occupied for sleeping purposes, and all other places where large numbers of persons work, live, or congregate from time to time for any purpose.
- (7) Requiring the issuance of permits by the fire chief of the district before burning trash or waste materials.

- (8) Providing for the inspection of premises by officers designated by the board of directors, and requiring the removal of fire hazards found on premises at such inspections.

478.927 Building permit review for fire prevention code.

A district adopting a fire prevention code shall provide plan review at the applicable city or county agency responsible for the issuance of building permits for the orderly administration of that portion of the fire prevention code that requires approval prior to the issuance of building permits.

Senate Bill 360

Senate Bill 360, passed in 1997, is state legislation put in place to address the growing wildland/urban interface problem. The bill has three purposes:

1. To provide an interface fire protection system in Oregon to minimize cost and risk and maximize effectiveness and efficiency;
2. To promote and encourage property owners' efforts to minimize and mitigate fire hazards and risks; and
3. To promote and encourage involvement of all levels of government and the private sector in interface solutions.⁴²

The bill has a five-year implementation plan that includes public education and outreach, and the development of rules, standards, and guidelines that address landowner and agency responsibilities. The success of Senate Bill 360 depends upon cooperation among local and regional fire departments, fire prevention cooperatives, and the Oregon Department of Forestry, which means interagency collaboration is vital for successful implementation of the bill. This cooperation is important in all aspects of wildland firefighting. Resources and funding are often limited, and no single agency has enough resources to tackle a tough fire season alone. The introductory language of Senate Bill 360 states: "The fire protection needs of the interface must be satisfied if we are to meet the basic policy of the protection of human life, natural resources, and personal property. This protection must be provided in an efficient and effective manner, and in a cooperative partnership approach between property owners, local citizens, government leaders, and fire protection agencies."

Office of the State Fire Marshal

State Fire Marshall is similar to OEM in that the office has no authority, but advocates and represents fire districts that have authority within communities. The State Fire Marshall is a structural advocate, and works in partnership with ODF.

The State Fire Marshall can provide information about requirements, but cannot force entities and persons to adhere to those requirements, although if entities and persons do not adhere to requirements, then it is less likely that such entities and persons would receive financial or other resource support from the State Fire Marshall. Like OEM, the Office of the State Fire Marshall provides resources, training, leadership and guidance.

Oregon Department of Forestry (ODF)

ODF provides training for local fire chiefs and local fire departments to provide training. Local firefighters can get a range of experience from exposure to wildland firefighting. Local firefighters can also obtain their 'red card' (wildland fire training documentation), and attend extensive workshops combining elements of structural and wildland firefighting, defending homes, and operations experience.⁴³

ODF has been involved with emergency managers to provide support during non-fire events and for years, ODF has worked with industrial partners (large timber companies) to share equipment in the case of extremely large fires.⁴⁴

Federal Programs

The proposed role of the federal land managing agencies, such as the U.S. Forest Service and the Bureau of Land Management, in the wildland/urban interface is diverse. Their roles include: reducing fuel hazards on the lands they administer; cooperating in prevention and education programs; providing technical and financial assistance; and developing agreements, partnerships, and relationships with property owners, local protection agencies, states, and other stakeholders in wildland/urban interface areas. These relationships focus on activities before a fire occurs, which render structures and communities safer and better able to survive a fire occurrence.⁴⁵

States must have an approved hazard mitigation plan in place to receive either a Fire Suppression Assistance Grant or a Hazard Mitigation Grant.

Federal Emergency Management Agency Programs

The Federal Emergency Management Agency (FEMA) is directly responsible for providing fire suppression assistance grants and, in certain cases, major disaster assistance and hazard mitigation grants in response to fires. The role of FEMA in the wildland/urban interface is to encourage comprehensive disaster preparedness plans and programs, increase the capability of state and local governments, and provide for a greater understanding of FEMA's programs at the federal, state, and local levels.⁴⁶

Fire Suppression Assistance Grants

Fire Suppression Assistance Grants may be provided to a state with an approved hazard mitigation plan for the suppression of a forest or grassland fire that threatens to become a major disaster on public or private lands. These grants are provided to protect life and improved property, and encourage the development and implementation of viable multi-hazard mitigation measures, and provide training to clarify FEMA's programs. The grant may include funds for equipment, supplies, and personnel. A Fire Suppression Assistance Grant is the form of assistance most often provided by FEMA to a state for a fire. The grants are cost-shared with states. Once the federal grant money is provided to the State, it is then passed along to local jurisdictions. FEMA's US Fire Administration (USFA) provides public education materials addressing wildland/urban interface issues, and the USFA's National Fire Academy provides training programs.⁴⁷

Hazard Mitigation Grant Program

Following a major disaster declaration, the FEMA Hazard Mitigation Grant Program provides funding for long-term hazard mitigation projects and activities to reduce the possibility of damages from all future fire hazards and to reduce the costs to the nation for responding to and recovering from the disaster.

National Wildland/Urban Interface Fire Protection Program

Federal agencies can use the National Wildland/Urban Interface Fire Protection Program to focus on wildland/urban interface fire protection issues and actions. The Western Governors' Association (WGA) can act as a catalyst to involve state agencies, as well as local and private stakeholders, with the objective of developing an implementation plan to achieve a uniform, integrated national approach to hazard and risk assessment and fire prevention and protection in the wildland/urban interface. The program helps states develop viable and comprehensive wildland fire mitigation plans and performance-based partnerships.

“New data from National Forest Service fire ecologists shows that for every dollar spent on prescribed burning, forest thinning and the training of fire-management personnel, seven dollars worth of savings are realized in the costs of having to extinguish big fires. When that ratio is placed in the context of an average \$1 billion spent annually over the past decade on fire suppression, the implications of foresighted fire management are profound.”

The Nature Conservancy Magazine –
May/June 2001

US Forest Service

The US Forest Service (USFS) is involved in a fuel-loading program implemented to assess fuels and reduce hazardous buildup on US forestlands. The USFS is a cooperating agency and, while it does not have jurisdiction within city limits, it still has an interest in preventing fires in the interface, as fires often burn up the hills and into the higher elevation US forestlands.⁴⁸ This is especially an

important issue as Yamhill County's larger cities of McMinnville and Newberg consider any annexations of land in the wildland-urban interface in the future.

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Other Mitigation Programs and Activities

Some areas of the country are facing wildland/urban issues collaboratively. These are model programs that include local solutions. One example of this is in Ashland, Oregon. Because of the highly flammable slopes above Ashland, homeowners in the wildland-urban interface face a high risk of encountering a wildland fire. Ashland has partnered with local organizations to help coordinate mitigation strategies with homeowners in high-risk areas. Currently, more than 40 acres have been treated in the interface above Ashland.⁵⁰

Treatment has included thinning of tree stands, removing highly flammable noxious weeds (i.e., Scotch Broom), and the creation of fuel breaks along ridge tops most susceptible to wildland fire. Ashland has contributed approximately \$500,000 dollars towards cost shares with homeowners to help reduce fuels near their homes.⁵¹ In California, the Los Angeles County Fire Department has retrofitted more than 100 fire engines with fire retardant foam capability, and Orange County is evaluating a pilot insurance grading and rating schedule specific to the wildland/urban interface. Both are examples of successful programs that demonstrate the value of pre-suppression and prevention efforts when combined with property owner support to mitigate hazards within the wildland/urban interface.⁵²

Prescribed Burning

The health and condition of a forest will determine the magnitude of a wildfire. If fuels – slash, dry or dead vegetation, fallen limbs and branches – are allowed to accumulate over long periods of time without being methodically cleared, fire can move more quickly and destroy everything in its path. The results are more catastrophic than if the fuels are periodically eliminated. Prescribed burning is the most efficient method to get rid of these fuels. In 1998, 3,000 prescribed fires were used to burn approximately 163,000 acres statewide.⁵³

Firewise

Firewise is a program developed within the National Wildland/Urban Interface Fire Protection Program, and it is the primary federal program addressing interface fire. It is administered through the National Wildfire Coordinating Group whose extensive list of participants includes a wide range of federal agencies. The program is intended to empower planners and decision makers at the local level. Through conferences and information dissemination, Firewise increases support for interface wildfire mitigation by educating professionals and the general public about hazard evaluation and policy implementation techniques. Firewise offers online wildfire protection information and checklists, as well as listings of other publications, videos, and conferences. The interactive home page allows users to ask fire protection experts questions, and to register for new information as it becomes available.

For more information on the Firewise program, contact:
The Wildland/Urban Interface Fire Program
C/o The National Fire Protection Association
1 Batterymarch Park, Quincy, MA 02269 - <http://www.firewise.org>

FireFree Program

FireFree is a unique private/public program for interface wildfire mitigation involving partnerships between an insurance company and local government agencies. It is an example of an effective non-regulatory approach to hazard mitigation. Originating in Bend, Oregon, the program was developed in response to the city's "Skeleton Fire" of 1996, which burned over 17,000 acres and damaged or destroyed 30 homes and structures.⁵⁴ Bend sought to create a new kind of public education initiative that emphasized local involvement. SAFECO Insurance Corporation was a willing collaborator in this effort. Bend's pilot program included:

For information on FireFree, contact:
SAFECO Plaza T-8,
Seattle, WA 98185, (206) 545-6188
<http://www.FireFree.org>

- A short video production featuring local citizens as actors, made available at local video stores, libraries, and fire stations;
- Two city-wide yard debris removal events;
- A 30-minute program on a model FireFree home, aired on a local cable television station; and
- Distribution of brochures, featuring a property owner's evaluation checklist and a listing of fire-resistant indigenous plants.

The success of the program helped to secure \$300,000 in Federal Emergency Management Agency (FEMA) "Project Impact" matching

funds. By fostering local community involvement, FireFree also has the potential for building support for sound interface wildfire policy.

Wildfire Mitigation Action Items

The mitigation action items for wildfire were formulated through research of regional mitigation plans, natural hazards planning literature, and interviews with local stakeholders. Plan action items were refined through discussions with the mitigation plan steering committee and through an open house at which the county received comments from the public.

The wildfire mitigation action items provide direction on specific activities that organizations and residents in Yamhill County can undertake to reduce risk and prevent loss from wildfires. Each action item is followed by ideas for implementation, which can be used by local decision makers in pursuing strategies for implementation.

This section lists action items identified to reduce the risk from wildfires in Yamhill County. These action items are designed to meet the mitigation plan goals.

Short-term (ST) Wildfire Action Items

Short-term wildfire action items include general mitigation activities that agencies are capable of implementing during the next two years, given their existing resources and authorities.

ST-WF #1: Work with the Yamhill Fire Defense Board in the review of plans and inspection of structures, access and water supply for fire code compliance.

Note: Currently, construction plans for commercial and industrial structures are reviewed, but not residential plans. Identification of areas with lack of experienced fire staff to review plans may be necessary.

Coordinating Organization: Building Department
Internal Partners: Public Works, Planning, Emergency Management
External Partners: Yamhill Fire Defense Board, State Fire Marshal
Timeline: 1 year and on-going
Plan Goals Addressed: Partnerships; Preventive; Natural Resources Utilization

ST-WF #2: Develop a Community Wildfire Protection Plan for susceptible wildland/ urban interface (WUI) areas in Yamhill County.

Coordinating Organization: Emergency Management
Internal Partners: Public Works, GIS, Planning
External Partners: Yamhill Fire Defense Board, State Fire Marshal, Oregon Department of Forestry
Timeline: 1 to 2 years; on-going
Plan Goals Addressed: Emergency Operations; Partnerships; Preventive

ST-WF #3: Advocate water storage facilities with fire-resistant electrical pump systems in developments not connected to a community water/hydrant system.

Ideas for Implementation

- Make such storage facilities accessible by standard firefighting equipment and adequate for the needs of the structure(s) built; and
- Encourage the use of fire-resistant electrical pump systems so water can be replenished during use.

Coordinating Organizations: Yamhill Fire Defense Board, State Fire Marshal
Internal Partners: Building, Planning
External Partner: ODF
Timeline: On-going
Plan Goals Addressed: Emergency Operations; Preventive; Natural Resources Utilization; Implementation

ST-WF #4: Continue to promote public awareness campaigns for individual property owners living in the wildland/urban interface (WUI).

Ideas for Implementation

- Focus on individual community outreach through:
 - Working demonstrations of risk reduction awareness measures (i.e., survivable space around structures; driveway, road and bridge specifications; and landscaping) at the State Fair and the Oregon Garden;
 - Voluntary site visits by fire crews to consult with landowners about specific ways to reduce risk to their property and to identify properties that would not be saved if a wildfire event occurred;
 - Mailings;
 - Public service announcements in the media;
 - Suggest to prospective rural home buyers to ask about the level of fire protection available and fire insurance rating for properties in Yamhill County; and

- Noxious weed abatement.
- Encourage the use of hazard-specific information to identify wildfire hazard areas, and promote the use of mitigation strategies and opportunities to reduce risks; and
- Assess available fire suppression assistance and disseminate information about opportunities to the public.

Coordinating Organization: Emergency Management
 Internal Partner: Planning
 External Partners: City emergency management, media, OEM, FEMA, DLCDC, State Fire Marshal, ODF, insurance and real estate industries, ODA, Oregon Garden, State Fair, Yamhill SWCD
 Timeline: 1 to 5 years, on-going
 Plan Goals Addressed: Emergency Operations; Education & Outreach; Partnerships; Preventive; Natural Resources Utilization

ST-WF #5: Seek funding and labor opportunities to staff fuel-reduction projects throughout wildfire hazard-prone areas in Yamhill County

Ideas for Implementation

- Work on Wildfire Hazard mapping of Yamhill County to identify areas and homes that would most benefit from fuel reduction projects;
- Promote opportunities for landowners to utilize fuel reduction projects;
- Enable communities and agencies to quickly transform grant opportunities to on-the-ground projects; and
- Investigate potential funding opportunities for individual mitigation projects.

Coordinating Organization: Emergency Management
 Internal Partner: GIS
 External Partners: Yamhill Fire Defense Board, State Fire Marshal, ODF, BLM, USFS, The Confederated Tribes of Grand Ronde, Yamhill SWCD
 Timeline: 2 years
 Plan Goals Addressed: Education & Outreach; Preventive; Natural Resources Utilizations

ST-WF #6: Create incentives and assist landowners in reducing fuel loads on private property.

Ideas for Implementation

- Investigate potential funding opportunities for individual mitigation projects; and

- Develop, approve, and promote cost share and assistance programs for landowners seeking fire mitigation activities and suppression preparedness.

Coordinating Organization: Emergency Management
 External Partners: Yamhill Fire Defense Board, State Fire Marshal, ODF, insurance companies
 Timeline: 1 to 2 years
 Plan Goals Addressed: Education & Outreach; Partnerships; Preventive; Natural Resources Utilization

ST-WF #7: Increase communication, coordination, and collaboration between wildland/urban interface (WUI) property owners, city and county planners, and fire prevention crews and officials to address inherent risks in WUI areas, existing mitigation (prevention /protection) measures, and federal mitigation assistance programs.

Ideas for Implementation

- Encourage single-family residences in wildfire hazard areas to develop fire plans and promote homeowner wildfire hazard mitigation e.g., practice evacuation routes;
- Encourage fire safety surveys of residential homes by fire districts to increase awareness among homeowners and potential fire responders;
- Require fire department notification of new business applications to ensure that appropriate fire plans have been developed;
- Encourage Planning and Building Departments to work closely with landowners and/or developers who chose to build in the wildland/urban interface area to identify and mitigate conditions that aggravate wildland/urban interface wildfire hazards, including:
 1. Limited access for emergency equipment due to width and grade of roadways;
 2. Inadequate water supplies, and the spacing, consistency, and species of vegetation around structures;
 3. Inadequate water pressure for fire suppression;
 4. Inadequate fuel breaks, or lack of defensible space;
 5. Inappropriate i.e., highly flammable construction materials;
 6. Preexisting, older building lots and subdivisions that are not in compliance with state and local land use and fire protection regulations;
 7. Inadequate entry/escape routes.
- Encourage all new homes and major remodels involving roofs or additions located in the interface to have fire resistant roofs and residential sprinkler systems;

- Provide education and training to the public to assess if their homes meet fire safety performance standards;
- Partner with the Oregon Garden on safe plants for around an interface house. Encourage the Oregon Garden to create a display on defensible space around an interface house.
- Review development and building codes to ensure adequate requirements for sprinkler systems, setbacks, etc. in identified wildland interface areas;
- Encourage the public to evaluate access routes to rural homes for fire-fighting vehicles and to develop passable routes if they do not exist; and
- Close and/or limit access to roads in the forest during high fire hazards.

Coordinating Organization: Planning, Building
 Internal Partners: Emergency Management
 External Partners: Yamhill Fire Defense Board, ODF, State Fire Marshal; Oregon Garden, OSU Extension, BLM, Timber Industry
 Timeline: 1 to 5 years, on-going
 Plan Goals Addressed: Emergency Operations; Education & Outreach; Partnerships; Preventive; Natural Resources Utilization; Implementation

ST-WF #8: Seek improved information gathering and distribution, and technology for enhancing fire identification, initial response and evacuation if necessary.

Ideas for Implementation

- Update wildland/urban interface hazard maps;
- Conduct risk analysis incorporating data and the created hazard maps using GIS technology to identify risk sites and further assist in prioritizing mitigation activities; and
- Encourage development and use of new data and systems to identify hazard areas and better inform firefighters, communities and landowners of wildfire status once a fire occurs.

Coordinating Organization: Emergency Management
 Internal Partners: GIS, Planning
 External Partners: State Fire Marshal, ODF, Yamhill Fire Defense Board, Confederated Tribes of Grand Ronde
 Timeline: 1 to 3 years
 Plan Goals Addressed: Emergency Operations; Education & Outreach, Partnerships; Preventive; Natural Resources Utilization; Implementation

ST-WF #9: Enhance emergency services to increase the efficiency of wildfire response and recovery activities.

Ideas for Implementation

- Develop a county call list that includes all at-risk urban/wildland interface residents in Yamhill County in order to contact them during evacuations; and
- Inventory bridges on evacuation routes, assess the bridges for their ability to support fire apparatus ingress, and encourage replacement of unstable bridges.

Coordinating Organization: Yamhill Fire Defense Board
Internal Partner: Public Works
External Partners: State Fire Marshal, ODF, telephone companies
Timeline: 2 years
Plan Goals Addressed: Emergency Operations; Partnerships; Preventive

ST-WF #10: Educate agency personnel on federal cost-share and grant programs, fire protection agreements, and other related federal programs so the full array of assistance available to local agencies is understood.

Ideas for Implementation

- Investigate potential funding opportunities for individual mitigation projects; and
- Develop, approve, and promote Fire Protection Agreements and partnerships to clarify roles and responsibilities and to provide for fire mitigation activities and suppression preparedness.

Coordinating Organization: Yamhill Fire Defense Board, Emergency Management
External Partners: State Fire Marshal, ODF, FEMA
Timeline: 1 to 2 years
Plan Goals Addressed: Emergency Operations; Education & Outreach; Partnerships; Implementation

ST-WF #11: Identify funding for and develop an inventory of alternative firefighting water sources and encourage the development of additional sources.

Ideas for Implementation

- Advocate for water storage facilities with fire-resistant electrical pump systems in residential developments outside of fire protection districts that are not connected to a community water or hydrant system;

- Develop a protocol for fire jurisdictions and water districts to communicate all hydrant outages and water shortage information; and
- Maintain access roads and ramps to artificial and natural water sources.

Coordinating Organization: Emergency Management
 External Partners: Yamhill Fire Defense Board, State Fire Marshal, Oregon Association of Water Utilities (OAWU), irrigation districts, Yamhill SWCD, NRCS, Yamhill Basin Council, cities
 Timeline: 1 to 2 years
 Plan Goals Addressed: Emergency Operations; Partnerships; Preventive; Natural Resources Utilization

ST-WF #12: Identify funding for and develop an inventory of firefighting hardware to be better prepared when attacking wildfires.

-
 Coordinating Organization: Emergency Management
 External Partners: Yamhill Fire Defense Board, ODF, USFS, BLM
 Timeline: 1 to 2 years
 Plan Goals Addressed: Emergency Operations; Partnerships

ST-WF #13: Identify funding for and develop wildland fire training for fire districts near and/or within WUI communities.

-
 Coordinating Organization: Emergency Management
 External Partners: Yamhill Fire Defense Board, State Fire Marshal, ODF, USFS, BLM
 Timeline: 1 to 2 years
 Plan Goals Addressed: Emergency Operations; Education & Outreach; Preventive

Long-term (LT) Wildfire Action Items

Long-term wildfire action items include general mitigation activities that are likely to take more than two years to implement and may require new or additional resources and/or authorities.

LT-WF #1: Promote the expansion of rural fire districts.

Coordinating Organizations: Yamhill Fire Defense Board, County Assessor
 Internal Partner: Emergency Management

External Partners: Yamhill Rural Fire Districts, State Fire Marshal, ODF
Timeline: On-going
Plan Goals Addressed: Emergency Operations; Partnerships; Preventive

LT-WF #2: Look for solutions to protect structures located outside of fire districts through partnerships, grant funding or expansion of fire district services.

Ideas for Implementation

- Form community partnerships that are equipped and trained by fire district personnel to combat fires in those areas.

Coordinating Organization: Emergency Management
External Partners: State Fire Marshal, Yamhill Fire Defense Board, ODF; The Confederated Tribes of Grand Ronde
Timeline: On-going
Plan Goals Addressed: Emergency Operations; Education & Outreach; Partnerships; Preventive; Natural Resources Utilization

LT-WF #3: Reduce wildfire fuels.

Ideas for Implementation

- Identify methods of disposal or utilization of fire fuels removed from individual properties (i.e., prescribed fire application, fuel reduction through grass/timber/brush removal, small diameter forest product-based industries, chipping, etc.);
- Adapt a program similar to the “Firefree” spring-cleaning program in Bend; and
- Adapt a program similar to Deschutes County’s “Project Wildfire,” which encourages fuel-reduction activities and programs.

Coordinating Organization: Emergency Management
Internal Partner: Planning
External Partners: Yamhill Fire Defense Board, ODF, State Fire Marshal, BLM, USFS, The Confederated Tribes of Grand Ronde
Timeline: 3 to 5 years
Plan Goals Addressed: Emergency Operations; Education & Outreach; Partnerships; Preventive; Natural Resources Utilization; Implementation

LT-WF #4: Promote and continue support of agricultural uses that reduce fuel loads in WUI areas.

Ideas for Implementation

- Educate the public on how agriculture can help to reduce fuel loads in interface areas; and
- Investigate and seek funding for conventional, chemical and biological fuel reduction and weed control programs.

Coordinating Organization: Yamhill SWCD
Internal Partner: Planning
External Partners: NRCS, Yamhill Basin Council, OSU Extension, ODF, ODA
Timeline: On-going
Plan Goals Addressed: Education & Outreach; Partnerships; Preventive; Natural Resources Utilization; Implementation

LT-WF #5: Maintain and further develop interagency and private industry relationships for continuing strong fire response in Yamhill County.

Ideas for Implementation

- Maintain and enhance protocol for fire jurisdictions, private industry cooperators and landowners to avoid problems during wildfire chaos; and
- Promote and advocate reduction of “red tape” to enable faster private industry assistance (use of vehicles, manpower, etc.) in a wildfire situation.

Coordinating Organization: Emergency Management
Internal Partner: Public Works
External Partners: Yamhill Fire Defense Board, State Fire Marshal, USFS, BLM, Confederated Tribes of Grand Ronde, timber industry, jobs in the woods programs
Timeline: On-going
Plan Goals Addressed: Education & Outreach; Partnerships; Preventive; Natural Resources Utilization

LT-WF #6: Seek funding to develop and implement, or enhance existing outreach and education programs aimed at mitigating wildfire hazards and reducing or preventing the exposure of citizens, public agencies, private property owners, and businesses to natural hazards.

Ideas for Implementation:

Outreach

- Encourage the hiring of fire prevention and education personnel to oversee education programs;

- Visit urban interface neighborhoods and rural areas and conduct education and outreach activities;
- Conduct specific community-based demonstration projects for fire prevention and mitigation in the urban interface; and
- Perform public outreach and information activities at Fire District fire stations by creating “Wildfire Awareness Week” activities. Fire stations can hold open houses and allow the public to visit, see the equipment, and discuss wildfire mitigation with the station crews.

Education

- Encourage communities in the wildland/urban interface to develop public awareness programs and land use development policies that ensure specific recommendations for wildfire mitigation policies, programs, and community-based activities that will be implemented; and
- Develop a “preventative approach” campaign by educating the public on hazardous human activities that should be regulated and controlled because of the danger of starting fires, including residential pile burning and industrial slash burning, campfires, smoking, and the use of fireplaces without spark arrestors.

Coordinating Organization: Emergency Management
 Internal Partner: Planning
 External Partners: Yamhill Fire Defense Board, school districts, OEM, ODF, cities
 Timeline: On-going
 Plan Goals Addressed: Education & Outreach; Partnerships; Preventive; Natural Resources Utilization; Implementation

LT-WF #7: Encourage development and dissemination of maps relating to fire hazards to help educate and assist builders and homeowners in being engaged in wildfire mitigation activities, and to help guide emergency services during response.

Ideas for Implementation:

- Identify and establish a data-collection mechanism in coordination with county, state, and local governments, fire agencies, the insurance industry, and the National Fire Protection Association;
- Using collected data and research, assess the nature and scope of the wildland/urban interface fire problem in Yamhill County;
- Conduct risk analysis incorporating data and the county’s hazard maps using GIS technology to identify risk sites and further assist in prioritizing mitigation activities; and
- Encourage coordination between fire jurisdictions and County GIS to make sure that the most accurate elevation maps are being used.

Coordinating Organization: Emergency Management

Internal Partners: GIS, Planning
External Partners: State Fire Marshal, Yamhill Fire Defense Board, ODF, DLCD, cities, insurance industry, National Fire Protection Association, utilities
Timeline: 1 to 3 years
Plan Goals Addressed: Education & Outreach; Partnerships; Preventive; Natural Resources Utilization; Implementation

LT-WF #8: Encourage implementation of wildfire mitigation activities in a manner consistent with the goals of promoting sustainable ecological management and community stability.

Ideas for Implementation:

- Employ mechanical thinning and prescribed burning to abate the risk of catastrophic fire and restore the more natural regime of high frequency, low-intensity burns. Prescribed burning can provide benefits to ecosystems by thinning hazardous vegetation and restoring ecological diversity to areas homogenized by invasive plants;
- Use a variety of appropriate tools (prescribed fire application, fuel reduction through grass/timber/brush removal, small diameter forest product-based industries, etc.) to address the complex issue of mitigating wildfire hazards in urban/interface areas; and
- Clear trimmings, trees, brush, and other debris completely from sites when performing routine maintenance and landscaping to reduce fire risk.

Coordinating Organization: Emergency Management
Internal Partner: Public Works
External Partners: Yamhill Fire Defense Board, ODF, Yamhill SWCD, Yamhill Basin Council, utilities, Confederated Tribes of the Grand Ronde, land managers
Timeline: 1 to 5 years, on-going
Plan Goals Addressed: Education & Outreach; Partnerships; Preventive; Natural Resources Utilization; Implementation

Wildfire Resource Directory

Regional Resources

Northwest Interagency Coordination Center (NWCC)

The Northwest Interagency Coordination Center serves as the northwest area geographic focal point to provide logistical support and intelligence relative to anticipated and ongoing wildfire activity for all federal and cooperating state wildland fire suppression agencies. The

Center facilitates movement of resources between agencies' units and, concurrently, ensures fire suppression capabilities to support large fire potential by monitoring weather and prescribed burning activity within the area. The Center also responds to requests for support to other geographic areas from the [National Interagency Coordination Center](#) at Boise, ID.

Contact: Northwest Coordination Center
Address: 5420 NE Marine Drive, Portland, OR 97218-1007
Phone: 503-808-2720
Fax: 503-808-2789
Email: ornwc@dms.nwcc.gov
Website: <http://www.or.blm.gov/nwcc/>

State Resources

Department of Land Conservation and Development (DLCD)

DLCD administers the state's Land Use Planning Program. The program is based on 19 Statewide Planning Goals, including Goal 7, related to natural hazards. In order to help local governments address natural hazards effectively, DLCD provides technical assistance such as conducting workshops, reviewing local land use plan amendments, and working interactively with other agencies.

Contact: Natural Hazards Program Manager, DLCD
Address: 635 Capitol St. NE, Suite 200, Salem, OR 97301-2540
Phone: 503-373-0050
Fax: 503-378-6033
Website: <http://www.lcd.state.or.us/hazards.html>

Oregon Department of Consumer and Business Services

The Building Codes Division of Oregon's Department of Consumer and Business Services is responsible for administering statewide building codes. Its responsibilities include adoption of statewide construction standards that help create disaster-resistant buildings, particularly for flood, wildfire, wind, foundation stability, and seismic hazards. Information about wildfire-related building codes is found through this department.

Contact: Building Codes Division
Address: 1535 Edgewater St. NW, P.O. Box 14470, Salem, OR 97309
Phone: 503-378-4133
Fax: 503-378-2322
Website: <http://www.cbs.state.or.us/external/bcd>

Oregon Department of Forestry (ODF)

ODF's Fire Prevention Unit is involved in interface wildfire mitigation and provides information about Oregon's Wildfire Hazard Zones. The Protection From Fire section of the ODF website includes Oregon-specific fire protection resources. Wildfire condition reports can be accessed on the website as well. ODF's Protection from Fire Program works to do the following:

- Clarify roles of ODF, landowners, and other agencies in relation to wildland fire protection in Oregon;
- Strengthen the role of forest landowners and the forest industry in the protection system;
- Understand and respond to needs for improving forest health conditions and the role/use of prescribed fire in relation to mixed ownerships, forest fuels and insects and disease; and
- Understand and respond to needs for improving the wildland/urban interface situation.

Contact: Oregon Department of Forestry, Fire Prevention Unit
Address: 2600 State Street, Salem, Oregon 97310
Phone: 503-945-7440
Website: <http://www.odf.state.or.us/fireprot.htm>

Oregon Forest Resources Institute (OFRI)

The Oregon Legislature created the Oregon Forest Resources Institute (OFRI) in 1991 to improve public understanding of the state's forest resources. OFRI provides information on Oregon's forest practices and encourages sound forest management. The Institute is funded by a tax on forest products producers.

Contact: Oregon Forest Resources Institute
Address: 317 SW Sixth Avenue, #400, Portland, OR 97204
Phone: 503-229-6718
Fax: 503-229-5823
Email: info@ofri.com
Website: <http://www.forestresourceinstitute.com/>

Oregon State Police (OSP)-Office of Emergency Management (OEM)

The purpose of OEM is to execute the Governor's responsibilities to maintain an emergency services system as prescribed in Oregon Revised Statutes Chapter 401 by planning, preparing, and providing for the prevention, mitigation, and management of emergencies or disasters that present a threat to the lives and property of citizens of and visitors to the state of Oregon.

Contact: Office of Emergency Management
Address: 3225 State Street, Salem, OR 97301
Phone: 503-378-2911
Fax: 503-373-7833
Website: <http://www.osp.state.or.us/oem/>

Office of the State Fire Marshal (OSFM)

The Prevention Unit of Oregon's Office of the State Fire Marshal contains 19 Deputy State Fire Marshals located in various regions. The responsibilities of these deputies include public education for local fire districts and inspection of businesses, public assemblies, schools, daycare centers, and adult foster homes. The State Fire Marshal's Community Education Services unit works to keep Oregonians safe

from fires and injury by providing them with the knowledge to protect themselves and their property.

Contact: Oregon State Fire Marshal
Address: 4760 Portland Road NE, Salem, Oregon 97305-1760
Phone: 503-378-3473
Fax: 503-373-1825
Website: <http://159.121.82.250/>
Oregon Laws Relating to Fire Protection:
http://159.121.82.250/SFM_Admin/firelaws.htm
Email: Oregon.sfm@state.or.us

Office of the State Fire Marshal (OSFM) – Emergency Mobilization

The Office of State Fire Marshal assists and supports the Oregon fire services during major emergency operations through the Conflagration Act (ORS 476.510). The Conflagration Act was developed in 1940 as a civil defense measure and can be invoked only by the Governor. The act allows the State Fire Marshal to mobilize firefighters and equipment from around the state and provides for the funding of resources through state funds. The Conflagration Act is **only** used for fires that involve or **threaten life and structures**.

Website: http://www.sfm.state.or.us/Em%20Mob_Conflag%20Act/Emergency_Mobilization%20HOME.htm

Federal Resources and Programs

Federal Emergency Management Agency (FEMA)

FEMA's mission is "to reduce loss of life and property and protect our nation's critical infrastructure from all types of hazards through a comprehensive, risk-based, emergency management program of mitigation, preparedness, response and recovery." FEMA Region X serves the northwestern states of Alaska, Idaho, Oregon, and Washington.

Contact: FEMA, Federal Regional Center, Region 10
Address: 130-228th St. SW, Bothell, WA 98021-9796
Phone: 425-487-4678
Website: <http://www.fema.gov/Reg-X/index.htm>

Federal Wildland Fire Policy, Wildland/Urban Interface Protection

This is a report describing federal policy and interface fire. Areas of needed improvement are identified and addressed through recommended goals and actions.

Website: <http://www.fs.fed.us/land/wdfire7c.thm>

National Fire Protection Association (NFPA)

This is the principal federal agency involved in the National Wildland/Urban Interface Fire Protection Initiative. NFPA has information on the Initiative's programs and documents. Other members of the initiative include the National Association of State

Foresters, the US Department of Agriculture Forest Service, the US Department of the Interior, and the United States Fire Administration.

Contact: Public Fire Protection Division
Address: 1 Battery March Park, P.O. Box 9101, Quincy, MA 02269-9101
Phone: (617) 770-3000
Website: <http://www.nfpa.org>

National Interagency Fire Center (NIFC)

The NIFC in Boise, Idaho is the nation's support center for wildland firefighting. Seven federal agencies work together to coordinate and support wildland fire and disaster operations. These agencies include the Bureau of Indian Affairs, Bureau of Land Management, Forest Service, Fish and Wildlife Service, National Park Service, National Weather Service, and Office of Aircraft Services.

Contact: National Interagency Fire Center
Address: 3833 S. Development Avenue, Boise, Idaho 83705-5354
Phone: 208-387-5512
Website: <http://www.nifc.gov/>

United States Fire Administration (USFA) of the Federal Emergency Management Agency (FEMA)

As an entity of FEMA, the mission of the USFA is to reduce life and economic losses due to fire and related emergencies through leadership, advocacy, coordination, and support.

Contact: USFA, Planning Branch, Mitigation Directorate
Address: 16825 S. Seton Ave., Emmitsburg, MD 21727
Phone: 301-447-1000
Website: <http://www.fema.gov/mit/wfmit.htm> - Wildfire Mitigation Planning
<http://www.usfa.fema.gov/index.htm> - USFA Homepage
<http://www.usfa.fema.gov/wildfire/> - USFA Resources on Wildfire

United States Forest Service (USFS)

The USFS is a federal land management organization established to manage the nation's federally owned forests. As part of the Department of Agriculture, it provides timber for people, forage for cattle and wildlife, habitat for fish, plants, and animals, and recreation lands throughout the country.

The USFS offers a possible link for local jurisdictions to federal grant programs.

Contact: USDA Forest Service - Pacific Northwest Region
Address: 333 SW First Avenue, Portland, Oregon 97204-3440;
P.O. Box 3623, Portland, OR 97208-3623
Phone: 503-808-2468
Website: <http://www.fs.fed.us/r6/welcome.htm>

Additional Resources

American Red Cross

The American Red Cross is a humanitarian organization led by volunteers that provides relief to victims of disasters and helps people prevent, prepare for, and respond to emergencies. The Oregon Trail Chapter was chartered as a Red Cross unit in 1917. The chapter serves the residents of Clackamas, Clatsop, Columbia, Multnomah, Tillamook, Washington and Yamhill counties. The Oregon Trail Chapter provides a variety of community services, which are consistent with the Red Cross mission, and meets the specific needs of this area, including disaster planning, preparedness, and education.

Contact: American Red Cross, Oregon Trail Chapter
Address: 3131 N Vancouver Ave, Portland, OR 97227-1560
P.O. Box 3200, Portland, OR 97208
Phone: 503-284-1234
Fax: 503-284-4247
Email: info@redcross-pdx.org
Website: <http://www.redcross-oregontrail.org>

Institute for Business & Home Safety (IBHS)

IBHS was created as an initiative of the insurance industry to reduce damage and losses caused by natural disasters. This website provides educational resources and on-line publications for insurers, businesses, and homeowners who are interested in taking the initiative to minimize future damages and losses.

Contact: Institute for Business and Home Safety
Address: 1408 North Westshore Boulevard - Suite 208 - Tampa, FL 33607
Phone: 813-286-3400
Fax: 813-286-9960
E-mail: info@ibhs.org
Website: <http://www.ibhs.org/ibhs2>

FireFree Program to Promote Home Safety

In a pioneering effort to address wildfire danger in Bend, Oregon, four local agencies and a Fortune 500 corporation joined together to create "FireFree! Get In The Zone," a public education campaign designed to increase resident participation in wildfire safety and mitigate losses. Spearheaded by SAFECO Corporation, the partnership includes the Bend Fire Department, Deschutes County Rural Fire Protection District #2, Bend City Planning, and The Deschutes National Forest. The Oregon Department of Forestry and a number of local government agencies and businesses have joined the program.

Contact: FireFree
Address: 1212 SW Simpson, Bend, OR 97701
Phone: 541-322-6309
Website: <http://www.firefree.org>

Deschutes Project Wildfire

Community leaders in Deschutes County formed Project Wildfire in 2002. The mission of Project Wildfire is to reduce deaths, injuries, property, and environmental damage resulting from wildfires in Deschutes County. They seek to involve all communities while creating public-private partnerships that develop and implement pre-disaster strategies and activities. Project Wildfire incorporates a variety of funding sources to add to existing programs and/or build new needed programs. A governing committee sanctioned by the Deschutes County Commission oversees the business, policy and public awareness of Project Wildfire. The OSU Extension Service serves as coordination staff to manage grants and provide accountability to funding entities.

Contact: Teresa Hogue, Project Wildfire Coordinator
Address: OSU Extension, 3893 Airport Way, Redmond, OR 97756
Phone: 541-548-6088
Fax: 541-548-8919
E-mail: teresa.hogue@oregonstate.edu
Website: <http://impact.deschutes.org/>

Firewise – The National Wildland/Urban Interface Fire program

Firewise maintains a Website designed for people who live in wildfire-prone areas, but it also can be of use to local planners and decision makers. The site offers online wildfire protection information and checklists, as well as listings of other publications, videos, and conferences.

Contact: Firewise
Address: 1 Batterymarch Park, Quincy, MA 02269
Phone: 617-984-7056
E-mail: firewise@firewise.org
Website: <http://www.firewise.org/>

Society of American Foresters (SAF)

The Society of American Foresters (SAF) is the national scientific and educational organization representing the forestry profession in the United States. The mission of the SAF is to, in part, advance the science, education, technology, and practice of forestry; and to use the knowledge, skills, and conservation ethic of the profession to ensure the continued health and use of forest ecosystems and the present and future availability of forest resources to benefit society. The Oregon SAF is the largest state affiliate of the national Society. The Capital Chapter serves Yamhill, Polk and Marion Counties.

Contact: Society of American Foresters
Address: 5400 Grosvenor Lane, Bethesda, MD 20814-2198
Phone: 301-897-8720
Fax: 301-897-3690
E-mail: safweb@safnet.org
Website: <http://www.safnet.org>

Contact: Oregon Society of American Foresters
Address: 4033 SW Canyon Road, Portland, OR 97221
Phone: 503-224-8046
Fax: 503-226-2515
E-mail: rasor@safnwo.org
Website: <http://www.forestry.org>

Publications

Schwab, Jim, and Stuart Meck. *Planning for Wildfires*. PAS 429/530. Chicago, IL: American Planning Association. 2005.

This report outlines how knowledge of wildfire risks can be incorporated into comprehensive planning and identifies best practices for development in at-risk areas.

Contact: American Planning Association, Planners Book Service
Phone: 312-786-6344
Fax: 312-431-9985
Website: www.planning.org

National Fire Protection Association Standard 299: Protection of Life and Property from Wildfire. National Wildland/Urban Interface Fire Protection Program, (1991). National Fire Protection Association, Washington, D.C.

This document, developed by the NFPA Forest and Rural Fire Protection Committee, provides criteria for fire agencies, land use planners, architects, developers, and local governments to use in the development of areas that may be threatened by wildfire. To obtain this resource:

Contact: National Fire Protection Association Publications
Phone: 800-344-3555

Website: <http://www.firewise.org>

An International Collection of Wildland-Urban Interface Resource Materials (Information Report NOR-X-344). Hirsch, K., Pinedo, M., & Greenlee, J. (1996). Edmonton, Alberta: Canadian Forest Service.

This is a comprehensive bibliography of interface wildfire materials. Over 2,000 resources are included, grouped under the categories of general and technical reports, newspaper articles, and public education materials. The citation format allows the reader to obtain most items through a library or directly from the publisher. The bibliography is available in hard copy or diskette at no cost. It is also available in downloadable PDF form. To obtain this resource:

Contact: Canadian Forest Service, Northern Forestry Centre

Phone: 780-435-7210

Website: <http://bookstore.pfc.dfs.nrcan.gc.ca>

Wildland/Urban Interface Fire Hazard Assessment Methodology. National Wildland/Urban Interface Fire Protection Program, (1998), NFPA, Washington, D.C. To obtain this resource:

Contact: Firewise (NFPA Public Fire Protection Division)

Phone: 617-984-7486

Website: <http://www.firewise.org>

Fire Protection in the Wildland/Urban Interface: Everyone's Responsibility. National Wildland/Urban Interface Fire Protection Program. (1998). Washington, D.C.: Author. To obtain this resource:

Contact: Firewise (NFPA Public Fire Protection Division)

Phone: 617-984-7486

Website: <http://www.firewise.org>

Planning for Natural Hazards: The Oregon Technical Resource Guide, Department of Land Conservation and Development (July 2000).

Produced by the Community Planning Workshop for the Department of Land Conservation and Development, this is a natural hazards planning and mitigation resource for Oregon cities and counties. It provides hazard-specific resources and plan evaluation tools. The document was written for local staffs and officials. The Technical Resource Guide includes a natural hazards comprehensive plan review, a hazard mitigation legal issues guide, and five hazard-specific technical resource guides, including: flooding, wildfires, landslides, coastal hazards, and earthquakes. This document is available online. You can also write, call, or fax to obtain this document:

Contact: Natural Hazards Program Manager

Address: 635 Capitol St. NE, Suite 200, Salem, OR 97301-2540

Phone: 503-373-0050

Fax: 503-378-6033

Website: <http://www.lcd.state.or.us/hazards.html>

Burning Questions. A Social Science Research Plan for Federal Wildland Fire Management, Machlis, G., Kaplan, A., Tuler, S., Bagby, K., and McKendry, J. (2002) National Wildfire Coordinating Group.

The plan covers a wide range of topics and questions related to the human dimensions of federal wildland fire management. Both the beneficial and harmful affects of wild land fire are considered. The plan includes research in the social sciences or anthropology, economics, geography, psychology, political science, and sociology, as well as interdisciplinary fields of research. The plan is national in scale but recognizes the importance of regional variation in wild land fire issues.

Contact: Sheila Williams, National Interagency Fire Center
Phone: 208-387-5203
Email: Sheila.Williams@nps.gov
Website: <http://www.nwcg.gov/whatnew.htm> or
http://www.campusi.com/isbn_0756726158.htm

Forest Fire Risk and Restoration. 2004. Oregon Forest Resources Institute.

This 20-page report, full of color photographs, illustrations and charts, investigates what can be done to enhance the recovery of forest ecosystems that have been damaged by fire. It examines options for reducing the risk of large-scale fires recurring where uncharacteristically intense fires have occurred, and it looks at the short- and long-term consequences of each restoration option versus taking no action at all.

Contact: Oregon Forest Resources Institute
Address: 317 SW 6th Avenue, Suite 400, Portland, OR 97204
Fax: 503-229-5823
Website: <http://forestresourceinstitute.com/>

The Western Forester (periodical). Society of American Forester's publication.

The *Western Forester* is an official publication of the Society of American Foresters. It is issued bi-monthly by the Oregon and Washington State Societies of American Foresters and is produced by the SAF Northwest Office. The publication promotes a timely exchange of quality resource management information among foresters, resource managers, and those in related disciplines. Each issue focuses on a specific theme in addition to including other articles of interest to foresters.

Contact: Aimee Sanders, Assistant Editor
Phone: 503-224-8046
Email: aimee@safnwo.org
Website: <http://www.forestry.org>

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Section 9:

Severe Winter Storm

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Why are Severe Winter Storms a Threat to Yamhill County?

Severe winter storms pose a significant risk to life and property in Yamhill County by creating conditions that disrupt essential regional systems such as public utilities, telecommunications, and transportation routes. Severe winter storms can produce rain, freezing rain, ice, snow, cold temperatures, and wind. Ice storms accompanied by high winds can have destructive impacts, especially to trees, power lines, and utility services. Severe ice storms occur more frequently in areas exposed to east winds such as those blowing out of the Columbia River Gorge. Less common are severe freezes, where temperatures remain below freezing for five or more days, and severe or prolonged snow events. Both can produce widespread impacts on people and property throughout Yamhill County.

Historical Severe Winter Storm Events

Northwestern Oregon Region

Destructive storms, producing heavy snow and ice, have occurred throughout northwestern Oregon's history, most notably in 1937 and 1950. Over a five-day period between January 31 and February 4, 1937, snowstorms blew across most of Oregon. The heaviest snowfall occurred in the Cascade Mountains and Willamette Valley where Salem and Dallas recorded 26 inches of snow.¹ The storms were directly related to five Oregon deaths and caused over \$50,000 (in 1937 dollars) in damage to Salem.²

January 1950 was a very cold month statewide and was marked by three successive snowstorms that brought the heaviest snowfalls for the state as a whole since records were first kept in 1890. The snow and ice storms closed highways, stranded motorists, created power outages and resulted in hundreds of thousands of dollars of damage across the state.³

Snow Storms

December 1892

From December 20 to 23, 1892, substantial snow fell across most of northern Oregon, with the greatest snowfall reported over northwestern Oregon, where storm totals ranged from 15 to 30 inches.⁴

January 1909

A six-day storm in January brought many locations more snow than is usually accumulated in one year.⁵

December 1919

The December 1919 snowstorm was recorded as the third heaviest snowfall-producing storm in Oregon. The Columbia River froze over, closing the river to navigation from the confluence with the Willamette River upstream. The snowstorm affected nearly every part of the state, with heavy snow falling over a widespread area.⁶

January 1937

Much of the damage occurred as structures collapsed from the weight of the snow. In addition to property damage, many major roads were closed.⁷

January 1950

The entire month of January 1950 was cold and frequent snowstorms occurred statewide. Snowfall and precipitation including freezing rain was heaviest between the 9th and 18th.⁸ During this time, there were wind gusts up to 80 mph and sustained winds up to 25 mph in the Willamette Valley.^{9,10} Thirty-nine inches of snow fell on Salem over the course of the month.^{11,12} Schools throughout the county were sporadically closed and at least two weather related traffic fatalities occurred in Oregon, one in Lyons.

March 1960

The first week of March 1960 was marked by a winter storm that brought more snow to Yamhill County than any time since 1950. This storm was responsible for two fatalities in Oregon, and many storm related accidents in Yamhill County. In addition, most schools throughout the County were closed for several days.¹³

February 1989

A weather system from Alaska remained in the area for several days, bringing snow and plunging temperatures.¹⁴ The February 1989 storm saw temperatures as low as eight degrees Fahrenheit, and five-foot high snow drifts.¹⁵ The storm led to five accidents on Interstate 5 that closed the highway between Salem and Albany; and near Woodburn, an overturned truck spilled 1,000 gallons of oil. There was also a storm related four-vehicle accident on Highway 22 near Silverton. Hospitals in Salem reported 25 snow-related injuries. The Oregon Department of Transportation estimated \$25,000 in additional costs was necessary for wages and supplies to deal with the storm's effects.^{16,17,18} Two power outages affected 80 percent of McMinnville's customers,¹⁹ and the South Yamhill River began to freeze over.²⁰

February 1993

This storm event dropped nearly twelve inches of snow in Salem between February 18th and 19th; the greatest amount of snowfall ever recorded in a twenty-four hour period in Salem.²¹

Ice Storms

January 30-31, 1963 (Northern half of Oregon)

Cold temperatures and snow showers created hazardous driving conditions in Yamhill County during the last days of January 1963. Four inches of snow were recorded at McNary Field in Salem.²² Large numbers of power lines were downed due to large amounts of ice or felled trees. Injuries, one reported death, and statewide school closures were due to the icy streets and highways.

January, 1978

During the early days of January 1978 a layer of cold air was driven into the Willamette Valley from Eastern Oregon via the Columbia Gorge. Rain from a higher warm air mass fell through the cold air below causing it to freeze. The cold temperatures and freezing rain iced roads throughout Yamhill County and the Willamette Valley causing eight traffic fatalities and dozens of traffic accidents.²³

February 2-4, 1996

Similar to the 1978 event, this storm began with a mass of cold air trapped in western Oregon followed by a warmer front that blew over the top of the cold air mass. Once the two fronts collided, a severe ice storm was created. Traffic accidents and power outages plagued the Willamette Valley. Freezing rain fell for two days, causing a 100-car pileup between Clackamas County and Salem and a 22-car pile up on Highway 22 near Eola. One fatality occurred when a car lost control on the ice, slide off the road, and flipped over near Lincoln City.^{24, 25}

December 26, 2003 through January 14, 2004

According to state climatologist George Taylor, snowstorms that have swept through the region beginning December 26, 2003, are the snowiest, coldest winter since 1992-3. The winter snowstorm that blew through the northwest Oregon at the end of December turned into an ice storm in January.²⁶ Climatologists called this the worst storm to pelt the west side of Oregon's Cascade Range since 1992 – even worse than a big ice storm that hit in 1998. The storm resulted from the collision of a mass of moisture from the Pacific with an arctic cold front.

The storm's impact at Portland International Airport had thousands of passengers stranded for several days after the freezing rain cancelled flights. The runway conditions were among the worst in recorded history.²⁷ More than 330 flights were canceled on January 6, 2004, as airplanes sat on the runway encased in ice.²⁸ Another 140 flights were canceled for the morning of January 7th alone.²⁹

58,000 Portland General Electric (PGE) customers were without power on January 6, 2004.³⁰ The hardest hit areas are the eastern and southern sections of the service territory, including east Multnomah County, Oregon City, Estacada, Molalla and Mulino, and the Salem area.³¹

Salem received three inches of snow on January 6th, according to the National Weather Service.

On New Year's Eve, six- and seven-foot drifts collected atop Bald Peak and Mountain Top Roads, in the northeastern part of the county.³²

In Willamina, when water lines began to thaw, lines started breaking.³³ A big break occurred at Willamina Lumber Company on Willamina Creek Road, and another at the old Conifer Plywood Mill on Main Street.³⁴ The city lost about 200 gallons a minute until they were able to isolate the leaks and get them fixed.³⁵ In addition to the larger lines, residential lines also froze and broke when the thawing process started. A power outage knocked out Willamina's water intake pump for twelve hours during the storm.³⁶

Extreme Cold Weather Events

December 15-26, 1924

In December 1924, temperatures stayed near or below the freezing mark for eleven straight days. At the time, this event in 1924 was recorded as the coldest December ever in Oregon. The cold period was long and severe. Most streams and rivers were frozen and blocked with ice. People drove their automobiles across the Willamette River.³⁷

In addition to the cold weather, four inches of snow fell over much of the Willamette Valley. The weight of the snow downed 400 telephone lines in Salem and caused 21 car accidents there.^{38,39} The freezing temperatures formed ice in the Willamette River that crushed a steamboat and caused several thousand dollars of damage to the Dennison Bath House.⁴⁰

January 24-31, 1957

The cold weather in January 1957 was the result of an arctic air mass that moved into Eastern Oregon and spread west toward the coast. The cold temperatures brought icy roads throughout Yamhill County.⁴¹

Temperatures in Yamhill County during this seven-day period were in the mid-teens, not considering the wind-chill created by 21 mph wind gusts. The cold snap cut electricity for some county residents and froze water pipes in many homes.⁴² The cold temperatures also caused the Bonneville Power Authority to cut interruptible power to the region's industrial customers because ice behind the dam slowed water flow and limited the ability to generate power.⁴³

February 1-8, 1989

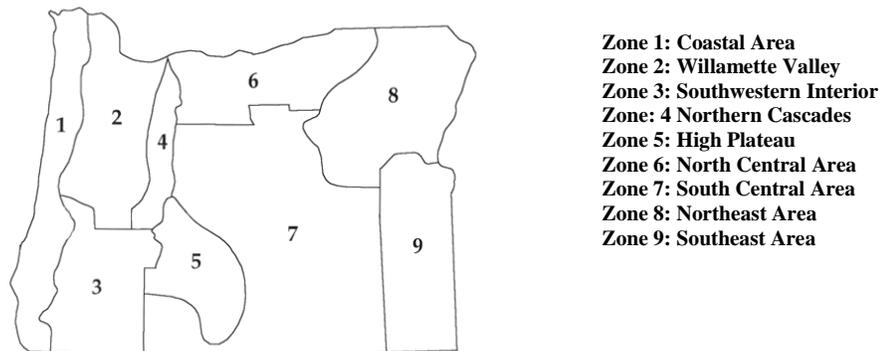
In early February 1989, Yamhill County experienced zero degree temperatures and wind gusts up to 40 mph that created a wind-chill factor of negative 65-75 degrees Fahrenheit. The extreme cold damaged crops, forced mills to send home employees and froze or burst residents' water pipes.^{44, 45, 46}

Characteristics of Severe Winter Storms in Yamhill County

Weather patterns

Severe winter storms affecting Yamhill County typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from October through March.⁴⁷ Yamhill County's average precipitation is 40.68 inches.⁴⁸ The National Climatic Data Center has established climate zones in the United States for areas that have similar temperature and precipitation characteristics. Oregon's latitude, topography, and proximity to the Pacific Ocean give the state diversified climates. Yamhill County is in Zone 2 as seen in Figure 9-1. The climate in Zone 2 generally consists of wet winters and dry summers.⁴⁹

Figure 9-1
Oregon Climate Zones



Source: Taylor, George H. and Hannan, Chris, *The Oregon Weather Book*, OSU Press (1999)

Snow

While snow is relatively rare in western Oregon, the break in the natural Cascades barrier at the Columbia Gorge provides a low-level passage through the mountains. Cold air, which lies east of the Cascades, often moves westward through the Gorge, and funnels cold air into the Portland Area, and may eventually sink southward into the Willamette Valley. If a wet Pacific storm happens to reach the area at the same time that the cold air is present, larger than average snow events may result.⁵⁰

An example of this type of snowstorm event occurred in January 1980, when strong storms, accompanied by snow, ice, wind, and freezing rain hit Oregon statewide. Impacts in the Portland area alone included one fatality, 200,000 customers left without power or phone service for several days. One hundred and twenty-five boats, with a combined value of over \$3 million dollars, sank in the Columbia Gorge.⁵¹

Ice

Ice storms occasionally occur in northern areas of Oregon, resulting from cold air flowing westward through the Columbia Gorge.⁵² Like snow, ice storms are comprised of cold temperatures and moisture, but subtle changes can result in varying types of ice formation, including freezing rain, sleet, and hail.⁵³

Freezing rain can be the most damaging of ice formations. While sleet and hail can create hazards for motorists when it accumulates, freezing rain can cause the most dangerous conditions within a community. Ice buildup can bring down trees, communication towers, and wires creating hazards for property owners, motorists, and pedestrians alike. The most common freezing rain problems occur near the Columbia Gorge, but also pose a hazard to Yamhill County. As noted above, the Gorge is the most significant east-west air passage through the Cascades. Rain originating from the west can fall on frozen streets, cars, and other sub-freezing surfaces, creating dangerous conditions.⁵⁴

Severe Winter Storm Hazard Assessment

Hazard Identification

A severe winter storm is generally a prolonged event involving snow or ice. The characteristics of severe winter storms are determined by a number of meteorological factors including the amount and extent of snow or ice, air temperature, wind speed, and event duration.

Precipitation, an additional element of severe winter storms, is measured by gauging stations. The National Weather Service, Portland Bureau, monitors the stations and provides public warnings on storm, snow, and ice events as appropriate.

Vulnerability Assessment

Vulnerability assessment is the second phase of a hazard assessment. It combines the information generated through severe winter storm identification with an inventory of the existing development exposed to this hazard assisting in the prediction of how different types of property and population groups will be affected by a hazard.⁵⁵ Data that includes the areas exposed to winter storms in Yamhill County can be used to assess the population and total value of property at risk from severe storms.

While a quantitative vulnerability assessment (an assessment that describes number of lives or amount of property exposed to the hazard) has not yet been conducted for Yamhill County severe winter storm events, there are many qualitative factors (issues relating to what is in danger within a community) that point to potential vulnerability. Severe winter storms can cause power outages and transportation and economic disruptions, and pose a high risk for injuries and loss of life. The events can also be typified by a need to shelter and care for adversely impacted individuals. Yamhill County has suffered severe

winter storms in the past that brought economic hardship and affected the life and safety of residents. Future severe winter storms may cause similar impacts countywide.

Risk Analysis

Risk analysis is the third, and most advanced phase of a hazard assessment. It is conducted by use of mathematical models and relies on information compiled during hazard identification and vulnerability assessments. Factors included in assessing severe winter storm risk include population and property distribution in the hazard area, the frequency of severe winter storm events, and information on trees, utilities, and infrastructure that may be impacted by severe winter storms. When sufficient data is collected for hazard identification and vulnerability assessment, a risk analysis can be completed. Insufficient data currently exists to complete a risk analysis.

Severe Winter Storm Community Issues

Life and Property

Winter storms are deceptive killers. Many winter storm deaths occur as a result of traffic accidents on icy roads, heart attacks while shoveling snow, and hypothermia from prolonged exposure to the cold.

Property is at risk due to flooding (see chapter 6) and landslides (see chapter 10) resulting from heavy snowmelt. Ice, wind, and snow can affect the stability of trees, power lines, telephone lines, and television and radio antennas. Falling trees and limbs affected by these events, and saturated soils can become hazards for houses, cars, utilities and other property. Similarly, icy streets are difficult for emergency personnel to travel and may pose a secondary threat to life if police, fire, and medical personnel cannot respond to calls.⁵⁶

Roads and Bridges

Inclement winter weather can cause prolonged and extreme traffic disruptions. Snow and ice events resulting in icy road conditions can lead to major traffic accidents. Roads blocked by fallen trees during a windstorm may have tragic consequences for people who need access to emergency services. The ability to travel after a natural hazard event is a priority issue for county residents, organizations, and providers of essential services such as hospitals and utilities.

Power Lines

Historically, falling trees have been the major cause of power outages resulting in interruption of services and damaged property. In addition, falling trees can bring electric power lines down, creating the possibility of lethal electric shock. Snow and ice can also damage utility lines and cause prolonged power outages. Rising population growth and new infrastructure in the county creates a higher probability for damage to occur from severe winter storms as more life and property are exposed to risk.

Water Lines

The most frequent water system problem related to cold weather is a break in cast iron mainlines. Breaks frequently occur during severe freeze events, as well as during extreme cooling periods during the months of October, November, and December. Another common problem during severe freeze events is the failure of commercial and residential water lines. Inadequately insulated potable water and fire sprinkler pipes can rupture and cause extensive damage to property.

Mitigation Plan Goals and Existing Activities

Mitigation Plan Goals

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

The plan goals help to guide the direction of future activities aimed at reducing risk and preventing loss from natural hazards. The goals listed here serve as checkpoints as agencies and organization begin implementing mitigation action items.

Goal #1: EMERGENCY OPERATIONS

Goal Statement: Coordinate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures and with various other agencies, as appropriate.

Goal #2: EDUCATION AND OUTREACH

Goal Statement: Develop and implement education and outreach programs to increase public awareness of the risks associated with natural hazards.

Goal #3: PARTNERSHIPS

Goal Statement: Develop effective partnerships with public and private sector organizations and significant agencies and businesses for future natural hazard mitigation efforts.

Goal #4: PREVENTIVE

Goal Statements:

- Develop and implement activities to protect human life, commerce, and property from natural hazards.
- Reduce losses and repetitive damage for chronic hazard events while promoting insurance coverage for catastrophic hazards.

Goal #5: NATURAL RESOURCES UTILIZATION

Goal Statement: Link natural resources management, land use planning, and watershed planning with natural hazard mitigation activities to protect natural systems and allow them to serve natural hazard mitigation functions.

Goal #6: IMPLEMENTATION

Goal Statement: Implement strategies to mitigate the effects of natural hazards.

Existing Mitigation Activities

County Programs

Yamhill County Public Works' Road Department

The Public Works' Department sands paved, county roads when cold weather events are anticipated.

State Programs

One of the strongest and most widespread existing mitigation strategies pertains to vegetation clearance. **Oregon Line Safety Statute**, ORS 757.035, is the minimum legal standard in Oregon for the construction, operation and maintenance of electrical supply and signal lines. The law and rule applies to any person, company, agency, municipality, cooperative or association, their agents, lessees or acting trustees or receivers, appointed by any court, engaged in the management, operation, ownership, or control of electrical supply, and telecommunications equipment.

Failure to allow a utility company to comply with the law can result in liability to the homeowner for damages or injuries resulting from a vegetation hazard. Many insurance companies do not cover these types of damages if the policy owner has refused to allow the hazard to be eliminated. The power companies, in compliance with the above regulations, collect data about tree failures and their impact on power lines. This mitigation strategy assists the power company in preventing future tree failure. From the collection of this data, the power company can advise residents as to the most appropriate vegetative planting and pruning procedures.

Oregon Department of Transportation (ODOT) Winter Maintenance Practices

ODOT spends about \$16 million per year on snow and ice removal from the state highway system. ODOT's goal for winter maintenance is to improve the driving surfaces during winter conditions. ODOT uses three main approaches to mitigation of snow hazards on state highways:

- Snow plowing – moving snow out of the road;
- Sanding roadways for ice to make roads less slick; and
- Using anti-icing chemicals to stop ice from forming on roads.

ODOT highway maintenance crews prepare for severe winter conditions by November 1st each year. Crews make sure all equipment, including radios, and signs, are ready for the first frost or snowstorm. Equipment operators learn or refresh their ability to maintain and use snow and ice equipment.

Oregon State Parks close parks during natural disasters, and evacuate people from parkland when necessary.

Federal Programs

National Weather Service

The Portland Office of the National Weather Service issues severe winter storm watches and warnings when appropriate to alert government agencies and the public of possible or impending weather events. The watches and warnings are broadcast over NOAA weather radio and are forwarded to the local media for retransmission using the Emergency Alert System.

The National Weather Service issues a variety of advisories for winter weather situations. In general, a *watch* lets the public know that dangerous weather is possible within the next 24 hours. An *advisory* indicates that dangerous (but not necessarily life-threatening) winter weather conditions are already happening or may be about to begin. A *warning* indicates that very dangerous (an possibly life-threatening) winter weather conditions are already happening or may be about to begin. A *warning* should be taken more serious than an *advisory*, which is more serious than a *watch*.

Severe Winter Storm Mitigation Action Items

The mitigation action items for severe winter storms were formulated through research of regional mitigation plans, natural hazards planning literature, and interviews with local stakeholders. Plan action items were refined through discussions with the mitigation plan steering committee and through an open house at which the county received comments from the public.

The severe winter storms mitigation action items provide direction on specific activities that organizations and residents in Yamhill County can undertake to reduce risk and prevent loss from severe winter storm events. Each action item is followed by ideas for implementation, which can be used by the steering committee and local decision makers in pursuing strategies for implementation.

This section lists action items identified to reduce the risk from severe winter storm impacts in Yamhill County. These action items are designed to meet the mitigation plan goals.

Short-term (ST) Severe Winter Storm Action Items

Short-term severe winter storm action items include general mitigation activities that agencies are capable of implementing during the next two years, given their existing resources and authorities.

ST-SWS #1: Develop and implement, or enhance strategies for debris management due to severe winter storms.

Ideas for Implementation

- Develop coordinated management strategies for de-icing roads, clearing roads of fallen trees and debris from public and private property; and
- Utilize Community Emergency Response Teams (CERT) to attend to downed power lines until utility crews arrive, assist with clearing roads, and directing citizens away from hazards. This prevents a drain on emergency response personnel resources.

Coordinating Organization:	Road Division of County Public Works
Internal Partner:	GIS, Planning, and Administrative Services Director
External Partner:	Community Emergency Response Teams (CERT)
Timeline:	2 years
Plan Goals Addressed:	Emergency Operations; Education & Outreach; Partnerships; Preventive; Natural Resources Utilization; Implementation

ST-SWS #2: Develop and implement programs to coordinate maintenance and mitigation activities to reduce risk to public infrastructure from severe winter storms.

Ideas for Implementation

- Partner with responsible agencies and organizations to design and implement programs that reduce risk to life, property, and utility systems;
- Seek funding for acquiring snow drift fences to strategically place along the Chehalem Ridge (Snowdrifts can reach heights of 10 to 12 feet when conditions include relatively dry snow and east winds); and
- Develop partnerships between utility providers and county and local public works agencies to document known hazard areas and minimize risk.

Coordinating Organization: Emergency Management
 Internal Partner: Community Development/Planning, Public Works
 External Partner: Cities, utilities
 Timeline: 2 years
 Plan Goals Addressed: Emergency Operations; Partnerships; Natural Resources Utilization; Implementation

ST-SWS #3: Seek funding to acquire necessary emergency back-up power systems for all Rural Fire Protection District facilities and other identified critical facilities.

Coordinating Organization: Emergency Management
 Internal Partner: Administrative Services Director
 External Partner: Fire Defense Board
 Timeline: 1 to 2 years
 Plan Goals Addressed: Emergency Operations; Partnerships; Implementation

Long-term (LT) Severe Winter Storms Action Items

Long-term severe winter storms action items include general mitigation activities that are likely to take more than two years to implement and may require new or additional resources and/or authorities.

LT-SWS #1: Increase and maintain public awareness of severe winter storms and the benefits of mitigation activities through education aimed at households and businesses and increase targeting of special needs populations.

Ideas for Implementation

- Collect additional information and add to existing informational sources on public education materials for protecting life, property, and the environment from severe winter storm events;
- Distribute educational materials to County residents and public and private sector organizations regarding evacuation routes during road closures;
- Maintain and update Yamhill County's Web site information as it pertains to severe winter storm tips;
- Distribute audience-specific educational materials to schools, churches, and other public and private sector organizations;
- Develop methods of improving emergency warning system;
- Educate citizens about the variety of National Weather Service winter weather advisories;
- Identify and contact at-risk populations such as the elderly or disabled not living in group homes/assisted care facilities; and
- Create inventory of supplies available for at-risk populations in severe winter storm situations.

Coordinating Organization: Emergency Management
Internal Partner: Community Development
External Partners: Utilities, cities, American Red Cross, St. Vincent DePaul, churches, Oregon voluntary organizations active in disaster, fire districts
Timeline: 1 to 2 years, on-going
Plan Goals Addressed: Emergency Operations; Education & Outreach; Partnerships; Preventive; Natural Resources Utilization; Implementation

LT-SWS #2: Enhance weather monitoring to attain earlier severe winter storm warnings.

Ideas for Implementation

- Coordinate with appropriate organizations to evaluate the need for more weather stations and/or weather instrumentation; and
- Encourage partnerships with local amateur radio operators (Hams - ARES) to effectively improve communications during storm events.

Coordinating Organization: Emergency Management
External Partner: NWS, OCS, ARES

Timeline: On-going
Plan Goals Addressed: Education & Outreach; Preventive;
Implementation

LT-SWS #3: Develop and implement programs to keep trees from threatening lives, property, and public infrastructure as a result of severe weather events.

Ideas for Implementation

- Consider use of an arborist to survey potential problem areas for tree damage;
- Coordinate with overhead utilities in developing GIS layers for power lines and at-risk trees; and
- Collaborate with overhead utilities on “Right Tree – Right Place Program.”

Coordinating Organization: Emergency Management
Internal Partner: GIS, Public Works, Community Development
External Partner: Overhead utilities, cities
Timeline: On-going
Plan Goals Addressed: Partnerships; Preventive; Natural Resources Utilization

LT-SWS #4: Develop and maintain comprehensive impact database and when possible, map and publicize historical severe weather events in Yamhill County.

NOTE: Hazardous areas can be identified for the public so precautions can be taken at appropriate times. Information about county road icing and county road closures due to snow or other severe winter storm events may already exist within county offices such as the Data Command Center, yet it can be mapped and disseminated countywide to make residents knowledgeable about severe winter (and windstorm) events.

Ideas for Implementation

- Research and analyze historic severe weather events’ damage in county;
- Identify and map reoccurring patterns;
- Identify a responsible agency for central collection and reporting of storm data. Data collected should include:
 1. Records of ice and snow in localities throughout Yamhill County.

2. Maps of the locations within Yamhill County most vulnerable to snow and ice, including roads, bridges, and utility lines.
 3. Injury and property damage estimates, including locations.
- Identify a responsible agency to collect and transfer data to the National Climate Data Center, Oregon Climate Service, FEMA, or any other agency concerned with the incidence of storms, to help establish and maintain baseline and historic records of storm events;
 - Document future events including impacts and losses; and
 - Identify public infrastructure and facilities subject to closures due to snowfall and ice hazards during winter storms.

Coordinating Organization: Yamhill County
 Internal Partner: Community Development, GIS
 External Partner: Cities, NWS, NOAA, ODOT, OCS, overhead utilities
 Timeline: On-going
 Plan Goals Addressed: Education & Outreach; Partnerships; Preventive; Natural Resources Utilization

LT-SWS #5: Support/encourage electrical utilities to use underground construction methods where possible to reduce power outages from severe winter storms through public incentives and partnerships.

Ideas for Implementation

- Continue support of utility under-grounding program in newly developed areas to minimize future conflicts with utilities;
- Increase the use of underground utilities where possible in redevelopment areas;
- Coordinate with local utility companies and contractors to install underground utilities;
- Partner with utilities to investigate under-grounding utilities in sections of the county that are prone to hazards related to overhead utilities; and
- Identify underground utilities projects as a part of future Capital Improvement Projects (CIP).

Coordinating Organization: Emergency Management
 Internal Partners: Community Development, GIS
 External Partner: Cities, overhead utilities
 Timeline: On-going
 Plan Goal Addressed: Partnerships; Preventive

LT-SWS #6: Promote the benefits of tree-trimming and tree replacement programs and help to coordinate local efforts by public and private agencies.

NOTE: Overhead utilities' tree-trimming and tree replacement programs provide tree maintenance benefits to local communities. The utilities could benefit in turn from cooperation with public and private foresters in harvest plans that are adjacent to roads and/or power line easements.

Coordinating Organization: Public Works (Roads Division)
Internal Partners: GIS, Emergency Management
External Partners: Utility and telecommunications companies, ODOT, city public works, BLM, timber industries
Timeline: 3 to 5 years
Plan Goals Addressed: Education & Outreach; Partnerships; Natural Resources Utilization

LT-SWS #7: Encourage harvesting of trees along utility and road corridors, preventing potential winter storm damage.

Ideas for Implementation

- Encourage the harvesting of trees along utility corridors and roads, which will prevent winter storm damage; and
- Encourage Federal, State, local agencies and utility operators to harvest trees in the corridors which will prevent winter storm damage, mitigate fire hazards, and could be used in fish enhancement projects.

Coordinating Organization: Public Works (Roads Division)
Internal Partner: Emergency Management
External Partners: Cities, utilities, FEMA, ODFW, DSL, BLM, ODOT, timber industries
Timeline: On-going
Plan Goals Addressed: Preventive; Natural Resources Utilization; Implementation

LT-SWS #8: Encourage right-of-way coordination, education and management between property owners, utility operators, and government agencies.

Ideas for Implementation

- Encourage the cooperation and education for managing right-of-way corridors with property owners.

Coordinating Organization: Public Works (Road Division)
Internal Partner: GIS, Planning, Building
External Partner: ODOT, BLM, timber industries, utility operators, county residents
Timeline: On-going
Plan Goals Addressed: Partnerships; Preventive; Natural Resources Utilization; Implementation

LT-SWS #9: Encourage harvesting of trees that are blown down during a winter storm.

Ideas for Implementation

- Encourage the harvesting of trees blown down during a winter storm; and
- Encourage Federal, State and Local Agencies to harvest trees that have fallen during a winter storm, which will mitigate fire hazards, and could be used in fish enhancement projects.

Coordinating Organization: Emergency Management
Internal Partner: Planning, Public Works
External Partner: Cities, utilities, FEMA, ODFW, DSL, BLM, ODOT, timber industries
Timeline: On-going
Plan Goals Addressed: Preventive; Natural Resources Utilization

Severe Winter Storm Resource Directory

State Resources

Department of Land Conservation and Development (DLCD)

DLCD administers the state's Land Use Planning Program. The program is based on 19 statewide planning goals, including Goal 7, related to natural hazards. In order to help local governments address natural hazards effectively, DLCD provides technical assistance such as conducting workshops, reviewing local land use plan amendments, and working interactively with other agencies.

Contact: Natural Hazards Program Manager, DLCD
Address: 635 Capitol St. NE, Suite 200, Salem, OR 97301-2540
Phone: 503-373-0050
Fax: 503-378-6033
Website: <http://www.lcd.state.or.us/hazards.html>

Oregon Climate Service (OCS)

The Oregon Climate Service collects, manages, and maintains Oregon weather and climate data. OCS provides weather and climate

information to those within and outside the state of Oregon and educates the citizens of Oregon on current and emerging climate issues. OCS also performs independent research related to weather and climate issues.

Contact: Oregon Climate Service
Address: Strand Agriculture Hall 326, Corvallis, OR 97331-2209
Phone: 541-737-5705
Fax: 541-737-5710
Website: <http://www.ocs.orst.edu>
Email: coas@oregonstate.edu

Oregon State Police (OSP)-Office of Emergency Management (OEM)

The purpose of OEM is to execute the Governor's responsibilities to maintain an emergency services system as prescribed in Oregon Revised Statutes Chapter 401 by planning, preparing, and providing for the prevention, mitigation, and management of emergencies or disasters that present a threat to the lives and property of citizens of and visitors to the state of Oregon.

Contact: Office of Emergency Management
Address: 3225 State Street, Salem, OR 97301
P.O. Box 14370, Salem, OR 97309-5022
Phone: 503-378-2911
Fax: 503-373-7833
Website: <http://www.osp.state.or.us/oem>

Federal Resources

Federal Emergency Management Agency (FEMA)

FEMA's mission is "to reduce loss of life and property and protect our nation's critical infrastructure from all types of hazards through a comprehensive, risk-based, emergency management program of mitigation, preparedness, response and recovery." FEMA Region X serves the northwestern states of Alaska, Idaho, Oregon, and Washington.

Contact: FEMA, Federal Regional Center, Region 10
Address: 130-228th St. SW, Bothell, WA 98021-9796
Phone: 425-487-4600
Fax: 425-487-4622
Website: <http://www.fema.gov/regions/x/regx.shtm>

National Oceanic and Atmospheric Administration (NOAA)

NOAA's historical role has been to predict environmental changes, protect life and property, provide decision makers with reliable scientific information, and foster global environmental stewardship.

Contact: National Oceanic and Atmospheric Administration
Address: 14th Street & Constitution Avenue, NW, Room 6217, Washington, DC 20230
Phone: 202-482-6090
Fax: 202-482-3154
Website: <http://www.noaa.gov>

Email: answers@noaa.gov

National Weather Service, Portland Bureau

The National Weather Service (NWS) provides weather, hydrologic, and climate forecasts and warnings for the United States, its territories, adjacent waters and ocean areas, for the protection of life and property and the enhancement of the national economy. NWS data and products form a national information database and infrastructure, which can be used by other governmental agencies, the private sector, the public, and the global community.

Contact: National Weather Service
Address: 5241 NE 122nd Ave, Portland, Oregon 97230-1089
Phone: 503-326-2340
Website: <http://nimbo.wrh.noaa.gov/Portland>

Additional Resources

American Red Cross

The American Red Cross is a humanitarian organization, led by volunteers, that provides relief to victims of disasters and helps people prevent, prepare for, and respond to emergencies. The Oregon Trail Chapter was chartered as a Red Cross unit in 1917. The chapter serves the residents of Clackamas, Clatsop, Columbia, Multnomah, Tillamook, Washington and Yamhill counties. The Oregon Trail Chapter provides a variety of community services, which are consistent with the Red Cross mission, and meets the specific needs of this area, including disaster planning, preparedness, and education.

Contact: American Red Cross, Willamette Chapter
Address: 3131 N Vancouver Ave, Portland, OR 97227-1560
P.O. Box 3200, Portland, OR 97208-3200
Phone: 503-284-1234
Fax: 503-284-4247
Email: info@redcross-pdx.org
Website: <http://www.redcross-oregontrail.org>

Institute for Business & Home Safety (IBHS)

IBHS was created as an initiative of the insurance industry to reduce damage and losses caused by natural disasters. Their website provides educational resources and on-line publications for insurers, businesses, and homeowners who are interested in taking the initiative to minimize future damages and losses.

Contact: Institute for Business and Home Safety
Address: 1408 North Westshore Boulevard - Suite 208 - Tampa, FL 33607
Phone: 813-286-3400
Fax: 813-286-9960
E-mail: info@ibhs.org
Website: <http://www.ibhs.org/ibhs2>

Publications

Public Assistance Debris Management Guide, Federal Emergency Management Agency (July 2000).

The Debris Management Guide was developed to assist local officials in planning, mobilizing, organizing, and controlling large-scale debris clearance, removal, and disposal operations. Debris management is generally associated with post-disaster recovery. While it should be compliant with local and county emergency operations plans, developing strategies to ensure strong debris management is a way to integrate debris management within mitigation activities. The *Public Assistance Debris Management Guide* is available in hard copy or on the FEMA website.

Contact: FEMA Distribution Center
Address: 130 - 228th Street, SW, Bothell, WA 98021-9796
Phone: 800-480-2520
Fax: 425-487-4622
Website: <http://www.fema.gov/r-n-r/pa/dmgtoc.htm>

Severe Winter Storms - Endnotes

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Section 10:

Windstorms (Including Tornadoes)

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Why are Windstorms a threat to Yamhill County?

When a strong windstorm strikes a community, it leaves behind a distinctive trail. Trees toppled over on buildings and cars, downed power lines crisscrossing the roads, and widespread power outages are a few of the signs that a windstorm has struck. After such an event, it can take communities days, weeks, or even longer to return to normal activities. In addition to costly structural damages, windstorms can cause injury or even death.

A windstorm in 1995 damaged numerous homes, businesses, and public facilities, generated tons of disaster-related debris, and cost local governments several million dollars to deal with the storm's impact throughout the state. Oregon received \$2.8 million through the Federal Emergency Management Agency's (FEMA) Public Assistance program to repair and restore damaged infrastructure. Approximately \$420,000 was allocated toward mitigation activities through FEMA's Hazard Mitigation Grant Program.

Similarly, a storm in February 2002 resulted in a Presidential Disaster Declaration for five Oregon Counties, and nine other counties, including Yamhill County, were declared contiguous Counties. Such a declaration allowed family farmers to apply for loans to assist with storm related damage.

Historical Windstorm Events

Regional

The Mid/Southern Willamette Valley, including Yamhill County, has experienced several powerful windstorms over the past several decades. Most of these storms resulted in building and property damage, utility failures, and in some cases injury or death. Table 10-1 outlines the most severe windstorms recorded in the region.

Table 10-1: Significant Wind Storms Affecting The Mid / Southern Willamette Valley, 1931-2002

Date	Affected Area	Characteristics
Apr., 1931	Western Oregon	Unofficial wind speeds reported at 78 mph. Damage to fruit orchards and timber.
Nov. 10-11, 1951	Statewide	Widespread damage; transmission and utility lines; Wind speed 40-60 mph; Gusts 75-80 mph
Dec., 1951	Statewide	Wind speed 60 mph in Willamette Valley. 75 mph gusts. Damage to buildings and utility lines.
Dec., 1955	Statewide	Wind speeds 55-65 mph with 69 mph gusts. Considerable damage to buildings and utility lines
Nov., 1958	Statewide	Wind speeds at 51 mph with 71 mph gusts. Every major highway blocked by fallen trees
Oct., 1962	Statewide	Columbus Day Storm; Oregon's most destructive storm to date. 116 mph winds in Willamette Valley. Estimated 84 houses destroyed, with 5,000 severely damaged. Total damage estimated at \$170 million
Mar., 1971	Most of Oregon	Greatest damage in Willamette Valley. Homes and power lines destroyed by falling trees. Destruction to timber in Lane Co.
Nov., 1981	Most of Oregon	Highest winds since 10/62. Wind speed 71 mph in Salem. Marinas, airports and bridges severely damaged
Jan., 1990	Statewide	Heavy rain with winds exceeding 75-mph. Significant damage. One fatality.
Dec., 1995	Statewide	Followed path of Columbus Day Storm. Wind speeds 62 mph in Willamette Valley. Damage to trees (saturated soil a factor) and homes. (FEMA-1107-DR-OR)
Nov., 1997	Western Oregon	Wind speed 52 mph in Willamette Valley. Trees uprooted. Considerable damage to small airports.
Feb., 2002	Western Oregon	Strongest storm to strike western Oregon in several years. Many downed power lines (trees); damage to buildings; water supply problems (lack of power). Estimated damage costs: \$6.14 million. (FEMA-1405-DR-OR)

Source: Taylor, George H., and Ray Hatton, The Oregon Weather Book (1999), pp.151-157, Hazard Mitigation Team Survey Report, Severe Windstorm in Western Oregon, February 7, 2002 (FEMA-1405-DR-OR)

Yamhill County

Windstorms have historically been a threat to Yamhill County and most of the storms described in Table 10-1 also impacted Yamhill County. The following storms, though not exclusive to Yamhill County, caused particularly severe damage to the County.

April 1931 Windstorm

This storm, with winds up to 40 mph and gales up to 75 mph, blew moving vehicles off roadways.¹ The storm consisted of northeastern winds that blew tons of dust from Eastern Oregon down the Columbia Gorge where it then settled over much of the Willamette Valley. The dust reduced visibility to distances less than one mile. The winds also caused several devastating fires. In Mehama, several buildings burned completely, including homes, a large store and the Stayton Bank. There were forest fires throughout the Willamette Valley, and one as large as 3,000 acres in Linn County, were whipped up by the winds.²

December 1951 Windstorm

This mid-century storm with winds recorded at 57 mph and gusts up to 76 mph resulted in four Oregon deaths. Power outages for up to a day were recorded at Union Hill, Waldo Hill, Victor Point, Scotts Mills, Silverton Hills and Marquem. The North and South Santiam highways and the Siuslaw highway were closed due to fallen trees.³

October 12, 1962 (The Columbus Day Storm)

The Columbus Day storm in 1962 produced sustained winds and gusts as high as 90 mph⁴. It was the most destructive windstorm ever recorded in Oregon, both in terms of loss of life and property damage. Damage was most severe in the Willamette Valley where the storm killed thirty-eight people and was responsible for three deaths in the county.⁵ The storm caused upwards of \$200 million in damage (over \$800 million in today's dollars) statewide.⁶ The storm swept across 75,000 square miles of Northern California, Oregon and Washington and carved a swath of destruction about a thousand miles long and 125 miles wide.⁷

The storm had its eye on Yamhill County and the Willamette Valley. The valley, framed by two mountain ranges, provided a natural funnel for the wind. Storm damage estimate for Yamhill County exceeded \$15 million.⁸ Yamhill County was designated a "catastrophe area" by the insurance industry.⁹ Several hundred farm buildings in the county were destroyed, and about 175,000 prune trees and 50,000 walnut trees were uprooted.¹⁰ OSU Extension estimated that the county might have lost half its prune and walnut acreage.¹¹

In downtown McMinnville, huge metal sheets off the roof of the First National Bank building sailed down Third Street.¹² Great pieces of metal from the roof of the Elks Lodge hurtled along the street.¹³ Dayton teen-agers were headed to Salem in their car when trees were blown across the car on Wallace Road. Both teens died as a result of the accident.¹⁴

A 39-year-old contractor attempted to cover hay in a large barn on his farm west of McMinnville as protection from rain when a heavy beam collapsed, hitting him in the back. He died later in a hospital.¹⁵ Streetlights were out at Fourth and Evans in McMinnville, when a

McMinnville resident was killed after being struck by an automobile.¹⁶ His death was attributed to the storm.

Jack Coleman, Yamhill County American Red Cross director, said that almost all the buildings in the county incurred some damage and estimated average damage at about \$300 per home.

Extensive damage occurred between McMinnville and Carlton, where a several-mile-wide swath cut across several farms.¹⁷ Numerous power and telephone lines were downed in the storm.¹⁸ McMinnville City Water and Light Department were kept busy replacing poles, clearing roads and restoring communications.¹⁹ Approximately 200 trees were downed at Wortman Park during the storm.²⁰

Hundreds of thousands of homes were without power for short periods of time, while others were without power for two to three weeks. More than 50,000 homes were seriously damaged, and nearly 100 were completely destroyed. The storm destroyed fruit and nut orchards and killed scores of livestock. 175,000 prune trees and 50,000 walnut trees, and several hundred farm buildings were destroyed in the storm.²¹

March 25-26, 1971

This March windstorm produced winds up to 50 mph and hit the area particularly hard while also causing power outages for approximately 60 homes in the mid-Willamette Valley²².

November 13-15, 1981

November 1981 saw two successive windstorms on the 13th and 14th. Sustained winds in the Willamette Valley reached 52 mph and gusts were recorded at 71 mph.²³ Eleven people were killed and \$50 million in damage was reported as a result of the two storms. Numerous injuries resulted from wind-blown debris in western Washington and Oregon.²⁴

Across the Pacific Northwest, hundreds of downed trees and power lines caused massive power outages and roof damage. The storm caused 500,000 Oregon residents to lose power²⁵.

December 12, 1995

This windstorm caused such widespread damage from downed trees and power and communication outages that Governor Kitzhaber declared a state of emergency for all of western Oregon and called 150 National Guard Troops to assist residents and public utility crews.²⁶

The storm caused three deaths. The windstorm resulted in over one million dollars in damage in the mid-Willamette Valley.²⁷ Some of this damage included environmental damage as “millions of gallons of raw sewage” flowed into Salem area creeks and the Willamette River.²⁸

In Salem, the National Weather Service reported average winds of 40 mph with gusts up to 59 mph. In the region between Salem and Corvallis, 7500 people lost phone service. In addition to power and

phone outages, Interstate 5 was shut down to truck traffic for several hours.²⁹

February 7, 2002

The most recent of large windstorm events arrived in the Willamette Valley with wind gusts up to 70 mph causing 27,000 power outages statewide.³⁰ The severity of this storm prompted President Bush to issue Major Disaster Declarations for five Oregon Counties and nine other Oregon Counties were named contiguous Counties, allowing family farmers to receive loans to address storm related damage.³¹ Polk and Marion Counties were two of the nine, named contiguous counties, but Yamhill was not named.

Characteristics of Windstorms in Yamhill County

The most frequent surface winds in Oregon are from the southwest. These widespread winds are associated with storms moving onto the coast from the Pacific Ocean. Winds coming from the south are the most destructive. The Columbus Day Storm of 1962 was an example of this type of windstorm. Chinook winds are strong easterly winds coming out of the Columbia Gorge. Chinook is a native Indian word meaning “snow eater.” The Chinook wind is a warm dry wind that often leads to the rapid disappearance of snow, and can gust up to 100 miles per hour. The gusts are caused by rapid atmospheric pressure changes. Studies have shown that these changes can result in physiological and psychological reactions in humans such as headaches and increased irritability.

West winds generate from the Pacific Ocean and are strong along the coast, but slow down inland due to the obstruction of the Coastal and Cascade mountain ranges.³² Prevailing winds in Oregon vary with the seasons. In summer, the most common wind directions are from the west or northwest; in winter, they are from the south and east. Local topography, however, plays a major role in affecting wind direction. For example, the north-south orientation of the Willamette Valley channels the wind most of the time, causing predominately north and south winds.³³

Tornadoes

Tornadoes are the most concentrated and violent storms produced by the earth’s atmosphere. They are created by a vortex of rotating winds and strong vertical motion, which possess remarkable strength and cause widespread damage. Wind speeds in excess of 300 mph have been observed within tornadoes, and it is suspected that some tornado winds exceed 400 mph. The low pressure at the center of a tornado can destroy buildings and other structures it passes over. Tornadoes are most common in the Midwest, and are more infrequent and generally small west of the Rockies. Nonetheless, Oregon and other western states have experienced tornadoes on occasion, many of which have produced significant damage and occasionally injury or death.

Based on data from 1950 to 1995, Oregon ranks 46th nationally for frequency of tornadoes, none for number of deaths and 34th for cost of damages.³⁴

Oregon's tornadoes can be formed in association with large Pacific storms arriving from the west. Most of them, however, are caused by intense local thunderstorms. These storms also produce lightning, hail, and heavy rain, and are more common during the warm season from April to October.³⁵ Five tornadoes of note have struck Yamhill County.

McMinnville – February 19, 1926³⁶

This tornado apparently felled many trees and destroyed a huge “dry house.” From several accounts, it seems that there may have been four or five separate whirlwinds in a bunch that lowered from the storm.

McMinnville – May 25, 1971.³⁷

This was a small, slow-moving tornado that touched down near a rural home. IT unroofed the barn and damaged the house. The tornado moved along a 0.4-mile long path damaging fir trees before lifting back into the cloud base. This was classified as a ‘Gale’ tornado (i.e., 40 to 72 mph, light damage), and caused between \$500 and \$5,000 worth of damage.

Amity – August 20, 1978³⁸

This tornado caused small amounts of damage and was determined to be a tornado only after later visits and inspection of the area. It caused between \$5,000 and \$50,000 worth of damage.

Woodland Heights – April 18, 1984.³⁹

A smaller tornado struck in Aurora destroying a machine shop and scattering its pieces over a half-mile area. It caused between \$500 and \$5,000 worth of damage.

Newberg – December 8, 1993⁴⁰

This “Significant” tornado (i.e., 113 to 157 mph, considerable damage) was the most powerful tornado in Oregon in many years. It started as a cold front that came with a deep surface low along the coast that moved across the Willamette Valley. Six veal calves were killed, a dairy farm was damaged, roofs were blown off some small buildings, and many trees were broken. People reported that the funnel was sucking water from the Willamette River as it moved northeast. There, it greatly damaged a mobile home park. A tree at least two feet in diameter was snapped off six feet above the ground and hit a two-story house. Remarkably, no one was injured. This significant tornado caused anywhere between \$500,000 and \$5 million worth of damage.

Windstorm Hazard Assessment

Hazard Identification

A windstorm is generally a short duration event involving straight-line winds and/or gusts in excess of 50 mph. Windstorms affect areas of the county with significant tree stands, as well as areas with exposed

property, major infrastructure, and aboveground utility lines. The lower wind speeds typical in the lower valleys are still high enough to knock down trees and power lines, and cause other property damage. Mountainous sections of the county experience much higher winds under more varied conditions. Because of the local nature of wind hazards in the mountains, a high-resolution wind speed map would be required to accurately identify the degree of wind hazard throughout the county. Such a map could identify wind hazards other than tree-falls, such as winds high enough to cause various degrees of structural damage. Unfortunately, high-resolution wind maps were not available at the time of this publication, so a precise wind hazard analysis could not be performed.

The characteristics of tornadoes are determined by the wind speed, and event duration. Tornadoes often occur quickly with a duration ranging from several minutes to several hours. The typical tornado damage path is about one or two miles, with a width of about 50 yards.⁴¹ The largest tornado path widths can exceed one mile, and the smallest widths can be less than ten yards.⁴² Widths can vary considerably during a single tornado, because the size of the tornado can change considerably during its lifetime.⁴³ Path lengths can vary from a single point to more than 100 miles.⁴⁴ More highly populated areas within the county are those at greatest risk during a tornado.

The probability of a major tornado occurring in Yamhill County is uncertain due to limited historical records. The National Weather Service, Portland Bureau, provides public warnings on tornadoes as appropriate.

Vulnerability Assessment

A vulnerability assessment that describes the number of lives and amount of property exposed to the wind hazard has not yet been conducted for Yamhill County windstorms. There are many issues related, however, to what is in danger within communities experiencing windstorms. Windstorms can cause power outages, transportation, and economic disruptions, and significant property damage and pose a high risk for injuries and loss of life. They can also be typified by a need to shelter and care for individuals impacted by the events. Several destructive windstorms, (most notably the 1962 Columbus Day storm and the December 12, 1995 windstorm) brought economic hardship and affected the life and safety of county residents. Future windstorms may cause similar impacts countywide.

Factors that should be included in windstorm risk analysis include: population and property distribution in the hazard area; the frequency of windstorm events; and information on the types of trees and failure rates most susceptible to windstorm events. When sufficient data is collected for hazard identification and vulnerability assessment, a risk analysis can be completed. Currently, insufficient data currently exists to complete a risk analysis.

Risk Analysis

Risk analysis is the third, and most advanced phase of a hazard assessment. It is conducted by use of mathematical models and relies on information compiled during hazard identification and vulnerability assessments. Factors included in windstorm and tornado risk analysis include population and property distribution in the hazard area, the frequency of windstorm events, and information on the types of trees and failure rates most susceptible to windstorm events. When sufficient data is collected for hazard identification and vulnerability assessment, a risk analysis can be completed. Insufficient data currently exists to complete a risk analysis.

Windstorm Community Issues

Property and Life

Windstorms have the ability to cause damage over 100 miles from the center of storm activity. Isolated wind phenomena in the mountainous regions have more localized effects. Winds impacting walls, doors, windows, and roofs, may cause structural components to fail. Wind pressure can create a direct and frontal assault on a structure, pushing walls, doors, and windows inward. Conversely, passing currents can create lift and suction forces that act to pull building components and surfaces outward. The effects of winds are magnified in the upper levels of multi-story structures. As positive and negative forces impact the building's protective envelope (doors, windows, and walls), the result can be roof or building component failures and considerable structural damage. The effects of wind speed are shown in Table 10-2.

Table 10-2. Effect of Wind Speed

Wind Speed (Mph)	Wind Effects
25-31	Large branches will be in motion.
32-38	Whole trees in motion; inconvenience felt walking against the wind.
39-54	Twigs and small branches may break off of trees; wind generally impedes progress when walking; high profile vehicles such as trucks and motor homes may be difficult to control.
55-74	Potential damage to TV antennas; may push over shallow-rooted trees, especially if the soil is saturated.
75-95	Potential for minimal structural damage, particularly to unanchored mobile homes; power lines, signs, and tree branches may be blown down.
96-110	Moderate structural damage to walls, roofs and windows; large signs and tree branches blown down; moving vehicles pushed off roads.
111-130	Extensive structural damage to walls, roofs, and windows; trees blown down; mobile homes may be destroyed.
131-155	Extreme damage to structures and roofs; trees uprooted or snapped.
Greater than 155	Catastrophic damage; structures destroyed.

Source: Washington County Office of Consolidated Emergency Management

Debris carried along by extreme winds can directly contribute to loss of life and indirectly to the failure of protective building envelopes, siding, or walls of buildings. When severe windstorms strike a community, downed trees, power lines, and damaged property can be major hindrances to emergency response and disaster recovery.

Infrastructure

Storm winds can damage buildings, power lines, and other property and infrastructure due to falling trees and branches. During wet winters, saturated soils cause trees to become less stable and more vulnerable to uprooting from high winds.

Yamhill County is susceptible to direct impacts on infrastructure and property. Windstorms can result in collapsed or damaged buildings, damaged or blocked roads and bridges, damaged traffic signals, streetlights, and parks, among others. Roads blocked by fallen trees during a windstorm may have severe consequences to people who need access to emergency services. Emergency response operations can be complicated when roads are blocked or when power supplies are interrupted.⁴⁵ Industry and commerce can suffer losses from interruptions in electric service and from extended road closures. They can also sustain direct losses to buildings, personnel, and other vital equipment. There are direct consequences to the local economy resulting from windstorms related to both physical damages and interrupted services.

Utilities

Historically, falling trees have been the major cause of power outages in Yamhill County. Windstorms can cause flying debris and downed utility lines. For example, tree limbs breaking in winds of only 45 mph can be thrown over 75 feet. Thus, overhead power lines can be damaged even in relatively minor windstorm events. Utility lines brought down by summer thunderstorms have also been known to cause fires, which start in dry roadside vegetation. Falling trees can bring electric power lines down to the pavement, creating the possibility of lethal electric shock. Rising population growth and new infrastructure in the county creates a higher probability for damage to occur from windstorms as more life and property are exposed to risk.

Tree Failure and Resulting Power Line Outages

Tree failure is one of the leading causes of power outages during severe weather events. According to Portland General Electric (PGE), trees are the leading cause of storm-related power outages in PGE's service area.⁴⁶ Tables 10-3 and 10-4 are Tree Failure Profiles developed by PGE for two of the most common tree failures in the PGE service territory. The profiles are developed from the data collected and used by PGE foresters in targeting "at-risk" trees during routine vegetation maintenance cycles.

Table 10-3. Tree Failure Profile - Species: Douglas fir (*Psuedotsuga menziesii*)

Failed Part	Description of failure/ Tree characteristics	Associated defects/ Indicators	Environment	Management History
BRANCH Frequency: High	Small dia. branches from mature trees can sail up to 75 ft & wrap lines. Overhanging branch failure from snow/ice loading.	Evidence of previous branch failures.	Exposure to winds/gusts greater than 40 mph. Line downwind.	Side trimmed trees.
TRUNK Frequency: Low	Failure of multiple tops.	Old topping cut, previous break, decay present.	Wind or ice storms.	Previous topping.
	Interior trees, 3-8" dia.	Intermediate/suppressed trees.	Wind, snow/ice loading, recent exposure.	Thinning of stand, exposure as edge tree.
	Dead tree of any size in close proximity to line.	Entire tree dead for some time.	Line downwind.	
ROOT Frequency: High	Trees of all ages.	Evidence of other root failures.	Slight to moderate wind.	Site disturbance; leave trees from logging or development.
	Small, interior trees.	Poor taper, low live crown ratio, aggravating site characteristics.	Slight to moderate wind.	Thinning of stand; overstocked, unmanaged stands.

Source: Portland General Electric, Forester's Office, 2001.

Table 10-4. Tree Failure Profile - Species: Bigleaf Maple (*Acer macrophyllum*)

Failed Part	Description of failure/ Tree characteristics	Associated defects/ Indicators	Environment	Management History
BRANCH Frequency: High	Mature trees; scaffold branches; or during full leaf-out.	Decay present at multiple branch attachment. Co-dominant stems with included bark.	Heavy rains after leaf-out in spring; heavy fall rains. Exposure to winds/gusts greater than 30 mph. Line downwind, ivy covered.	Natural and previously pruned; history of side trimming.
TRUNK Frequency: Low	Trunk failure at base of tree up to 12 feet.	Decay present in trunk or at base.	On a slope, line downwind, or ivy covered.	In unmanaged or natural areas.

Source: Portland General Electric, Forester's Office, 2001.

Community Tornado Issues

Life and Property

Tornadoes generate tremendous force and associated wind speeds. Winds impacting walls, doors, windows, and roofs, may cause structural components to fail. Wind pressure can create a direct and frontal assault on a structure, pushing walls, doors, and windows inward. Conversely, passing currents can create lift and suction forces that act to pull building components and surfaces outward. These effects of

winds are magnified in the upper levels of multi-story structures. As positive and negative forces impact the building's protective envelope (doors, windows, and walls), the result can be roof or building component failures and considerable structural damage. In the most serious events, whole buildings may be leveled or torn from foundations and carried airborne.

Debris carried along by tornadoes can directly contribute to loss of life and indirectly to the failure of protective building envelopes, siding, or walls of buildings. When tornadoes strike a community, downed trees, power lines, and damaged property can be major hindrances to emergency response and disaster recovery.

The Fujita Tornado Damage Scale was developed in 1971, at the University of Chicago, as a means of estimating levels of tornado damage. The scale is used post-disaster to categorize tornadoes based on the damage inflicted. About 75 percent of all tornadoes fall within the "weak" end of the scale (F0 or F1).⁴⁷ Table 10-5 shows the various damage levels used to categorize tornadoes.

Table 10.5 Fujita Tornado Damage Scale

Scale	Wind Estimate (MPH)	Typical Damage
F0	< 73	Light damage. Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; signboards damaged.
F1	73-112	Moderate damage. Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
F2	113-157	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
F3	158-206	Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
F4	207-260	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.
F5	261-318	Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109 yards); trees debarked; incredible phenomena will occur.

Source: National Weather Service Storm Prediction Center

Infrastructure

Tornadoes can result in collapsed or damaged buildings, damaged or blocked roads and bridges, damaged traffic signals, streetlights, and parks, among others. Tornadoes can also damage buildings, power lines, and other property and infrastructure due to falling trees and branches and windblown debris. Roads blocked by fallen trees may

have severe consequences to people who need access to emergency services. Emergency response operations can be complicated when roads are blocked or when power supplies are interrupted.⁴⁸ Industry and commerce can suffer losses from interruptions in electric service and from extended road closures. They can also sustain direct losses to buildings, personnel, and other vital equipment. There are direct consequences to the local economy resulting from tornadoes related to both physical damages and interrupted services.

Rising population growth and new infrastructure in the county creates a higher probability for damage to occur from tornadoes storms as more life and property are exposed to risk.

Mitigation Plan Goals

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

The plan goals help to guide the direction of future activities aimed at reducing risk and preventing loss from natural hazards. The goals listed here serve as checkpoints as agencies and organization begin implementing mitigation action items.

Goal #1: EMERGENCY OPERATIONS

Goal Statement: Coordinate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures and with various other agencies, as appropriate.

Goal #2: EDUCATION AND OUTREACH

Goal Statement: Develop and implement education and outreach programs to increase public awareness of the risks associated with natural hazards.

Goal #3: PARTNERSHIPS

Goal Statement: Develop effective partnerships with public and private sector organizations and significant agencies and businesses for future natural hazard mitigation efforts.

Goal #4: PREVENTIVE

Goal Statements:

- Develop and implement activities to protect human life, commerce, and property from natural hazards.
- Reduce losses and repetitive damage for chronic hazard events while promoting insurance coverage for catastrophic hazards.

Goal #5: NATURAL RESOURCES UTILIZATION

Goal Statement: Link natural resources management, land use planning, and watershed planning with natural hazard mitigation activities to protect natural systems and allow them to serve natural hazard mitigation functions.

Goal #6: IMPLEMENTATION

Goal Statement: Implement strategies to mitigate the effects of natural hazards.

Existing Mitigation Activities

State

One of the strongest and most widespread existing mitigation strategies pertains to vegetation clearance. **Oregon Line Safety Statute**, ORS 757.035, is the minimum legal standard in Oregon for the construction, operation and maintenance of electrical supply and signal lines. The law and rule applies to any person, company, agency, municipality, cooperative or association, their agents, lessees or acting trustees or receivers, appointed by any court, engaged in the management, operation, ownership, or control of electrical supply, and telecommunications equipment.

Failure to allow a utility company to comply with the law can result in liability to the homeowner for damages or injuries resulting from a vegetation hazard. Many insurance companies do not cover these types of damages if the policy owner has refused to allow the hazard to be eliminated. The power companies, in compliance with the above regulations, collect data about tree failures and their impact on power lines. This mitigation strategy assists the power company in preventing future tree failure. From the collection of this data, the power company can advise residents as to the most appropriate vegetative planting and pruning procedures.

Federal

National Weather Service

The Portland Office of the National Weather Service issues severe winter storm and tornado watches and warnings when appropriate to alert government agencies and the public of possible or impending weather events. The watches and warnings are broadcast over NOAA weather radio and are forwarded to the local media for retransmission using the Emergency Alert System.

Windstorm (and Tornado) Mitigation Action Items

The mitigation action items for windstorms, which include tornadoes, were formulated through research of regional mitigation plans, natural hazards planning literature, and interviews with local stakeholders. Plan action items were refined through discussions with the mitigation plan steering committee and through an open house at which the county received comments from the public.

The windstorms mitigation action items provide direction on specific activities that organizations and residents in Yamhill County can undertake to reduce risk and prevent loss from windstorms. Each action item is followed by ideas for implementation, which can be used

by the steering committee and local decision makers in pursuing strategies for implementation.

This section lists action items identified to reduce the risk from windstorms in Yamhill County. These action items are designed to meet the mitigation plan goals.

Short-term (ST) Windstorm Action Items

Short-term windstorm action items include general mitigation activities that agencies are capable of implementing during the next two years, given their existing resources and authorities.

ST-WS #1: Develop and implement programs to keep trees from threatening lives, property, and public infrastructure during windstorm events.

Ideas for Implementation

- Partner with responsible agencies and organizations to design and disseminate education information to property owners to reduce risk from tree failure to life, property, commerce and utility systems;
- Develop partnerships between utility providers and county and local public works agencies to document known hazard areas and minimize risks;
- Identify and find solutions to potentially hazardous trees in urban areas, near utility corridors, and near vital infrastructure; and
- Partner with responsible agencies and organizations to develop landscaping and tree programs that have less impact on aboveground utility lines and roads.

Coordinating Organization:	Public Works, Community Development
Internal Partner:	GIS
External Partner:	Cities, USFS, BLM, State Parks, utility providers
Timeline:	2 years
Plan Goals Addressed:	Emergency Operations; Education & Outreach; Partnerships; Prevention; Natural Resources Utilization; Implementation

ST-WS #2: Develop and implement, or enhance strategies for debris management and/or removal after windstorm events.

Ideas for Implementation

- Develop coordinated management strategies for clearing roads of fallen trees, and clearing debris from public and private property;
- Coordinate with those local agencies responsible for debris removal and provide residents locations for debris disposal; and
- Notify area residents, business owners, and employees of alternative routes in case of road blockage.

Coordinating Organization: Emergency Management
Internal Partner: Public Works
External Partner: ODOT, cities, regional recycling facilities
Timeline: 2 years
Plan Goals Addressed: Emergency Operations; Partnerships;
Preventive; Natural Resources Utilization;
Implementation

ST-WS #3: Maintain tree trimming for above-ground power lines.

Ideas for Implementation

- Coordinate with overhead utilities to evaluate tree trimming.

Coordinating Organization: Public Works
Internal Partner: Emergency Management
External Partner: Overhead utilities, cities
Timeline: Ongoing
Plan Goals Addressed: Emergency Operations; Partnerships;
Preventive; Natural Resources Utilization;
Implementation

Long-term (LT) Windstorm Action Items

Long-term windstorm action items include general mitigation activities that are likely to take more than two years to implement and may require new or additional resources and/or authorities.

LT-WS #1: Map and publicize locations around the county that have the highest incidence of extreme windstorms.

Ideas for Implementation

- Identify a responsible agency for central collection and reporting of storm data. Data collected should include:

1. Windstorm data (sustained speeds, gusts, storm durations) for localities throughout the county.
 2. Maps of the locations within the county most vulnerable to high winds.
 3. Injury and property damage estimates, including locations.
- Identify a responsible agency to collect and transfer data to the National Climate Data Center (NCDC), Oregon Climate Service (OCS), FEMA, or other agencies concerned with the incidence of storms, to help establish and maintain baseline and historic records of storm events; and
 - Identify public infrastructure and facilities subject to damage or closure during windstorm events.

Coordinating Organization: Emergency Management
 Internal Partner: Planning, GIS
 External Partner: FEMA, NCDC, OCS, NWS
 Timeline: 5 years
 Plan Goals Addressed: Preventive; Natural Resources Utilization

LT-WS #2 Support/encourage electrical utilities to use underground construction methods where possible to reduce power outages from windstorms.

Ideas for Implementation

- Increase the use of underground utilities where possible.

Coordinating Organization: Public Works
 Internal Partner: GIS, Emergency Management
 External Partner: Utility companies
 Timeline: On-going
 Plan Goals Addressed: Preventive; Natural Resources Utilization

LT-WS #3: Increase public awareness of windstorm mitigation activities.

Ideas for Implementation

- Collect existing information on public education materials for protecting life, property, and the environment from windstorm events;
- Identify and collect additional information and programs as necessary; and
- Distribute educational materials to County residents and public and private sector organizations regarding preparedness for no-power situations.

Coordinating Organization: Emergency Management
 Internal Partner: Planning

External Partner: Utilities, cities, FEMA
Timeline: On-going
Plan Goals Addressed: Emergency Operations; Education & Outreach; Preventive; Natural Resources Utilization

LT-WS #4: Support/encourage contractors, homeowners and electrical utilities to use windstorm resistant construction methods where possible to reduce damage and power outages from windstorms.

Ideas for Implementation

- Increase the use of underground utilities where possible;
- Provide guidance on wind-resistant construction methods; and
- Evaluate current building codes for efficiency in protecting structures from wind damage.

Coordinating Organization: Building
Internal Partner: Planning
External Partner: Cities, utilities
Timeline: 5 years
Plan Goals Addressed: Education and Outreach; Preventive

LT-WS #5: Develop and implement programs to keep trees from threatening lives, property, and public infrastructure during windstorm events.

Ideas for Implementation

- Partner with responsible agencies and organizations to design and implement tree programs that reduce risk to life, property, and utility systems.

Coordinating Organization: Public Works
Internal Partner: Planning
External Partner: Utilities, cities
Timeline: On-going
Plan Goals Addressed: Preventive; Natural Resources Utilization

LT-WS #6: Identify trees that are potentially susceptible to wind throw.

Ideas for Implementation

- Analyze current map of trees from any available sources (e.g., satellite imaging);
- Develop education material on tree species that are susceptible to wind throw; and
- Locate, evaluate and map hazardous trees in the county.

Coordinating Organization: Planning
Internal Partner: Emergency Management, GIS
External Partner: Cities, overhead utilities
Timeline: On-going
Plan Goals Addressed: Preventive; Natural Resources Utilization

LT-WS #7: Encourage critical facilities to secure emergency power.

Ideas for Implementation

- Seek funding and capital improvements for emergency power supplies for all identified critical facilities.

Coordinating Organization: Emergency Management
Internal Partner: Community Development (Planning)
External Partner: Cities, neighboring counties, Yamhill Fire Defense Board, police stations, water systems
Timeline: On-going
Plan Goals Addressed: Emergency Operations; Partnerships; Natural Resources Utilization; Implementation

LT-WS #8: Encourage harvesting of trees along utility and road corridors, preventing potential windstorm damage.

Ideas for Implementation

- Encourage the harvesting of trees along utility corridors and roads, which will prevent windstorm damage; and
- Encourage Federal, State and Local Agencies to harvest trees that have fallen during a winter storm, which will mitigate fire hazards, and could be used in fish enhancement projects.

Coordinating Organization: Emergency Management
Internal Partner: Planning, Public Works
External Partner: Cities, utilities, FEMA, USFS, ODFW, DSL, BLM, ODOT, forest product industries
Timeline: On-going
Plan Goals Addressed: Preventive; Natural Resources Utilization

LT-WS #9: Encourage harvesting of trees that are blown down during a windstorm.

Ideas for Implementation

- Encourage the harvesting of trees blown down in a windstorm; and
- Encourage Federal, State and Local Agencies to harvest trees that have fallen during a windstorm, which will mitigate fire hazards, and could be used in fish enhancement projects.

Coordinating Organization: Emergency Management
Internal Partner: Planning, Public Works
External Partner: Cities, utilities, FEMA, USFS, ODFW, DSL, BLM, ODOT, forest products industries
Timeline: On-going
Plan Goals Addressed: Preventive; Natural Resources Utilization

LT-WS #10: Increase and maintain public awareness of severe windstorms and the benefits of mitigation activities through education aimed at households and businesses and increase targeting of special needs populations.

Ideas for Implementation

- Collect additional information and add to existing informational sources on public education materials for protecting life, property, and the environment from windstorm events;
- Distribute educational materials to County residents and public and private sector organizations regarding evacuation routes during road closures;
- Distribute audience-specific educational materials to schools, churches, and other public and private sector organizations;
- Develop methods of improving emergency warning system;

Coordinating Organization: Emergency Management
Internal Partner: Community Development
External Partners: Utilities, cCities, American Red Cross, St. Vincent DePaul, Churches, ARES, Yamhill Fire Defense Board
Timeline: On-going
Plan Goals Addressed: Education & Outreach; Preventive; Partnerships

Windstorm Resource Directory

State Resources

Oregon Department of Consumer and Business Services

The Building Codes Division of Oregon's Department of Consumer and Business Services is responsible for administering statewide building codes. Its responsibilities include adoption of statewide construction standards that help create disaster-resistant buildings, particularly for flood, wildfire, wind, foundation stability, and seismic hazards.

Contact: Building Codes Division

Address: 1535 Edgewater St. NW, P.O. Box 14470, Salem, OR 97309

Phone: 503-373-4133

Fax: 503-378-2322

Website: <http://www.cbs.state.or.us/external/bcd>

Oregon Climate Service

The Oregon Climate Service collects, manages, and maintains Oregon weather and climate data. OCS provides weather and climate information to those within and outside the state of Oregon and educates the citizens of Oregon on current and emerging climate issues. OCS also performs independent research related to weather and climate issues.

Contact: Oregon Climate Service

Address: Strand Agriculture Hall 326, Corvallis, OR 97331-2209

Phone: 541-737-5705

Fax: 541-737-5710

Website: <http://www.ocs.orst.edu>

Email: coas@oregonstate.edu

Oregon State Police (OSP)-Office of Emergency Management (OEM)

The purpose of OEM is to execute the Governor's responsibilities to maintain an emergency services system as prescribed in Oregon Revised Statutes Chapter 401 by planning, preparing, and providing for the prevention, mitigation, and management of emergencies or disasters that present a threat to the lives and property of citizens of and visitors to the state of Oregon.

Contact: Office of Emergency Management

Address: 3225 State Street, Salem, OR 97301

P.O. Box 14370, Salem, OR 97309-5022

Phone: 503-378-2911

Fax: 503-373-7833

Website: <http://www.osp.state.or.us/oem>

Federal Resources

Federal Emergency Management Agency (FEMA)

FEMA's mission is "to reduce loss of life and property and protect the nation's critical infrastructure from all types of hazards through a comprehensive, risk-based, emergency management program of mitigation, preparedness, response and recovery." FEMA Region X serves the northwestern states of Alaska, Idaho, Oregon, and Washington.

Contact: FEMA, Federal Regional Center, Region 10
Address: 130-228th St. SW, Bothell, WA 98021-9796
Phone: 425-487-4600
Fax: 425-487-4622
Website: <http://www.fema.gov/regions/x/regx.shtm>

National Weather Service, Portland Bureau

The National Weather Service (NWS) provides weather, hydrologic, and climate forecasts and warnings for the United States, its territories, adjacent waters, and ocean areas for the protection of life and property and the enhancement of the national economy. NWS data and products form a national information database and infrastructure, which can be used by other governmental agencies, the private sector, the public, and the global community.

Contact: National Weather Service
Address: 5241 NE 122nd Ave, Portland, Oregon 97230-1089
Phone: 503-326-2340
Website: <http://nimbo.wrh.noaa.gov/Portland>

National Oceanic and Atmospheric Administration (NOAA)

NOAA's historical role has been to predict environmental changes, protect life and property, provide decision makers with reliable scientific information, and foster global environmental stewardship.

Contact: National Oceanic and Atmospheric Administration
Address: 14th Street & Constitution Avenue, NW, Room 6217, Washington, DC 20230
Phone: 202-482-6090
Fax: 202-482-3154
Website: <http://www.noaa.gov>
Email: answers@noaa.gov

Additional Resources

American Red Cross

The American Red Cross is a humanitarian organization, led by volunteers, that provides relief to victims of disasters and helps people prevent, prepare for, and respond to emergencies. The Oregon Trail Chapter serves the residents of Clackamas, Clatsop, Columbia, Multnomah, Tillamook, Washington and Yamhill counties. The Oregon Trail Chapter provides a variety of community services that are

consistent with the Red Cross mission and meet the specific needs of this area, including disaster planning, preparedness, and education.

Contact: American Red Cross, Oregon Trail Chapter
Address: 3131 N Vancouver Ave, Portland, OR 97227-1560
P.O. Box 3200, Portland, OR 97208-3200
Phone: 503-284-1234
Fax: 503-284-4247
Website: <http://www.redcross-oregontrail.org>
Email: info@redcross-pdx.org

Institute for Business & Home Safety (IBHS)

IBHS was created as an initiative of the insurance industry to reduce damage and losses caused by natural disasters. Their website provides educational resources and on-line publications for insurers, businesses, and homeowners who are interested in taking the initiative to minimize future damages and losses.

Contact: Institute for Business and Home Safety
Address: 1408 North Westshore Boulevard - Suite 208 - Tampa, FL 33607
Phone: 813-286-3400
Fax: 813-286-9960
E-mail: info@ibhs.org
Website: <http://www.ibhs.org/>

Publications

Public Assistance Debris Management Guide, Federal Emergency Management Agency (July 2000).

The Debris Management Guide was developed to assist local officials in planning, mobilizing, organizing, and controlling large-scale debris clearance, removal, and disposal operations. Debris management is generally associated with post-disaster recovery. While it should be compliant with local and county emergency operations plans, developing strategies to ensure strong debris management is a way to integrate debris management within mitigation activities. The Public Assistance Debris Management Guide is available in hard copy or on the FEMA website.

Contact: FEMA Distribution Center
Address: 130 - 228th Street, SW, Bothell, WA 98021-9796
Phone: 800-480-2520
Fax: 425-487-4622
Website: <http://www.fema.gov/rrr/pa/dmgtoc.shtm>

Bilello, Joseph. June 2000. *Technology Transfer and Technology Place: Windstorm Mitigation Design Innovation for House Forms in Asia Pacific Architecture.*

The paper shares how adverse wind effects on buildings have been mitigated in Asia Pacific countries through design, particularly through the proper siting of buildings, appropriate materials selections, and

improvements to methods of construction. This paper has application to rural areas in the county where vulnerability to wind storms is highest.

Contact: Architecture Research Center, College of Architecture, Texas Tech University

Address: Box 42091, Lubbock, TX 79409-2091

Phone: 800-742-3136

Email: ArchitecturePrograms@ttu.edu

Website: <http://www.arch.ttu.edu/arc/>

Chubb Personal Insurance – Household Tips.

Preparing Your Home for Severe Windstorms is available from http://www.chubb.com/personal/html/helpful_tips_home_windstorm.html

The Hazard Tree Prevention Webpage

Educational modules present what it takes to keep trees healthy, safe, and beautiful, and prevent them from becoming hazardous. The Pacific Northwest Chapter of the International Society of Arboriculture and the Oregon Department of Forestry created the Hazard Tree Prevention Webpage with a grant from Oregon Emergency Management and the Federal Emergency Management Agency.

Website: <http://www.pnwisa.org/http/index.html>

Reducing Windstorm Damage to Electric Utilities

Interagency Hazard Mitigation Team Report for the Western Oregon Windstorms of December 10-12, 1995 (FEMA-1107-DR-OR) OEM-FEMA

Website: .../resources/print/community/pdf/FEMA_DR-OR/dr-1107.pdf

Reducing Windstorm Damage to Property and Electrical Utilities

Hazard Mitigation Survey Team Report for the Severe Windstorm in Western Oregon February 7, 2002 — (FEMA-1405-DR-OR) Prepared by Oregon Emergency Management and the Federal Emergency Management Agency

Website: .../resources/print/community/pdf/FEMA_DR-OR/dr-1405.pdf

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Section 11: Drought

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Why is Drought a Threat to Yamhill County?

A drought is a long period of abnormally low precipitation that persists long enough to produce a serious hydrologic imbalance.¹ Drought is a normal part of virtually every climate on the planet, even relatively wet climates. It is the most complex of all natural hazards, and it affects more people than any other hazard. Analysis shows that it can be as expensive as floods and hurricanes.²

Drought produces a complex web of impacts that spans many sectors of the economy and reaches well beyond the area experiencing physical drought. This complexity exists because water is integral to our ability to produce goods and provide services.

The impacts of drought are greater than the impacts of any other natural hazard. They are estimated to be between \$6 billion and \$8 billion annually in the United States and occur primarily in agriculture, transportation, recreation and tourism, forestry, and energy sectors.³ Social and environmental impacts are also significant, although it is difficult to quantify these impacts.

Many economic impacts occur in agriculture and related sectors, including forestry and fisheries, because of the reliance of these sectors on surface and subsurface water supplies. In addition to obvious losses in yields in crop and livestock production, drought is associated with increases in insect infestations, plant disease, and wind erosion.⁴ Droughts also bring increased problems with insects and diseases to forests and reduce growth.⁵ The incidence of forest and range fires increases substantially during extended droughts, which in turn places both human and wildlife populations at higher levels of risk.

Recent droughts in both developing and developed countries and the resulting economic and environmental impacts and personal hardships have underscored the vulnerability of all societies to this “natural” hazard.

Historical Drought Events

Oregon

1928-1941

A significant drought affected all of Oregon from 1928 to 1941. The prolonged statewide drought created significant problems for the agriculture industry. The first of the three Tillamook Forest burns occurred during this drought in 1933.⁶

1985-1994

Although not as severe as the 1976-77 drought in any one year, the cumulative effect of ten dry years caused problems statewide. The peak year was 1992, when a drought emergency was declared. In the seven-year period from 1986-1992, Medford received only five years worth of precipitation and others areas of southern Oregon were also hard

significantly affected. Forests throughout Oregon suffered from a lack of moisture with fires common and insect pests flourishing.⁷

2000-2001

Severe drought conditions affected southern, central, and eastern Oregon in response to a larger drought that impacted the western United States. According to the US Department of Agriculture's SNOTEL network, the mid-March 2001 snow pack water equivalents generally ranged from 45 to 75 percent of normal in key watershed areas from the Cascades to the northern Rockies.⁸

In 2001, Governor Kitzhaber declared a drought emergency for eighteen counties in southern, central, and eastern Oregon. Yamhill County was not one of them.

The period from October 2000 to February 2001 was the second driest such period during the 106-year period of record in Washington and Oregon.⁹ Washington, Oregon, and Idaho experienced its second-driest March-February period on record, with a twelve-month precipitation total slightly less than two-thirds of the long-term average.¹⁰ Only March 1976 to February 1977 was drier in the Northwest.¹¹

2003

In Oregon, Wasco and Washington counties are designated as primary disaster areas due to damages and losses caused by ongoing drought, which started January 1, 2003.¹² Yamhill County is also eligible because it is one of nine contiguous counties (Clackamas, Clatsop, Columbia, Hood River, Marion, Multnomah, Tillamook and Yamhill). The Secretary of Agriculture declared the listed counties having disasters due to drought on March 22, 2004.¹³

Northwestern Oregon

1976-1981

During this drought period in western Oregon, low stream flows prevailed. The period between 1976 and 1977 was the single driest year of the century. The Portland Airport received only 7.19 inches of rain between October 1976 and February 1977.¹⁴

In the twelve-month period from September 1976 through August 1977, Corvallis received only 22.2 inches of precipitation, only 52 percent of the "normal" of 42.7 inches.¹⁵ During the winter of that year, airborne dry ice seeding was used in Polk County as a means of enhancing winter precipitation for agricultural use.

2005

February 2005 was the driest February on record since 1977, surpassing 2001's conditions.¹⁶ Governor Ted Kulongoski's Office posted a State of Oregon Drought and Fire Web page. This page features weekly updates, drought and fire information, and agency links.

With above normal temperatures, and knowing that water will be short this summer, some irrigators are already contacting Oregon Watermaster offices requesting permission to start irrigation a month early. In the Tualatin Basin the Watermaster reports sections of the Tualatin River, Gales Creek and the East Fork of Dairy Creek were all regulated to protect water rights. This is the first time that regulation has occurred in the pre-irrigation season period prior to May 1. Regulation normally begins in June or early July. Flow in the Tualatin River at Farmington is the lowest for this time of year since the Watermaster started keeping record in 1989. Irrigators are being told that water use outside the conditions of their permits, including time limits or season of use, is not discretionary.

If the current conditions persist, many irrigators will not have sufficient supply for their needs. Public water providers - cities, water districts, and others - will experience some shortages. Low stream flows will also mean problems for fish and other aquatic life. Recreational water users - boaters, fishers, and others - and the state's recreation industry will be impacted by low reservoir levels and low streams and rivers.

Characteristics of Drought in Oregon

Weather Patterns

A drought is a period of drier than normal conditions that results in water-related problems.¹⁷ Drought occurs in virtually every climatic zone, but its characteristics vary significantly from one region to another.¹⁸ Drought is a temporary condition; it differs from aridity, which is restricted to low rainfall regions and is a permanent feature of climate.¹⁹

In Oregon, drought is often associated with El Niño events. In strong El Niño situations, warmer than normal waters cover nearly the entire eastern and central tropical Pacific.²⁰ The area of strong convection, which produces large rain clouds, usually shifts eastward as waters in those areas warm.²¹ In the western Pacific, easterly trade winds often reverse and blow from the west, reducing ocean temperatures.²²

Warmer temperatures in the central and eastern Pacific cause much greater cloudiness in those regions, while cooler than average temperatures in the western Pacific cause that normally very active area to be less cloudy, with fewer storms and less rainfall.²³ Both the polar and subtropical jet streams are changed as well.²⁴ The former often dips southward over the North Pacific, and then veers northward into Alaska.²⁵ Although some storms still reach the Northwest, they tend to be less frequent than during average years.²⁶ This causes the Northwest to be generally drier than average during such an event.

Drought Hazard Assessment

Hazard Identification

The severity of the drought depends upon the degree of moisture deficiency, and the duration and size of the affected area. There are four different ways to define drought:

- Meteorological drought is defined usually on the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period.²⁷ Definitions of meteorological drought must be considered as region specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.
- Agricultural drought links various characteristics of meteorological (or hydrological) drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, reduced groundwater or reservoir levels, etc.²⁸ In short, agricultural drought refers to a situation when the amount of moisture in the soil no longer meets the needs of a particular crop.²⁹
- Hydrological drought is associated with the effects of periods of precipitation (including snowfall), and shortfalls on surface or subsurface water supply (i.e., stream flow, reservoir and lake levels, groundwater).³⁰ The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system.³¹ Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts.³² For example, a precipitation deficiency may result in a rapid depletion of soil moisture that is almost immediately discernible to agriculturalists, but the impact of this deficiency on reservoir levels may not affect hydroelectric power production or recreational uses for many months.³³ Also, water in hydrologic storage systems (e.g., reservoirs, rivers) is often used for multiple and competing purposes (e.g., flood control, irrigation, recreation, navigation, hydropower, wildlife habitat), further complicating the sequence and quantification of impacts.
- Socioeconomic definitions of drought associate the supply and demand of some economic good with elements of meteorological, hydrological, and agricultural drought.³⁴ Socioeconomic drought refers to the situation that occurs when physical water shortage begins to affect people.³⁵ Socioeconomic drought occurs when the demand for an economic good exceeds supply as a result of a weather-related shortfall in water supply.³⁶

Developing drought climatology i.e., investigating drought phenomena and causes for Yamhill County and the Mid-Willamette Valley region in general provides a greater understanding of its characteristics and the probability of recurrence at various levels of severity. Information of this type is extremely beneficial in the development of response and mitigation strategies and preparedness plans.

Sequence of Drought Impacts

The sequence of impacts associated with meteorological, agricultural, and hydrological drought further emphasizes their differences. When drought begins, the agricultural sector is usually the first to be affected because of its heavy dependence on stored soil water (i.e., water held to soil particles). Soil water can be rapidly depleted during extended dry periods.³⁷ If precipitation deficiencies continue, then people dependent on other sources of water will begin to feel the effects of the shortage. Those who rely on surface water (i.e., reservoirs and lakes) and subsurface water (i.e., groundwater), for example, are usually the last to be affected. A short-term drought that persists for 3 to 6 months may have little impact on these sectors, depending on the characteristics of the hydrologic system and water use requirements.

Vulnerability and Risk

A vulnerability assessment that describes the number of lives or amount of property exposed to elements of drought has not yet been conducted for Yamhill County. Depending on its severity, drought poses a risk for agricultural and timber losses, as well as for property damage, disruption of water supplies, and availability in urban and rural areas.

Factors included in assessing drought risk include agricultural practices, including crop types and varieties grown, soil types, topography, and water storage capacity. When sufficient data is collected for hazard identification and vulnerability assessment, a risk analysis can be completed. Insufficient data currently exists to complete a risk analysis.

Community Drought Issues

Life and Property

Many drought-related economic impacts occur in agriculture and related sectors because of the reliance of these sectors on surface and subsurface water supplies. In addition to obvious losses in yields in crop and livestock production, drought is also associated with increases in insect infestations, plant disease, and wind erosion. The incidence of forest and range fires increases substantially during extended droughts, which in turn places both human and wildlife populations at higher levels of risk.³⁸

Both urban and rural water users are impacted by drought. Based on the severity of the drought, water usage may be limited or curtailed for

specific uses to ensure that sufficient water is available to maintain water pressure, firefighting supply, drinking, and sanitation requirements.

Environmental

Environmental losses are the result of damages to plant and animal species, wildlife habitat, and air and water quality; forest and range fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Some of the effects are short-term and conditions quickly return to normal following the end of the drought. Other environmental effects linger for some time or may even become permanent. Wildlife habitat, for example, may be degraded through the loss of wetlands, lakes, and vegetation. Many species, however, will eventually recover from this temporary aberration. The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity of the landscape.³⁹

Financial Cost

One of the major impediments to drought planning is its cost. Officials may find it difficult to justify the costs of a plan, which are immediate and fixed, against the unknown costs of some future drought. Unknown costs of drought are not all economic; they also include human suffering, damage to biological resources, and the degradation of the physical environment, items that are inherently difficult to estimate. Studies have shown that crisis-oriented drought response efforts are largely ineffective, poorly coordinated, untimely, and inefficient in terms of the resources allocated. For example, in the mid-1970s, the U.S. government spent more than \$7 billion in drought relief. Compared to such large expenditures, investing in drought preparedness i.e., mitigation projects is a sound economic decision. Mitigation efforts can use existing political and institutional structures, thereby reducing costs when drought actually impacts the county.

Income loss is another indicator used in assessing the impacts of drought because so many sectors are affected. Reduced income for farmers has a ripple effect. Retailers and others who provide goods and services to farmers face reduced business. This leads to unemployment, increased credit risk for financial institutions, capital shortfalls, and loss of tax revenue for local, state, and federal government. Less discretionary income affects the recreation and tourism industries. Prices for food, energy, and other products increase as supplies are reduced. In some cases, local shortages of certain goods result in the need to import these goods from outside the stricken region. Reduced water supply impairs the navigability of rivers and results in increased transportation costs because products must be transported by rail or truck. Hydropower production may also be curtailed significantly.

Existing Mitigation Activities

County

The staff employed by the **Yamhill Soil and Water Conservation District** (Yamhill SWCD) provides technical assistance to landowners and operators regarding soil and water quality issues on their land. The staff also provides education and outreach on various natural resource issues and topics.

Federal

The **National Drought Mitigation Center** (NDMC), part of a federally coordinated effort to monitor droughts, helps people and institutions develop and implement measures to reduce societal vulnerability to drought, stressing preparedness and risk management. Most of the NDMC's services are directed to state, federal, regional, and tribal governments that are involved in drought and water supply planning.

Mitigation Plan Goals

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

The plan goals help to guide the direction of future activities aimed at reducing risk and preventing loss from natural hazards. The goals listed here serve as checkpoints as agencies and organization begin implementing mitigation action items.

Goal #1: EMERGENCY OPERATIONS

Goal Statement: Coordinate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures and with various other agencies, as appropriate.

Goal #2: EDUCATION AND OUTREACH

Goal Statement: Develop and implement education and outreach programs to increase public awareness of the risks associated with natural hazards.

Goal #3: PARTNERSHIPS

Goal Statement: Develop effective partnerships with public and private sector organizations and significant agencies and businesses for future natural hazard mitigation efforts.

Goal #4: PREVENTIVE

Goal Statements:

- Develop and implement activities to protect human life, commerce, and property from natural hazards.
- Reduce losses and repetitive damage for chronic hazard events while promoting insurance coverage for catastrophic hazards.

Goal #5: NATURAL RESOURCES UTILIZATION

Goal Statement: Link natural resources management, land use planning, and watershed planning with natural hazard mitigation activities to protect natural systems and allow them to serve natural hazard mitigation functions.

Goal #6: IMPLEMENTATION

Goal Statement: Implement strategies to mitigate the effects of natural hazards.

Drought Mitigation Action Items

Although drought is a natural hazard, it is possible to reduce the county's vulnerability and therefore lessen the risks associated with drought episodes. The impacts of drought, like those of other natural hazards, can be reduced through mitigation and preparedness (risk management). Planning ahead to mitigate drought gives decision makers the chance to relieve the most suffering at the least expense. Reacting to drought in "crisis mode" decreases self-reliance and increases dependence on government and donors.

The mitigation action items were formulated through research of regional mitigation plans, natural hazards planning literature, and interviews with local stakeholders. Plan action items were refined through discussions with the mitigation plan steering committee and through a public open house at which the county received comments from stakeholders, guests, and county residents.

The drought action items provide direction on specific activities that organizations and residents in Yamhill County can undertake to reduce risk and prevent loss from drought. Each action item is followed by ideas for implementation, which can be used by local decision makers in pursuing strategies for implementation.

This section lists action items identified to reduce the risk from drought impacts in Yamhill County. These action items are designed to meet the mitigation plan goals.

Short-term (ST) Drought Action Items

Short-term drought action items include general mitigation activities that agencies are capable of implementing during the next two years, given their existing resources and authorities.

ST-D #1: Support the technical services provided by county-based agencies on effective methods of water use curtailment.

Ideas for Implementation

- Support Yamhill SWCD, NRCS and Yamhill Basin Council when they provide technical services for local land owners on ways to reduce water use during drought emergencies, including voluntary and enforced methods, including no outside use of water (residential), mandatory reductions of certain uses, etc.

Coordinating Organization: Yamhill SWCD, Yamhill Basin Council, OSU Extension Service
Internal Partner: Planning, Emergency Management
External Partner: NRCS, WRD, water systems
Timeline: 2 years; on-going
Plan Goals Addressed: Education & Outreach; Partnerships; Preventive; Natural Resources Utilization; Implementation

ST-D #2: Encourage local governments to inter-tie water systems.

Ideas for Implementation

- Encourage local governments located proximate to one another, yet with separate water systems, to develop the physical capability to send water from one system to the other; and
- Assist local governments planning to inter-tie water systems with agreements necessary to execute such projects.

Coordinating Organization: Yamhill County, MWVCOG
Internal Partners: Planning, Public Works
External Partners: McMinnville Water & Light, Valley View Water Company, cities and rural communities; OECDD, Rural Development (funding sources); WRD, ODFW, PUC, NRCS, Yamhill SWCD, BLM
Timeline: 2 years; on-going
Plan Goals Addressed: Partnerships; Preventive; Implementation

Long-term (LT) Drought Action Items

Long-term drought action items include general mitigation activities that are likely to take more than two years to implement and may require new or additional resources and/or authorities.

LT-D #1: Support local agencies' training on water conservation measures to farmers and ranchers, including drought management practices for crops and livestock.

Ideas for Implementation

- In cooperation with OSU Extension Service and agricultural organizations prominent and respected within the farming and ranching community, build on existing outreach methods with the goal of providing water conservation/drought management training to farmers and ranchers.

Coordinating Organization: Yamhill SWCD
Internal Partner: Planning
External Partners: OSU Extension Service, NRCS, Yamhill Basin Council, Farm Bureau, ODA, WRD, ODFW
Timeline: 1 to 2 years, on-going
Plan Goals Addressed: Education & Outreach; Partnerships; Preventive; Natural Resources Utilization; Implementation

LT-D #2: Support the technical service and low-interest loans provided to farmers and ranchers so that they can develop livestock watering systems.

Note:

- Livestock water systems provide additional options for farmers and ranchers to provide drinking water, and can sometimes also improve riparian habitat. Systems can be divided into three types:
 - controlled access (to a river or stream);
 - gravity flow; and
 - pressure systems run by pumps, which are sometimes powered by wind or solar electricity.

Coordinating Organization: Yamhill SWCD

External Partners: ODA, WRD, OECDD, DEQ, ODFW, NRCS,
OSU Extension Service
Timeline: On-going
Plan Goals Addressed: Education & Outreach; Preventive;
Implementation

LT-D #3: Encourage storage of water, especially off-stream storage.

Ideas for Implementation

- Encourage storage facilities where they are needed and where they are feasible to construct e.g., very high in drainage basins so that the impact to anadromous fish would be minimal;
- Encourage development of aquifer storage and recovery projects i.e., diversion of surface water during times of abundance that is injected into underground aquifers for storage; and
- Support land management practices that slow down or prevent runoff i.e., retains water in the watershed such as creation of wetlands, catchment's depressions, diversion dikes, or terraces.

Coordinating Organization: Public Works
Internal Partner: GIS, Planning
External Partner: OSU Extension Service, Yamhill Basin
Council, NRCS, Yamhill SWCD, ODA, WRD,
DSL, ODFW, DEQ
Timeline: On-going
Plan Goals Addressed: Partnerships; Preventive; Natural Resources
Utilization; Implementation

LT-D #4: Support agencies' determination of locations for additional aquifer studies that might lead to greater water supplies and help determine funding sources for the studies.

NOTE: Studying aquifers may reveal under-utilized water resources and other information useful to water managers.

Ideas for Implementation

- Assist in the determination of which aquifers in Yamhill County would benefit by detailed studies and also assist in the determination of how these studies can be funded.

Coordinating Organization: Public Works
Internal Partner: Planning, GIS
External Partner: Yamhill SWCD, WRD, ODA, DEQ, ODFW,
OECDD, DOGAMI, DLCD
Timeline: 3 to 5 years

Drought Resource Directory

County Resources

Yamhill Soil & Water Conservation District

The Yamhill Soil & Water Conservation District promotes wise use and conservation of Oregon's natural resources within Yamhill County. Yamhill SWCD provides local leadership, technical assistance, information, and improved access to state and federal cost-share assistance to make positive changes on an owner's land.

Contact: Yamhill Soil and Water Conservation District

Address: 2200 SW 2nd Street, McMinnville, OR 97128

Phone: 503-472-6403

Fax: 503-472-2459

Website: www.yamhillswcd.org

Email: yamhill-swcd@or.nacdnet.org

State Resources

Oregon Drought Council

Drought Council is responsible for assessing the impact of drought conditions and making recommendations to the Governor's senior advisors. Drought Council is chaired and facilitated by Oregon Emergency Management. The goal of the Drought Council is to "strive to reduce the effects of an impending drought through a coordinated federal, state, local, and voluntary effort, consisting of the development of drought plans, policies, and procedures, and through coordinated state response."

Contact: Oregon Drought Council - Oregon Emergency Management

Address: 3225 State Street, P.O. Box 14370, Salem, OR 97301

Phone: 503-378-2911

Water Availability Committee

The Water Availability Committee monitors conditions throughout the state and report these conditions monthly. The Committee advises the Drought Council, and is chaired by the Oregon Water Resource Department. Committee members include representatives from the National Weather Service, NW River Forecast Center, NRCS, US Geological Survey, State Climatologist, and Oregon Department of Forestry. The primary responsibility of the Water Availability Committee is to determine the appropriate Oregon Drought Severity Index for locations throughout the state.

Contact: Oregon Water Resources Department

Address: 725 Summer Street NE, Suite A, Salem, OR 97301

Phone: 503-986-0900

Fax: 503-986-0903

Oregon Department of Agriculture

The mission of the Oregon Department of Agriculture is 1) to ensure food safety and provide consumer protection; 2) to protect the natural resource base for present and future generations of farmers and ranchers, and 3) to promote economic development and expand market opportunities for Oregon agricultural products. The three broad policy areas of the mission statement are interdependent. Without a strong and healthy natural resource base – particularly land and water – there is little or no agricultural production to promote and market. Without assurance that the food produced in Oregon is safe, there is little chance that many agricultural products will be of interest to potential customers.

Contact: Oregon Department of Agriculture
Address: 635 Capitol St. NE, Salem, OR 97301-2532
Phone: 503-986-4550
Fax: 503-986-4747
Website: [http:// www.oregon.gov/ODA/](http://www.oregon.gov/ODA/)
Email: info@oda.state.or.us

Oregon Water Resources (WRD)

The Water Resources Department’s role during a drought is one of overseeing a managed, responsible use of Oregon’s water according to the water rights in place. Water Resources has three primary mechanisms to help individuals and communities cope with drought: emergency water use permits, temporary transfers of water rights, and use of existing right Option/Agreement. In counties where the Governor has declared a drought, residents may apply for emergency use permits. This means that a person in the county may apply to the Department for a permit to use water that they otherwise would not have right to. The permitting process for these counties is expedited in order to provide the use as soon as possible, if there is water available. The permit, however, is only valid for the extent of the drought and no longer than one year. Once the Governor undeclares the drought in the county, the emergency permits immediately become invalid. Additionally, due to the expedited review of the permits, potential for unseen harm to other users may be found later. In cases such as that, the emergency use permit may be suspended or rescinded immediately.

Contact: Northwest Region Manager,
Oregon Water Resources Department
Address: 725 Summer St NE, Suite A, Salem, Oregon 97301-1271
Phone: 503-986-0900
Fax: 503-986-0903
Website: <http://oregon.gov/OWRD/offices.shtml>

Oregon Water Resources Department (WRD) – Watermasters

The Oregon Water Resources Department has 20 watermaster offices statewide. Marion County is District 16. A watermaster’s job, during the summer months, is

to regulate the use of water among all the users. Regulation is done according to the date of priority - or the date an irrigator originally was granted the authority to use water. Some priority dates go back into the middle 1800's and some dates are as recent as this year. Irrigators with the oldest priority dates get their water first, and if there is water left over the younger priority dates are allowed to have water. In 2005, in many locations, only irrigators with the earliest priority dates will have sufficient water to meet their needs.

Contact: Bill Ferber, District 15 Watermaster,
Oregon Water Resources Department
Address: 725 Summer St NE, Suite A, Salem, Oregon 97301-1271
Phone: 503-986-0892
Fax: 503-986-0903
Website: <http://oregon.gov/OWRD/offices.shtml>

Oregon Climate Service

The Oregon Climate Service (OCS) collects, manages, and maintains Oregon weather and climate data. OCS provides weather and climate information to those within and outside the state of Oregon and educates the citizens of Oregon on current and emerging climate issues. OCS also performs independent research related to weather and climate issues.

Contact: Oregon Climate Service
Address: Strand Agriculture Hall 326, Corvallis, OR 97331-2209
Phone: 541-737-5705
Fax: 541-737-5710
Website: <http://www.ocs.orst.edu>
Email: coas@oregonstate.edu

Federal Resources

National Oceanic and Atmospheric Administration (NOAA)

NOAA's historical role has been to predict environmental changes, protect life and property, provide decision makers with reliable scientific information, and foster global environmental stewardship. NOAA's drought information center is a roundup of the various NOAA Web sites and information on drought and climate conditions. Some external links are included for convenience.

Contact: National Oceanic and Atmospheric Administration
Address: 14th Street & Constitution Avenue, NW, Room 6217, Washington, DC 20230
Phone: 202-482-6090
Fax: 202-482-3154
Website: <http://www.drought.noaa.gov>
Email: answers@noaa.gov

National Drought Mitigation Center

The National Drought Mitigation Center (NMDC), part of a federally coordinated effort to monitor droughts, helps people and institutions

develop and implement measures to reduce societal vulnerability to drought, stressing preparedness and risk management. Most of the NDMC's services are directed to state, federal, regional, and tribal governments that are involved in drought and water supply planning.

Contact: National Drought Mitigation Center
Address: University of Nebraska–Lincoln
239 L.W. Chase Hall
P.O. Box 830749
Lincoln, NE 68583–0749
Phone: 402-472–6707
Fax: 402-472–6614
Website: <http://www.drought.unl.edu/index.htm>
Email: ndmc@drought.unl.edu

National Weather Service, Portland Bureau

The National Weather Service (NWS) provides weather, hydrologic, and climate forecasts and warnings for the United States, its territories, adjacent waters and ocean areas, for the protection of life and property and the enhancement of the national economy. NWS data and products form a national information database and infrastructure, which can be used by other governmental agencies, the private sector, the public, and the global community.

Contact: National Weather Service
Address: 5241 NE 122nd Ave, Portland, Oregon 97230-1809
Phone: 503-326-2340
Website: <http://nimbo.wrh.noaa.gov/Portland>

Natural Resources Conservation Service – National Water & Climate Center

Contact: Natural Resources Conservation Service
National Water and Climate Center
Address: 101 SW Main Street, Suite 1600, Portland, OR 97204-3224
Website: <http://www.wcc.nrcs.usda.gov>
Email: jmarron@wcc.nrcs.usda.gov

Additional Resources

Washington State University Extension Drought Alert

Access WSU Extension publications and news releases about drought concerns and issues, a list of experts on related subjects, and a list of useful links from other organizations and agencies.

Contact: Washington State University Extension Drought Alert
Address: 534 East Trent, PO Box 1495, Washington State University
Spokane, WA, 99210-1495
Phone: 509-358-7960
Website: <http://drought.wsu.edu/>

Drought - Endnotes

¹ Interagency Hazard Mitigation Team. 2000. *State Hazard Mitigation Plan*. Oregon State Police – Office of Emergency Management. Salem, OR.

² National Drought Mitigation Center, available on the World Wide Web <http://www.drought.unl.edu/index.htm>. Accessed August 24, 2004.

³ Id.

⁴ Id.

⁵ Halemeier, David. Hydrologist. Willamette National Forest, Detroit and Sweet Home Ranger Districts. Personal Interview. November 30, 2004.

⁶ Taylor, George H. and Chris Hannan. 1999. *The Oregon Weather Book*. Corvallis, OR: Oregon State University Press.

⁷ Id.

⁸ National Drought Mitigation Center.

⁹ Id.

¹⁰ Id.

¹¹ Id.

¹² “USDA Declares More Agriculture Disaster Counties.” March 26, 2004. Available on the World Wide Web <http://www.statpub.com/open/86021.html>. Accessed August 24, 2004.

¹³ Disaster Help. Available on the World Wide Web <https://disasterhelp.gov/portal/jhtml/usda/usdacountysec.jhtml?community=OR&County=YAMHILL>. Accessed August 24, 2004.

¹⁴ National Drought Mitigation Center.

¹⁵ Taylor, George. “Weather Matters.” *Mid-Valley Sunday*. January 9, 2000.

¹⁶ “Willamette Valley Reservoirs Succumb to Dry Weather.” US Army Corps of Engineers Press Release. March 9, 2005. KATU 2 News. Available on the World Wide Web <http://www.katu.com/printstory.asp?ID=7552>

¹⁷ A. Moreland. U.S. Geological Survey. 1993. Open-File Report 93-642.

¹⁸ National Drought Mitigation Center.

¹⁹ Id.

²⁰ Taylor, George H. March 1998. *Impacts of the El Niño/Southern Oscillation on the Pacific Northwest*.

²¹ Id.

²² Id.

²³ Id.

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²⁵ Id.

²⁶ Id.

²⁷ National Drought Mitigation Center, available on the World Wide Web <http://www.drought.unl.edu/index.htm>. Accessed August 24, 2004.

²⁸ Id.

²⁹ Interagency Hazard Mitigation Team. 2000. *State Hazard Mitigation Plan*.

³⁰ National Drought Mitigation Center, available on the World Wide Web <http://www.drought.unl.edu/index.htm>. Accessed August 24, 2004.

³¹ Id.

³² Id.

³³ Id.

³⁴ Id.

³⁵ Interagency Hazard Mitigation Team. 2000. *State Hazard Mitigation Plan*.

³⁶ National Drought Mitigation Center, available on the World Wide Web <http://www.drought.unl.edu/index.htm>. Accessed August 24, 2004.

³⁷ Donahue, Roy L., Raymond W. Miller, and John C. Shickluna. 1983. *Soils: An Introduction to Soils and Plant Growth*. Englewood Cliffs, NJ: Prentice-Hall, Inc.

³⁸ National Drought Mitigation Center

³⁹ Id.

Section 12: Earthquake

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Why are Earthquakes a threat to Yamhill County?

Social and geological records show that Oregon has a history of seismic events. Oregon has experienced damaging earthquakes in the historic past, and geologic evidence indicates that because of our increasing population and development, we may expect earthquakes with even greater damage potential to occur in the future. The highest probabilities of experiencing an earthquake are in western Oregon, although the entire state is susceptible.

Recent research suggests that the Cascadia Subduction Zone is capable of producing magnitude 9 earthquakes. To put this in perspective, the 1906 San Francisco earthquake was about an 8.0.¹ South of McMinnville, near Dayton, there is a series of inferred faults, faults that extend underground from a visible fault, and concealed faults (completely underground faults).²

Earthquakes pose a serious threat to many Oregon communities. Local governments, planners, and engineers must consider the threat as they seek to balance development and risk. Identifying locations susceptible to seismic activity generated by local faults or the Cascadia Subduction Zone, adopting strong policies and implementing measures, and using other mitigation techniques are essential to reducing risk from seismic hazards in Yamhill County.³

The most recent significant earthquake event affecting Yamhill County was the February 28, 2001 Nisqually earthquake. The epicenter of the 6.8-magnitude earthquake was near Anderson Island in Pierce County, Washington, and shook western Washington and areas of western Oregon. Residents in the surrounding area, including Yamhill County felt the tremor. While the impacts of this quake were not severe in Oregon, the economic losses in Washington are estimated at \$1 to \$2 billion. Oregon ranks third in the nation for earthquake damage estimates in the future. Projected losses in the Cascadia region alone could exceed \$12 billion, with over 30,000 destroyed buildings, and 8,000 lives lost in the event of a magnitude 8.5 Cascadia Subduction Zone earthquake.⁴

Most of the earthquake mapping and mitigation efforts made in Oregon have been accomplished in the past two decades, and public awareness has risen remarkably during this time. Major federal, state, and local government agencies and private organizations support earthquake risk reduction, and have made significant contributions in reducing the adverse impacts of earthquakes. Despite the progress, the majority of Oregon communities remain unprepared because there is a general lack of understanding regarding earthquake hazards among Oregonians.⁵

To better understand the earthquake hazard, the scientific community has looked at historical records and accelerated research on crustal faults, which are among the sources of the earthquakes occurring in the

Yamhill County region. Historical earthquake records can generally be divided into records of the pre-instrumental period and the instrumental period. In the absence of instrumentation, the detection of earthquakes is based on observations and felt reports, and is dependent upon population density and distribution. Since Oregon was sparsely populated in the 1800s, the detection of pre-instrumental earthquakes is quite difficult. Populations in some regions in or near the Willamette Valley and along the Columbia River began growing as early as the 1850s, including Portland (1840), Salem (1844), Hillsboro (1845), Forest Grove (1850), Eugene (1852), McMinnville (1853), and Tillamook (1866). Newspapers from these towns provide a good source of historical documentation of earthquakes of a magnitude five or greater since about 1850.⁶ The seismic risk is more severe today than in the past because population is increasing.

It is imperative that residents of Yamhill County prepare for earthquakes. It is almost certain that significant loss of life, injuries and property damage will occur during a strong earthquake. The bases for this conclusion are:

- A significant portion of the population, and a large portion of the State government infrastructure is located within an area of greatest hazard; and
- Many of the older buildings as well as utility facilities in the western portions of the State have not been designed to resist earthquake damage.

Historical Earthquake Events

Dating back to 1841, there have been more than 6,000-recorded earthquakes in Oregon, most with a magnitude below three. The mid-Willamette Valley, including Yamhill County has experienced multiple earthquakes of an estimated magnitude of four and greater, with major earthquakes felt in 1941 (magnitude 7.1), 1962 (magnitude 5.2), and 2001 (magnitude 6.8). Figure 10-1 shows the location of selected Pacific Northwest earthquakes that have occurred since 1872.

Although seismograph stations were established as early as 1906 in Seattle and 1944 in Corvallis, improved seismograph coverage of the Yamhill County region did not begin until 1980, when the University of Washington expanded its regional network into northwestern Oregon.

February 28, 2001, Nisqually Earthquake- Magnitude 6.8

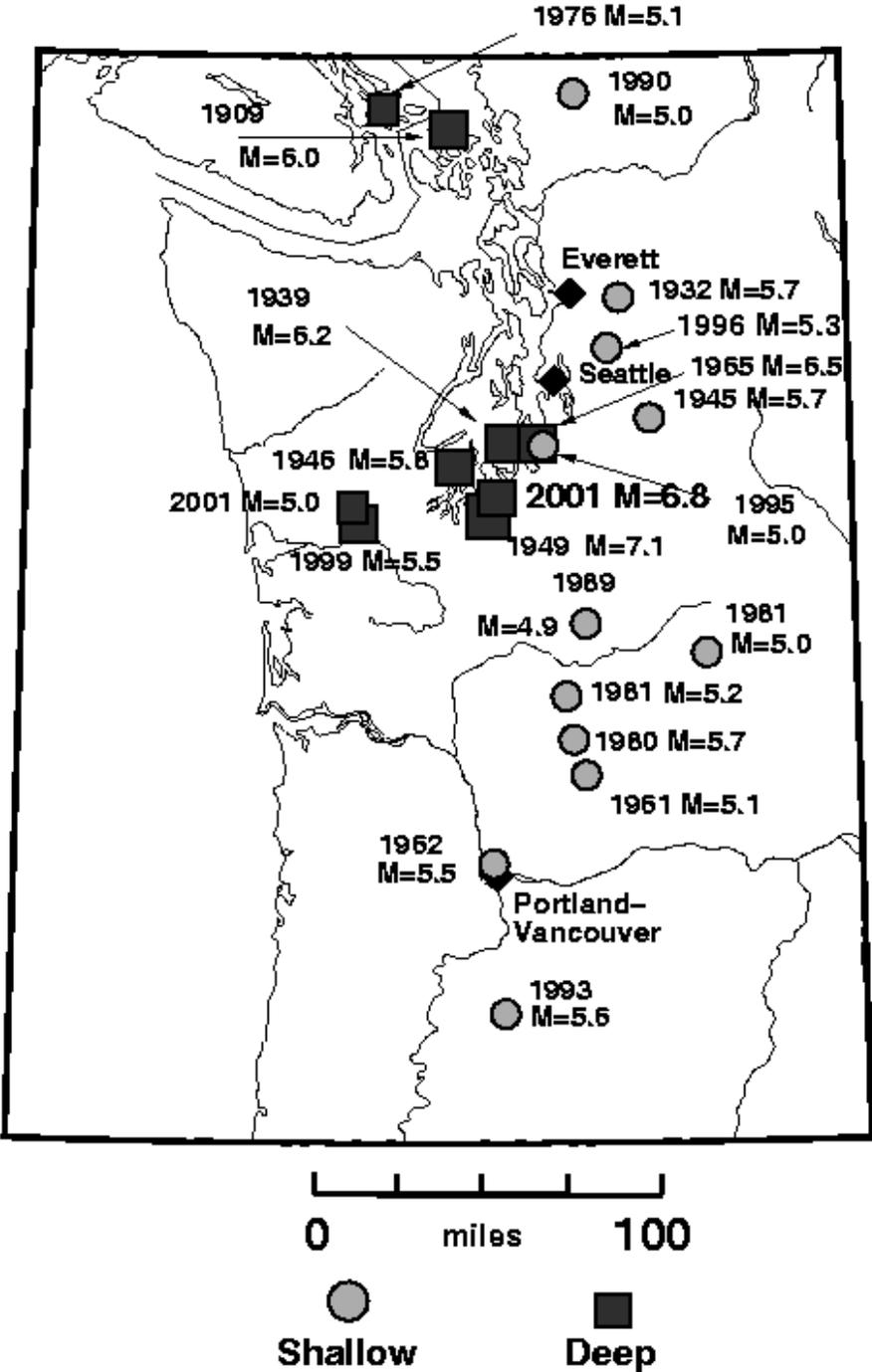
The most recent earthquake to be felt in Yamhill County was the Nisqually earthquake, on February 28, 2001. The earthquake hit at 10:54 a.m. and was centered 35 miles southwest of Seattle.⁷ The quake registered 6.8 on the Richter Scale. In the Puget Sound area, this quake caused 400 injuries, one quake-related death, and about \$2 billion dollars in damage.⁸

People evacuated buildings throughout the Willamette Valley, as well as places along the north Oregon coast.⁹ Although there was no danger of a tsunami, many residents on the coast acted responsibly in heading for high ground when they felt the earth shake.¹⁰

While the quake caused little damage in Yamhill County, it slowed businesses and schools as potential damage was assessed. At the Dundee Fire Hall, cracks developed in the walls, and Fire Chief John Stock moved the fire trucks and personnel outside until an engineer could inspect the building.¹¹ Tremors were also felt in the upper floors of the Oregon State Capitol, and legislators and staff said they could feel the building swaying.¹² Schools in Yamhill County also felt the Nisqually Earthquake, though little damage was found. The local schools that reported the strongest tremors were mostly in northern Marion County.¹³ Saint Paul and North Marion high schools, both north of Woodburn, also briefly evacuated students.¹⁴

Even though the quake amounted to billions of dollars in damage in Washington, the cost there could have been much higher if not for retrofitting. Officials said millions of dollars spent to remodel buildings and highways to protect against earthquakes had paid off.¹⁵

Figure 12-1. Selected Pacific Northwest Earthquakes since 1872



Source: Pacific Northwest Seismograph Network.
www.geophys.washington.edu/SEIS/PNSN/INFO_GENERAL/hist.html

March 25, 1993, Scotts Mills Earthquake – Magnitude 5.6

The Scotts Mills Earthquake (also known as the “Spring Break Quake”) was centered in Marion County, near the town of Woodburn and Scotts Mills. Most of the day’s business had not begun when the 5:30 a.m.

quake hit. Schools were not in session; some brick buildings, including schoolhouses, suffered major damage. The earthquake originated on the Mt. Angel-Gales Creek fault, about two miles south of Scotts Mills and twelve to thirteen miles underground.¹⁶

Due to the earthquake's location in Marion County, there was more damage reported in Yamhill County than during the Nisqually quake in 2001. In Salem, approximately 20 miles southwest of the epicenter, the state Capitol rotunda cracked, and the Golden Pioneer statue nearly was rocked off its base.¹⁷ The earthquake caused \$30 million in damage in Oregon, but resulted in no deaths or serious injuries.¹⁸ In the town of Mount Angel, authorities closed the historic St. Mary Catholic Church for fear its 200-foot bell tower could collapse.¹⁹

In Dayton, some bricks fell from an old, two-story un-reinforced masonry building (URM).²⁰ At least 90 buildings, which were generally URM construction, suffered some damage in Newberg, 28 miles from the epicenter.²¹ This damage may have been due to local amplification of ground motion at this site.²²

Approximately 23 miles northwest of the epicenter, the southwest deck of a six-span bridge on Highway 18 pulled away from the northeast deck at the separation joint and crushed bearings on the top of the middle pier.²³ Beams fell eight to nine inches, and a driver on the bridge had all four tires on his car flattened by the impact.²⁴ After assessing several bridges for structural damage in the state, ODOT closed the Dayton Bridge on Highway 18. This was the only bridge in the Mid-Willamette Valley that remained closed. Also, the north end of Highway 18 at Highway 99W was closed to southbound traffic, and Portland General Electric customers in the Dundee area experienced power failure.²⁵

March 7, 1963, Salem, Oregon – Magnitude 4.6

On March 7, 1963, a quake measuring 4.6 on the Richter scale shook Yamhill County. Despite the low magnitude of the quake, damage still occurred – especially to older masonry buildings.

November 5, 1962, Vancouver, Washington – Magnitude 5.5

Three and a half weeks after the devastating Columbus Day Storm, an earthquake that measured approximately 5.5 on the Richter scale shook the Portland area. It was the largest recorded quake to be generated by a fault in the immediate Portland vicinity.²⁶ The shaking lasted up to 30 seconds. Chimneys cracked, windows were broken, and furniture moved. The *News Register* reported no damage in the county, although the County felt this quake, which occurred 364 days after the area's last quake.²⁷

The quake was felt over a wide area of Oregon and Washington. Reports of the earthquake came from Eugene, 110 miles south of Portland, and from Seattle, 135 miles to the north.²⁸ The heaviest damage report came from Tillamook on the Oregon coast where the quake, lasting only a few seconds, cracked open barn walls and broke out windows at a local ranch.²⁹

April 18, 1961, Albany, Oregon – Magnitude 4.5

A quake in April of 1961 caused little damage to the county, but startled many residents. The quake was centered just south of Salem, and registered 4.6 on the Richter scale. Described by most as a double shock, it shook houses, rattled dishes, woke the sleeping and startled the awake.³⁰ Damage was very limited – typical of an earthquake of lower magnitude. Albany reported some cracked plaster.³¹

April 13, 1949, Olympia, Washington- Magnitude 7.1

On April 13, 1949, Yamhill county residents felt an earthquake that was centered between Olympia and Tacoma, Washington. In Washington, this quake caused eight deaths. While Yamhill County was shaken by the quake, damage was minimal, and no deaths occurred.

The quake rocked northwestern Oregon, extending as far south as Eugene, Coos Bay, and Reedsport, and east as far as Prineville and La Grande.³² In downtown Salem, West Salem and in outlying areas buildings trembled, light fixtures swayed, dishes rattle in cupboards. Most of those who were outside at the time reported no shock.³³

Causes and Characteristics of Earthquake in Yamhill County

Most large earthquakes in the Pacific Northwest are shallow crustal, deep intraplate, or subduction zone earthquakes. These earthquakes can have great impact on Oregon communities. With its location in the Pacific Northwest, Yamhill County is susceptible to both intraplate and subduction zone earthquakes. In addition, the Mount Angel Fault, a crustal fault, is located less than fifteen miles east of Yamhill County. This fault was attributed with the “Spring Break Quake,” and has the potential of producing more earthquakes.

Crustal Fault Earthquakes

Crustal fault earthquakes are the most common of earthquakes and occur at relatively shallow depths of six to twelve miles below the surface.³⁴ While most crustal fault earthquakes are smaller than magnitude 4.0 and generally create little or no damage, they can produce earthquakes of magnitudes 7.0 and higher and cause extensive damage. The Mount Angel Fault, a crustal fault located less than fifteen miles east of Yamhill County, produced a 5.7 magnitude quake in 1993.

Deep Intraplate Earthquakes

Occurring at depths from 25 to 40 miles below the earth’s surface in the subducting oceanic crust, deep intraplate earthquakes can reach magnitude 7.5.³⁵ The February 28, 2001 earthquake in Washington State was a deep intraplate earthquake. It produced a rolling motion that was felt from Vancouver, British Columbia to Coos Bay, Oregon and east to Salt Lake City, Utah. A 1965 magnitude 6.5-intraplate

earthquake centered south of Seattle-Tacoma International Airport caused seven deaths.³⁶

Subduction Zone Earthquakes

The Pacific Northwest is located at a convergent plate boundary, where the Juan de Fuca and North American tectonic plates meet. The two plates are converging at a rate of about one to two inches per year. This boundary is called the Cascadia Subduction Zone (see Figure 10-2). It extends from British Columbia to northern California. Subduction zone earthquakes are caused by the abrupt release of slowly accumulated stress. Subduction zones similar to the Cascadia Subduction Zone have produced earthquakes with magnitudes of 8.0 or larger. Historic subduction zone earthquakes include the 1960 Chile (magnitude 9.5) and the 1964 southern Alaska (magnitude 9.2) earthquakes. Geologic evidence shows that the Cascadia Subduction Zone has generated great earthquakes, most recently about 300 years ago. It is generally accepted to have been magnitude 9.0 or greater. The average recurrence interval of these great Cascadia earthquakes is approximately 500 years, with gaps between events as small as 200 years and as large as 1000 years. Such earthquakes may cause great damage to the coastal area of Oregon as well as inland areas in western Oregon including Yamhill County. It is estimated that shaking from a large subduction zone earthquake could last up to five minutes.³⁷

Figure 12-2. Cascadia Subduction Zone



Source: Department of Land Conservation and Development.
www.lcd.state.or.us/coast/hazards/juandefuaplates.htm

Earthquake Related Hazards

Ground Shaking

Ground shaking is the motion felt on the earth's surface caused by seismic waves generated by the earthquake. It is the primary cause of earthquake damage. The strength of ground shaking depends on the magnitude of the earthquake, the type of fault, and distance from the epicenter (where the earthquake originates). Buildings on poorly consolidated and thick soils will typically see more damage than buildings on consolidated soils and bedrock.

Earthquake-Related Landslides

Earthquake-induced landslides are secondary earthquake hazards that occur from ground shaking. They can destroy roads, buildings, utilities, and other critical facilities necessary to respond to and recover from an earthquake. Many communities in Oregon, including those within Yamhill County, are likely to encounter such risks, especially in areas with steep slopes.

Liquefaction

Liquefaction occurs when ground shaking causes wet granular soils to change from a solid state to a liquid state. This results in the loss of soil strength and the soil's ability to support weight. Buildings and their occupants are at risk when the ground can no longer support these buildings and structures.³⁸ Areas of susceptibility to liquefaction include areas with groundwater tables and sandy soils.³⁹

Amplification

Soils and soft sedimentary rocks near the earth's surface can modify ground shaking caused by earthquakes. One of these modifications is amplification. Amplification increases the magnitude of the seismic waves generated by the earthquake. Amplification depends on the thickness of geologic materials and their physical properties. Buildings and structures built on soft and unconsolidated soils can face greater risk.⁴⁰ Amplification can also occur in areas with deep sediment-filled basins.

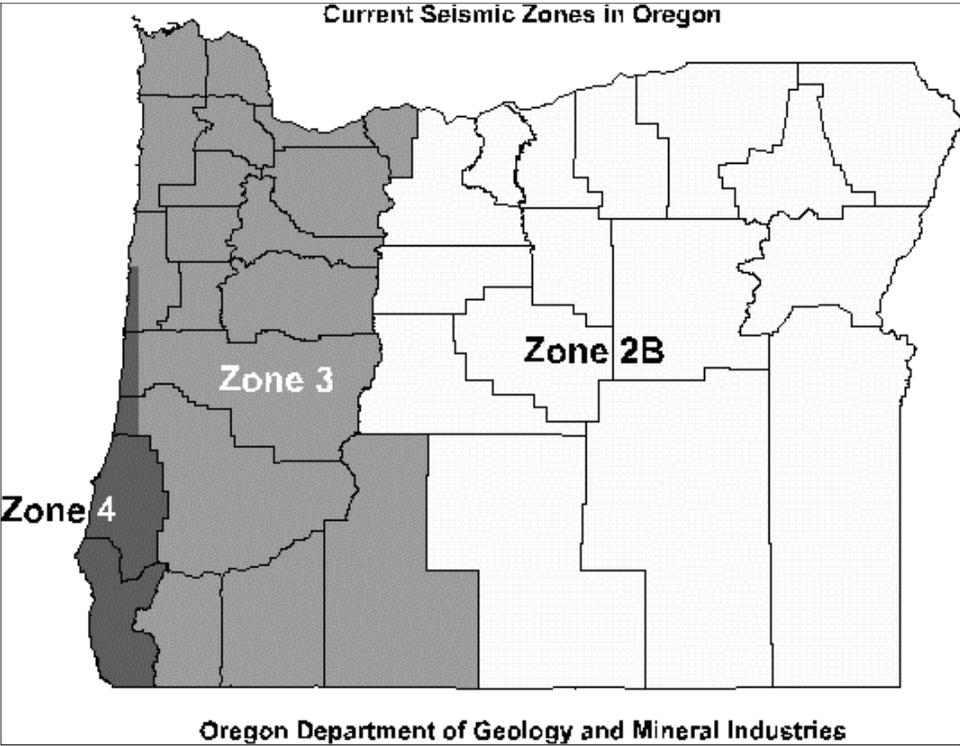
Earthquake Hazard Assessment

Hazard Identification

The Department of Geology and Mineral Industries (DOGAMI), in partnership with other state and federal agencies, has undertaken a rigorous program in Oregon to identify seismic hazards and risks, including active fault identification, bedrock shaking, tsunami inundation zones, ground motion amplification, liquefaction, and earthquake induced landslides. Seismic hazard maps have been published and are available for many communities in Oregon through DOGAMI.⁴¹

The Oregon Building Codes Division revised and upgraded its construction standards for new buildings to make them resistant to seismic events. The change in State Building Codes reflects updated seismic zones (see Figure 12-3). An increase in zone number reflects increased risk of seismic activity. Many buildings in Yamhill County were built prior to the imposition of the new seismic zone code requirements, established in 1993.

Figure 12-3. Seismic Zones in Oregon



Vulnerability Assessment

The effects of earthquakes span a large area. The degree to which earthquakes are felt, however, and the damages associated with them may vary. At risk from earthquake damage are large old buildings and bridges, many ‘high tech’ and hazardous material facilities, extensive sewer, water, and natural gas pipelines, petroleum pipelines, and other critical facilities and private property located within the county. The areas that are particularly vulnerable to potential earthquakes in the county have been identified as those areas near the crustal fault lines.

The relative or secondary earthquake hazards, which are liquefaction, ground shaking, amplification, and earthquake-induced landslides, can be just as devastating as the earthquake. DOGAMI is currently conducting research regarding the location and potential damage associated with secondary earthquake hazards.

Risk Analysis

Risk analysis is the third phase of a hazard assessment. Risk analysis involves estimating the damage and costs likely to be experienced in a geographic area over a period of time. Factors included in assessing earthquake risk include population and property distribution in the hazard area, the frequency of earthquake events, landslide susceptibility, buildings, infrastructure and disaster preparedness of

the region. This type of analysis can generate estimates of the damages to the county due to an earthquake event in a specific location. At the time of publication of this plan, data was insufficient to conduct a risk analysis and the software needed to conduct this type of analysis was not available. DOGAMI is leading state initiative in producing earthquake maps and conducting risk analyses of various regions in the state. Map 7 shows the relative geological fault lines within Yamhill County.

Community Earthquake Issues

Earthquake damage occurs because structures cannot withstand severe shaking. Buildings, airports, schools, and lifelines, including highways and phone, gas, and water lines suffer damage in earthquakes and can cause death or injury to humans.

The welfare of homes, major businesses, and public infrastructure is very important. Addressing the integrity of buildings, critical facilities, and infrastructure, and understanding the potential costs to government, businesses, and individuals as a result of an earthquake, are challenges faced by Yamhill County.

Buildings

The built environment is susceptible to damage from earthquakes. Buildings that collapse can trap and bury people, putting lives at risk and creating great costs to clean up the damages. Changes in the seismic zone for the Willamette Valley in 1990 and 1993 lead to increases in the construction standards for buildings in Yamhill County and the rest of the Willamette Valley. In 1993, the seismic zone for the Willamette Valley was upgraded from 2B to 3, requiring stricter construction standards.

In most Oregon communities, including those within Yamhill County, many buildings were built before 1993 when building codes were not as strict. Upgrading existing buildings to resist earthquake forces is more expensive than meeting code requirements for new construction. Only a few buildings in McMinnville have been retrofitted to help them withstand earthquakes, including the McMinnville Community Center, McMinnville Public Library, and McMinnville Hotel Oregon.⁴²

State code requires seismic upgrades only when there is significant structural alteration to the building or where there is a change in use that puts building occupants and the community at a greater risk. Therefore, the number of buildings at risk remains high. The lack of funding for such activity is a major issue. Although coordination among county and city building code officials is in progress, much work remains to be done to identify and plan for the risks to older structures.

Infrastructure and Communication

Residents in Yamhill County commute frequently by automobile and public transportation. An earthquake can greatly damage bridges and roads, hampering the movement of people and goods. Damaged

infrastructure strongly affects the economy of the community – it disconnects people from work, school, food, and leisure, and separates businesses from their employees, customers, and suppliers.

Bridge Damage

As mentioned in Section 6 concerning floods, bridges in Yamhill County are also key points of concern if an earthquake occurs in Yamhill County. Bridges are important links in road networks that cross rivers throughout the county.

Even modern bridges can sustain damage during earthquakes, leaving them unsafe for use. Some bridges have failed completely due to strong ground motion. Bridges are a vital transportation link – with even minor damages making some areas inaccessible. Because bridges vary in size, materials, siting, and design, any given earthquake will affect them differently. Of potential concern for Yamhill County is State Highway No. 39 (Salmon River Highway, Highway 18) Spur, which turns into Third Street in McMinnville. The spur provides access to the local hospital, Willamette Valley Medical Center. Part of the spur is a bridge at milepost Y46.75 that crosses the South Yamhill River, which may or may not fail due to an earthquake. Access to Willamette Valley Medical Center from the northern or southern parts of the county requires crossing at least one bridge.

Bridges built before the mid-1970s have a significantly higher risk of suffering structural damage during a moderate-to-large earthquake compared with bridges built after 1980, which contain structural improvements. Much of the interstate highway system was built in the mid to late 1960's.

Damage to Lifelines

Lifelines are the connections between communities and outside services. They include water and gas lines, transportation systems, electricity, and communication networks. Ground shaking and amplification can cause pipes to break, power lines to fall, roads and railways to crack or move, and radio and telephone communication to cease. Disruption to transportation makes it especially difficult to bring in supplies or services. All lifelines need to be usable after an earthquake to allow for rescue, recovery, and rebuilding efforts and to relay important information to the public.

Disruption of Critical Services

Critical facilities include police stations, fire stations, hospitals, shelters, and other facilities that provide important services to the community. These facilities and their services need to be functional after an earthquake event. Many critical facilities are housed in older buildings that are not up to current seismic codes.

Businesses

Seismic activity can cause great loss to businesses – both large-scale corporations and small retail shops. When a company is forced to stop

production for just a day, the economic loss can be tremendous, especially when its market is at a national or global level. Seismic activity can create economic loss that presents a burden to small shop owners who may have difficulty recovering from their losses.

Individual Preparedness

A 1999 DOGAMI survey shows that about 39 percent of respondents think an earthquake will occur in Oregon within the next ten years. Only 28 percent of Oregon residents say they are prepared for an earthquake, and prior to the Spring Break Quake of 1993, only three percent of Oregon homeowners had earthquake insurance.⁴³ About 30 percent of homeowners now have earthquake coverage, according to Insurance Information Services of Oregon and Idaho.⁴⁴

The DOGAMI survey also indicated that only 24 percent correctly identified what to do during an earthquake.⁴⁵

Because the potential for earthquake occurrences and earthquake-related property damage is relatively high, increasing individual preparedness is a significant need. Strapping down heavy furniture, water heaters, and expensive personal property as well as being insured for earthquake, are just a few steps individuals can take to prepare for an earthquake.

Death and Injury

Death and injury can occur both inside and outside of buildings due to falling equipment, furniture, debris, and structural materials. Downed power lines and broken water and gas lines can also endanger human life. Deaths can be prevented with proper building design and individual preparedness.

Fire

Downed power lines or broken gas mains can trigger fires. When fire stations suffer structural or lifeline damage, quick response to suppress fires is less likely. Therefore, it is necessary for fire stations and critical facilities to be well protected from natural disasters.

Debris

Following damage to structures, much time is spent cleaning up brick, glass, wood, steel or concrete building elements, office and home contents, and other materials. Developing strong debris management strategies can assist in post-disaster recovery.

Mitigation Plan Goals and Existing Activities

Mitigation Plan Goals Addressed

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

The plan goals help to guide the direction of future activities aimed at reducing risk and preventing loss from natural hazards. The goals

listed here serve as checkpoints as agencies and organization begin implementing mitigation action items.

Goal #1: EMERGENCY OPERATIONS

Goal Statement: Coordinate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures and with various other agencies, as appropriate.

Goal #2: EDUCATION AND OUTREACH

Goal Statement: Develop and implement education and outreach programs to increase public awareness of the risks associated with natural hazards.

Goal #3: PARTNERSHIPS

Goal Statement: Develop effective partnerships with public and private sector organizations and significant agencies and businesses for future natural hazard mitigation efforts.

Goal #4: PREVENTIVE

Goal Statements:

- Develop and implement activities to protect human life, commerce, and property from natural hazards.
- Reduce losses and repetitive damage for chronic hazard events while promoting insurance coverage for catastrophic hazards.

Goal #5: NATURAL RESOURCES UTILIZATION

Goal Statement: Link natural resources management, land use planning, and watershed planning with natural hazard mitigation activities to protect natural systems and allow them to serve natural hazard mitigation functions.

Goal #6: IMPLEMENTATION

Goal Statement: Implement strategies to mitigate the effects of natural hazards.

Existing Mitigation Activities

Existing mitigation activities include current mitigation programs and activities that are being implemented by county, regional, state, or federal agencies or organizations.

County Programs

Implementation of earthquake mitigation often takes place at the local government level. The Yamhill County Department of Planning and Development is the local agency that enforces zoning codes pertaining

to earthquake hazards. The standards for development are outlined in the Zoning Ordinance. The Building Division addresses the earthquake hazard by requiring new structures to meet current state seismic requirements. Generally, the Planning and Development Department seeks to discourage development in areas that could be prone to flooding landslide, wildfire and/or seismic hazards. Developers in potential hazard-prone areas are required to retain a professional engineer to evaluate level of risk onsite and recommend mitigation measures.

State Programs

Earthquake Awareness Month

April is Earthquake Awareness Month. Oregon Emergency Management (OEM) coordinates activities such as earthquake drills and encourages individuals to strap down computers, heavy furniture and bookshelves in homes and offices.

Earthquake Drills in Schools

School districts conduct earthquake drills regularly throughout Oregon and teach students how to respond when an earthquake occurs.

Prioritization of Oregon Bridges for Seismic Retrofit

In January 1997, the Oregon Department of Transportation (ODOT), Oregon Local Agencies Seismic Committee, and CH2Mhill consultants completed a four-year study of seismic vulnerability for Oregon's bridge inventory. From this assessment, Polk County and the state was able to prioritize bridges for seismic retrofit within the county. Bridges considered structurally safe will be retrofitted or rebuilt to withstand high-water flows, landslides and other natural hazards in addition to seismic events. ODOT can be contacted for more information on the state's bridge inventory.

State Building Codes

The Oregon State Building Codes Division adopts statewide standards for building construction that are administered by the state, cities and counties throughout Oregon. Oregon State Building Code Division (BCD) sets the minimum design and construction standards for new buildings.

The codes apply to new construction and to the alteration of, or addition to, existing structures. Effective April 1, 2003, the new Oregon Dwelling Specialty Code went into effect. The new code is based on the 2000 International Residential Code (IRC) and has Oregon amendments added to reflect changes specific to Oregon. The IRC is based primarily on the 1998 Edition of the International One- and Two-Family Dwelling Code, and has incorporated several significant changes to align it with other model codes. It has been enhanced and expanded to reflect industry advancements and practices, both nationally and locally, and reflects modern industry standards and practices.

The seismic design and lateral bracing criteria are updated to reflect changes that are taking place nationally to embrace modern technology and information. Seismic "zone" terminology has changed to reflect a national move to use seismic design categories. Oregon now has three seismic design categories: the coastal areas are Design Category D2, the valley areas are Design Category D1 and the eastern part of the state is Design Category C. In addition to these seismic zone changes, the state modified its lateral bracing requirements to reflect several interpretive rulings issued over the past several years.

Regional Programs

The Institute for Business and Home Safety (IBHS), a national non-profit organization, is actively providing natural hazards information to the public through the media and public meetings and workshops.

Insurance Information Service of Oregon and Idaho's (IISOI) speaker's bureau visits local communities to discuss loss prevention, insurance information, and effects from other natural hazards events.

Earthquake Mitigation Action Items

The following mitigation action items were formulated through research of regional mitigation plans, natural hazards planning literature, and interviews with local stakeholders. Plan action items were refined through discussions with the mitigation plan steering committee and through an open house at which the county received from the public.

The earthquake mitigation action items provide direction on specific activities that organizations and residents in Yamhill County can undertake to reduce risk and prevent loss from earthquakes. Each action item is followed by ideas for implementation, which can be used by the steering committee and local decision makers in pursuing strategies for implementation.

This section lists action items identified to reduce the risk from earthquakes in Yamhill County. These action items are designed to meet the mitigation plan goals.

Short-term (ST) Earthquake Action Items

Short-term earthquake action items include general mitigation activities that agencies are capable of implementing during the next two years, given their existing resources and authorities.

ST-EQ #1: Integrate new] earthquake hazard mapping data for Yamhill County and improve technical analysis of earthquake hazards.

Ideas for Implementation

- Update Yamhill County earthquake HAZUS data using more localized data; and
- Conduct risk analysis incorporating HAZUS data and the created hazard maps using GIS technology to identify risk sites and further assist in prioritizing mitigation activities and assessing the adequacy of current land use requirements.

Coordinating Organization:	GIS
Internal Partner:	Public Works, Planning, Emergency Management
External Partner:	OSU, USGS, BLM, MWVCOG, OEM, FEMA, DOGAMI
Timeline:	2 years
Plan Goals Addressed:	Education & Outreach; Partnerships; Preventive; Natural Resources Utilization

ST-EQ #2: Encourage reduction of nonstructural and structural earthquake hazards in homes, schools, businesses, and government offices.

Ideas for Implementation

- Provide information to government building and school facility managers and teachers on securing bookcases, filing cabinets, light fixtures, and other objects that can cause injuries and block exits;
- Encourage facility managers, business owners, and teachers to refer to FEMA's practical guidebook, *Reducing the Risks of Nonstructural Earthquake Damage*;
- Encourage homeowners and renters to use *Is Your Home Protected from Earthquake Disaster? A Homeowner's Guide to Earthquake Retrofit* (IBHS) for economic and efficient mitigation techniques;
- Work with local building supply outlets to feature checklists/retrofit kits for reducing nonstructural risk;
- Explore partnerships to provide retrofitting classes for homeowners, renters, building professionals, and contractors;
- Conduct periodic safety surveys (vs. inspections) of nonstructural seismic hazards;
- Use home shows to promote nonstructural strategies and mitigation information; and

- Target development located in potential fault zones or in unstable soils for intensive education and retrofitting resources.

Coordinating Organization: Emergency Management
 Internal Partners: Building, Planning
 External Partners: City building officials, school districts, builders' associations, IBHS, Red Cross, DOGAMI, IISOI, OSSPAC, Yamhill Fire Defense Board, FEMA, OEM
 Timeline: 1 to 2 years, on-going
 Plan Goals Addressed: Emergency Operations; Preventive; Natural Resources Utilization; Implementation

ST-EQ #3: Encourage purchase of earthquake hazard insurance by forming partnerships with the insurance and real estate industries.

Ideas for Implementation

- Provide earthquake insurance information to Yamhill County residents;
- Coordinate with insurance companies and organizations such as the Insurance Information Service of Oregon and Idaho (IISOI) to produce and distribute earthquake insurance information;
- Make contacts with insurance industry representatives to keep current about their requirements, rates, and plans; and
- Work with real estate industry representatives to educate them about what types of structures are resistant to earthquakes.

Coordinating Organization: Emergency Management
 External Partners: IISOI through local insurance agencies, mortgage companies, insurance and real estate industries, DOGAMI
 Timeline: On-going
 Plan Goals Addressed: Education & Outreach; Preventive; Natural Resources Utilization

ST-EQ #4: Maintain an inventory of all permitted dams in Yamhill County.

Ideas for Implementation

- Identify funding sources to conduct an analysis of the County's larger dams' vulnerability to seismic shakes, as well as an assessment of the possible liquefiable nature of alluvium remaining in the dam foundation and the stability of nearby landslides; and

- Update appropriate seismic criteria and procedures for evaluating performance of existing dams (varies within each permitted dam Emergency Action Plan).
 - Susceptibility to damage from flood events
 - Amount of water impounded
 - Type of construction
 - Year completed
 - Repair work performed

Coordinating Organization: Emergency Management
 External Partners: Watermasters, Yamhill Basin Council, WRD, McMinnville Power & Light
 Timeline: 1 to 5 years
 Plan Goals Addressed: Education and Outreach; Preventive; Natural Resources Utilization

ST-EQ #5: Identify funding sources for and implement high priority structural and nonstructural retrofits of structures that are identified as seismically vulnerable.

Lack of capital to upgrade structures is a major reason why many public and privately owned buildings and bridges are not retrofitted to stricter seismic standards.

Ideas for Implementation

- Evaluate grant and foundations that support earthquake mitigation activities;
- Provide information for property owners, small businesses, and organizations on sources of funds (loans, grants, etc.);
- Explore options for including seismic retrofitting in existing programs such as low-income housing, insurance reimbursements, and pre- and post-disaster repairs; and
- Adopt an ordinance that authorizes property tax incentives or deferrals to offset the costs of voluntary rehabilitation for existing buildings.

Coordinating Organization: Emergency Management
 Internal Partner: Building, Planning, County Assessor
 External Partners: IISOI, OSSPAC, local banks, credit unions, SBA, Rural Development (USDA), OECD; FEMA, OEM
 Timeline: 1 to 2 years

Plan Goals Addressed: Education & Outreach; Partnerships;
Implementation

Long-term (LT) Earthquake Action Items

Long-term earthquake action items include general mitigation activities that are likely to take more than two years to implement and may require new or additional resources and/or authorities.

LT-EQ #1: Promote and continue building code standards.

Ideas for Implementation

- Continue building code education, promotion, and utilization to ensure earthquake resistant new construction.

Coordinating Organization: Building Department
Internal Partner: Planning
External Partner: City planning departments, builders,
developers, property owners
Timeline: On-going
Plan Goals Addressed: Education & Outreach; Preventive; Natural
Resources Utilization

LT-EQ #2: Encourage seismic strength evaluations of critical facilities to identify vulnerabilities and to meet current seismic standards.

Ideas for Implementation

- Develop an inventory of schools, universities, and critical facilities that do not meet current seismic standards;
- Retrofit older public buildings to bring them up to current earthquake standards.
- Encourage owners of non-retrofitted reservoirs to upgrade them to meet seismic standards; and
- Encourage all water providers to replace all old cast iron pipes with more ductile iron, and identify partnership opportunities with other agencies for pipe replacement.

Coordinating Organization: Emergency Management
Internal Partners: Planning, Building
External Partners: City planning departments; water service providers; OAWU; school districts, hospitals, ODOT, colleges and universities; dam/reservoir owners/managers; architects, Willamette ESD, Oregon Building Codes Division, WRD
Timeline: On-going
Plan Goals Addressed: Emergency Operations; Education & Outreach; Partnerships; Preventive; Implementation

LT-EQ #3: Identify and enhance water, sewer, electric, gas and other utilities to improve their survivability in an earthquake.

Ideas for Implementation

- Coordinate utility improvements with companies, cities, and Yamhill County.

Coordinating Organization: Emergency Management
Internal Partners: Planning, Building, Public Works
External Partner: City planning departments, utilities
Timeline: On-going
Plan Goals Addressed: Education & Outreach; Partnerships; Preventive; Natural Resources Utilization

LT-EQ #4: Encourage earthquake safety promotion and drills to school children and community groups.

Ideas for Implementation

- Assure that all County residents, regardless of income, disability, or ethnic group, receive information about earthquakes and have the opportunity to mitigate earthquake hazards in their home;
- Conduct safety seminars with community groups to describe earthquake dangers, and steps that can be taken to reduce their impact;
- Develop educational materials in appropriate languages; and
- Encourage County schools to promote earthquake safety education.

Coordinating Organization: Emergency Management
Internal Partner: Planning
External Partners: City planning departments, school districts, community organizations, housing authority
Timeline: On-going
Plan Goals Addressed: Emergency Operations; Education & Outreach; Partnerships; Preventive; Natural Resources Utilization

LT-EQ #5: Improve local capabilities to perform earthquake building safety evaluations.

Ideas for Implementation

- Identify funding sources to offer training in procedures for earthquake building safety evaluations to CERT volunteers through acknowledged CERT teams throughout the County; and
- Identify funding sources to offer periodic training in ATC-20 and ATC-21 procedures for earthquake building safety evaluations and encourage local building officials and other public and private officials (facilities, maintenance, engineering, architecture) to attend.

Coordinating Organization: Emergency Management
Internal Partner: Building
External Partners: FEMA, OEM, Oregon Building Codes Division, IISOI
Timeline: On-going
Plan Goals Addressed: Preventive; Implementation

Earthquake Resource Directory

State Resources

Department of Land Conservation and Development (DLCD)

DLCD administers the state's Land Use Planning Program. The program is based on 19 Statewide Planning Goals, including Goal 7, related to natural hazards, also conducts various landslide related mitigation activities. In order to help local governments address natural hazards effectively, DLCD provides technical assistance such as conducting workshops, reviewing local land use plan amendments, and working interactively with other agencies.

Contact: Natural Hazards Program Manager
Address: 635 Capitol St. NE, Suite 200, Salem, OR 97301-2540
Phone: 503-373-0050
Fax: 503-378-6033
Website: <http://www.lcd.state.or.us/hazards.html>

Oregon Department of Geology and Mineral Industries (DOGAMI)

The mission of the Department of Geology and Mineral Industries is to serve a broad public by providing a cost-effective source of geologic information for Oregonians and to use that information in partnership to reduce the future loss of life and property due to potentially devastating earthquakes, tsunamis, landslides, floods, and other geologic hazards. The Department has mapped earthquake hazards in most of western Oregon.

Contact: Deputy State Geologist, Seismic, Tsunami, and Coastal Hazards Team Leaders
Address: 800 NE Oregon St., Suite 965, Portland, Oregon 97232
Phone: 503-731-4100
Fax: 503-731-4066
Email: james.roddey@state.or.us
Website: <http://sarvis.dogami.state.or.us/homepage>

Oregon Department of Consumer & Business Services-Building Codes Division

The Building Codes Division (BCD) sets statewide standards for design, construction, and alteration of buildings that include resistance to seismic forces. BCD is active on several earthquake committees and funds construction related continuing education programs. BCD registers persons qualified to inspect buildings as safe or unsafe to occupy following an earthquake and works with OEM to assign inspection teams where they are needed.

Contact: Building Codes Division
Address: 1535 Edgewater St. NW, P.O. Box 14470, Salem, Oregon 97309
Phone: 503-378-4133

Fax: 503-378-2322

Website: <http://www.cbs.state.or.us/external>

Oregon State Police (OSP)-Office of Emergency Management (OEM)

The purpose of OEM is to execute the Governor's responsibilities to maintain an emergency services system as prescribed in Oregon Revised Statutes Chapter 401 by planning, preparing, and providing for the prevention, mitigation and management of emergencies or disasters that present a threat to the lives and property of citizens of and visitors to the state of Oregon. OEM coordinates disaster support to local governments and works with BCD to deploy additional building inspectors when needed for damage assessment.

Contact: Earthquake and Tsunami Program Coordinator

Address: 3225 State Street, Salem, Oregon 97301
P.O. Box 14370, Salem, OR 97309-5062

Phone: 503-378-2911

Fax: 503-373-7833

Website: <http://www.osp.state.or.us/oem/>

The Nature of the Northwest Information Center

The Oregon Department of Geology and Mineral Industries and the USDA Forest Service operate the Nature of the Northwest Information Center jointly. It offers selections of maps and publications from state, federal, and private agencies. DOGAMI's earthquake hazard maps can be ordered from this site.

Address: Suite 177, 800 NE Oregon Street # 5, Portland, Oregon 97232

Phone: 503-872-2750

Fax: 503-731-4066

Email: Nature.of.NW@state.or.us

Website: <http://www.naturenw.org/geo-earthquakes.htm>

Federal Resources

Federal Emergency Management Agency (FEMA)

FEMA is heavily involved with seismic risks in Oregon and has aided in several projects in Portland and Klamath Falls. FEMA is an independent agency of the Federal Government, reporting to the President. FEMA's purpose is to reduce loss of life and property and protect the nation's critical infrastructure from all types of hazards through a comprehensive, risk-based, emergency management program of mitigation, preparedness, response, and recovery. FEMA coordinates the federal response and provides disaster relief funds following a natural hazard event and works most closely with Oregon Emergency Management (OEM).

Contact: Public Affairs Officer, FEMA, Federal Regional Center,

Address: 130 - 228th Street, St., Bothell, WA 98021-9796
Phone: 425-487-4610
Fax: 425-487-4690
Email: opa@fema.gov
Website: <http://www.fema.gov/library/quakef.htm>

FEMA – National Earthquake Hazards Reduction Program (NEHRP)

FEMA's earthquake program was established in 1977, under the authority of the Earthquake Hazards Reduction Act of 1977, enacted as Public Law 95-124. The purpose of the National Earthquake Hazards Reduction Program (NEHRP) is to reduce the risks of life and property from future earthquakes. FEMA serves as lead agency among the four primary NEHRP federal partners, responsible for planning and coordinating the Program.

Website: <http://www.fema.gov/hazards/earthquakes/nehrrp/>

U.S. Geological Survey (USGS) Earthquake Hazards Program

The Earthquake Hazard Program is part of the USGS effort to reduce earthquake hazard in the United States. The USGS is the only Federal agency with responsibility for recording and reporting earthquake activity nationwide. Citizens, emergency responders, and engineers rely on the USGS for accurate and timely information on where an earthquake occurred, how much the ground shook in different locations, and what the likelihood is of future significant ground shaking.

Contact: Earthquake Hazard Program, USGS
Address: University of Washington, Department of Earth and Space Sciences, Box 351310, Room 63, Seattle, WA 98195-1310
Website: <http://earthquake.usgs.gov/regional/pacnw>

USGS National Earthquake Information Center (NEIC)

The USGS is an active seismic research organization that also provides funding for research. (For an example of such research, see Recommended Seismic Publications below). The mission of the National Earthquake Information Center (NEIC) is to rapidly determine location and size of all destructive earthquakes worldwide and to immediately disseminate this information to concerned national and international agencies, scientists, and the general public. As [World Data Center for Seismology, Denver](#), the NEIC compiles and maintains an extensive, global seismic database on earthquake parameters and their effects that serves as a solid foundation for basic and applied earth science research.

Contact: USGS, National Earthquake Information Center
Address: Box 25046; DFC, MS 967; Denver, Colorado 80225-0046
Phone: 303-273-8500
Fax: 303-273-8450
Website: <http://neic.usgs.gov>

Building Seismic Safety Council (BSSC)

The Building Seismic Safety Council (BSSC), established by the National Institute of Building Sciences (NIBS), deals with complex regulatory, technical, social, and economic issues and develops and promotes building earthquake risk mitigation regulatory provisions for the nation.

Address: 1090 Vermont Avenue, NW, Suite 700, Washington, DC
20005-4905
Phone: 202-289-7800
Fax: 202-289-1092
Website: <http://www.bssconline.org/>

Western States Seismic Policy Council (WSSPC)

The WSSPC is a regional organization that includes representatives of the earthquake programs of thirteen states (Alaska, Arizona, California, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming), three U.S. territories (American Samoa, Commonwealth of the Northern Mariana Islands and Guam), one Canadian Province (British Columbia), and one Canadian Territory (Yukon). The primary aims of the organization have been to improve public understanding of seismic risk; to improve earthquake preparedness, and to provide a cooperative forum to enhance transfer of mitigation technologies at the local, state, interstate, and national levels.

The mission of the Council is to provide a forum to advance earthquake hazard reduction programs throughout the western region and to develop, recommend, and present seismic policies and programs through information exchange, research and education.

Contact: WSSPC
Address: 644 Emerson Street, Suite 22, Palo Alto, CA 94301
Phone: 650-330-1101
Fax: 650-330-1973
Email: wsspc@wsspc.com
Website: <http://www.wsspc.org/>

Cascadia Region Earthquake Workgroup (CREW)

CREW provides information on regional earthquake hazards, facts and mitigation strategies for the home and business office. CREW is a coalition of private and public representatives working together to improve the ability of Cascadia Region communities to reduce the effects of earthquake events. Members are from Oregon, Washington, California, and British Columbia. Goals are to:

- Promote efforts to reduce the loss of life and property.
- Conduct education efforts to motivate key decision makers to reduce risks associated with earthquakes.

- Foster productive linkages between scientists, critical infrastructure providers, businesses and governmental agencies in order to improve the viability of communities after an earthquake.

Contact: CREW, Executive Director
Address: 3110 Portage Bay Place E, Slip G, Seattle, WA 98102
Phone: 206-328-2533
Fax: 206-328-2533 (call first)
Email: bfreitag@mindspring.com
Website: <http://www.crew.org/>

Additional Resources

Red Cross

Each year, the American Red Cross responds immediately to more than 67,000 disasters, including house or apartment fires (the majority of disaster responses), hurricanes, floods, earthquakes, tornadoes, hazardous materials spills, transportation accidents, explosions, and other natural and human-created disasters. The Oregon Trail Chapter serves the residents of Clackamas, Clatsop, Columbia, Multnomah, Tillamook, Washington and Yamhill counties.

Contact: American Red Cross, Oregon Trail Chapter
Address: 3131 N Vancouver Ave, Portland, OR 97227-1560
P.O. Box 3200, Portland, OR 97208-3200
Phone: 503-284-1234
Fax: 503-284-4247
Website: <http://www.redcross-oregontrail.org>
Email: info@redcross-pdx.org

Institute for Business & Home Safety (IBHS)

IBHS was created as an initiative of the insurance industry to reduce damage and losses caused by natural disasters. Their website provides educational resources and on-line publications for insurers, businesses, and homeowners who are interested in taking the initiative to minimize future damages and losses.

Contact: Institute for Business and Home Safety
Address: 1408 North Westshore Boulevard - Suite 208 - Tampa, FL 33607
Phone: 813-286-3400
Fax: 813-286-9960
E-mail: info@ibhs.org
Website: <http://www.ibhs.org/>

Publications

Planning for Natural Hazards: The Oregon Technical Resource Guide, Department of Land Conservation and Development (July 2000).

Produced by the Community Planning Workshop for the Department of Land Conservation and Development, this is a natural hazards planning and mitigation resource for Oregon cities and counties. It

provides hazard-specific resources and plan evaluation tools. The document was written for local government employees and officials. The Technical Resource Guide includes a natural hazards comprehensive plan review, a hazard mitigation legal issues guide, and five hazard-specific technical resource guides, including: flooding, wildfires, landslides, coastal hazards, and earthquakes. Write, call, fax, or go on-line to obtain this document.

Contact: Natural Hazards Program Manager, DLCD
Address: 635 Capitol St. NE, Suite 200, Salem, OR 97301-2540
Phone: 503-373-0050
Fax: 503-378-6033
Website: <http://www.lcd.state.or.us/hazards.html>

Environmental, Groundwater and Engineering Geology: Applications for Oregon – Earthquake Risks and Mitigation in Oregon, Yumei Wang, (1998) Oregon Department of Geology and Mineral Industries, Star Publishing.

This paper deals with earthquake risks in Oregon, what is being done today, and what policies and programs are in action to help prevent loss and damage from seismic events. This article also gives a good list of organizations that are doing work in this field within the state. This article is somewhat technical but provides vital information to communities around the state.

Special Paper 29: Earthquake damage in Oregon: Preliminary estimates of future earthquake losses, Yumei Wang, Oregon Department Of Geology And Mineral Industries.

Wang, a geotechnical engineer, analyzed all faults with a ten percent chance of causing an earthquake in the next 50 years and projected potential damage. Wang stresses that these are preliminary figures. "There are two things we could not incorporate into this study that would significantly increase these figures. One is a tsunami. The other is an inventory of unreinforced brick or masonry buildings."

Contact: DOGAMI
Address: 800 NE Oregon St., Suite 965, Portland, Oregon 97232
Phone: 503-731-4100
Fax: 503-731-4066
Website: <http://sarvis.dogami.state.or.us/homepage>

Land Use Planning for Earthquake Hazard Mitigation: A Handbook for Planners. Wolfe, Myer R. et. al., (1986) University of Colorado, Institute of Behavioral Science, National Science Foundation.

This handbook provides techniques that planners and others can utilize to help mitigate for seismic hazards. It provides information on the effects of earthquakes, sources on risk assessment, and effects

of earthquakes on the built environment. The handbook also gives examples on application and implementation of planning techniques to be used by local communities.

Contact: Natural Hazards Research and Applications Information Center
Address: University of Colorado, 482 UCB, Boulder, CO 80309-0482
Phone: 303-492-6818
Fax: 303-492-2151
Email: hazctr@colorado.edu
Website: <http://www.colorado.edu/UCB/Research/IBS/hazards>

Using Earthquake Hazard Maps: A Guide for Local Governments in the Portland Metropolitan Region; Evaluation of Earthquake Hazard Maps for the Portland Metropolitan Region. Spangle Associates, (1998/1999) Urban Planning and Research, Portola Valley, California.

These two publications are useful for local governments concerned with land use in earthquake hazard areas. The proximity of Yamhill County to Portland and their interactive communities make these guides applicable to the County. The publications are written in clear and simplistic language and address issues such as how to apply earthquake hazard maps for land use decisions.

Contact: DOGAMI
Address: 800 NE Oregon St., Suite 965, Portland, Oregon 97232
Phone: 503-731-4100
Fax: 503-731-4066
Website: <http://sarvis.dogami.state.or.us/homepage>

Public Assistance Debris Management Guide, Federal Emergency Management Agency (July 2000).

The Debris Management Guide was developed to assist local officials in planning, mobilizing, organizing, and controlling large-scale debris clearance, removal, and disposal operations. Debris management is generally associated with post-disaster recovery. Developing strategies to ensure strong debris management is a way to integrate debris management within mitigation activities. The *Public Assistance Debris Management Guide* is available in hard copy or on the FEMA website.

Contact: FEMA Distribution Center
Address: 130 - 228th Street, SW, Bothell, WA 98021-9796
Phone: 800-480-2520
Fax: 425-487-4622
Website: <http://www.fema.gov/r-n-r/pa/dmgtoc.htm>

Earthquake - Endnotes

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- ⁶ Bott, Jacqueline D.J. and Ivan G. Wong. “Historical Earthquakes In and Around Portland, Oregon.” *Oregon Geology*. September 1993: 55(5). 116.
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- ⁸ Hill, Richard. “Geo Watch Warning Quake Shook Portland 40 Years Ago.” *The Oregonian*, October 30, 2002.
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- ¹⁰ Id.
- ¹¹ Forgey, Pat. “Earthquake Causes Little Damage Locally.” *News-Register*. March 1, 2001. Available on the World Wide Web http://www.newsregister.com/.../story_print.cfm?story_no=12716. Accessed August 26, 2004.
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- ³⁷ Community Planning Workshop, 2002.
- ³⁸ Department of Land Conservation and Development. July 2000. *Planning for Natural Hazards: The Oregon Technical Resource Guide*. Ch. 8, Page 7.
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⁴⁵ *Statesman Journal*. August 19, 1961.

⁴⁵ Id.

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⁴⁵ Hill, Richard. “Geo Watch Warning Quake Shook Portland 40 Years Ago.” *The Oregonian*. October 30, 2002.

⁴⁵ Community Planning Workshop, 2002.

⁴⁵ Department of Land Conservation and Development. July 2000. *Planning for Natural Hazards: The Oregon Technical Resource Guide*. Ch. 8, Page 7.

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⁴⁵ Id.

⁴⁵ Community Planning Workshop, 2002

Appendix A:

Multi-Hazard Mitigation Resource Directory

The following matrix provides information on county, state, and federal mitigation resources and programs. The resource directory is organized in four sections:

- County Resources and Programs
- State Resources and Programs
- Federal Resources and Programs
- Additional Resources and Programs

County and Regional Resources and Programs

Program	Hazard	Agency	Contact Information	Type of Assistance
Geological Research	Volcano, Earthquake	Oregon State University	Department of Geosciences Geology Program, Oregon State University, 104 Wilkinson Hall, Corvallis, OR 97331-5506 541-737-1201 E-mail: geo-info@geo.orst.edu http://www.geo.oregonstate.edu	The Geology Program in the OSU Department of Geosciences faculty research projects include the study of earthquake hazards in California, and the Pacific Northwest; mapping the Oregon Coast Range in search of gas fields; studying mineral deposits in the Cordillera; investigating the structure and origin of the mountain ranges; and tracing the eruptive history of western U.S. volcanoes.
Geological Research	Earthquake	Portland State University	Dept. of Civil Engineering, STAR Lab, 1719 SW 10 th Street, Portland, OR 97201 503-725-4257	The purpose of the Seismic Testing & Research (STAR) Lab is to generate, synthesize, correlate and interpret information, data and test results. It assists the professional community in effectively and economically designing structures and components to withstand anticipated dynamic and static loads.
Business Assistance	Multi-hazard	Strategic Economic Development Corporation (SEDCOR)	SEDCOR 745 Commercial Street NE Salem, OR 97301 503-588-6225	SEDCOR, an economic development agency for Marion and Polk Counties, is a private, non-profit membership organization, composed of over 400 business and community leaders. Its mission is to enhance and diversify the economy of the Mid-Willamette Valley by supporting and enhancing the performance of existing businesses and recruiting new businesses to Marion and Polk Counties.
Emergency Assistance	Multi-hazard	American Red Cross, Oregon Trail Chapter	ARC – Oregon Trail Chapter, P.O. Box 3200, Portland, OR 97208, 503-284-1234, infor@redcross-pdx.org , http://www.redcross-pdx.org	Services provided by the American Red Cross include emergency assistance, disaster relief, and health and safety courses

County and Regional Resources and Programs (continued)

Program	Hazard	Agency	Contact Information	Type of Assistance
Disaster Management	Multi-Hazard	Polk County Emergency Management	Sheriff's Office, Emergency Management, 850 Main St. Dallas, OR 97338, 503-623-9251, http://www.co.polk.or.us/Sheriff/EM.asp	The mission of County Emergency Management is to provide an effective countywide emergency management program that includes mitigation, preparedness, response, and recovery capabilities for major emergencies/disasters to minimize the loss of life and property.
Weather Forecasts and Warning	Severe Winter Storm, Windstorm, Flood	National Weather Service, Portland Office	National Weather Service, 5241 NE 122nd Avenue, Portland, OR 97230-1089, 503-261-9246, http://www.wrh.noaa.gov/pqr/	The National Weather Service Office in Portland provides timely weather warnings and forecasts for northwest Oregon and Southwest Washington, from the Cascade Crest to 60 nautical miles offshore.

State Resources and Programs

Program	Hazard	Agency	Contact Information	Type of Assistance
Emergency Management & Mitigation Programs	Earthquake	Oregon State Police (OSP) – Office of Emergency Management (OEM)	Earthquake and Tsunami Programs Coordinator, Plans and Training Section, Oregon Emergency Management, PO Box 14370, Salem, Oregon 97309-5062 503-378-2911 x22237	OEM coordinates the initial response to an earthquake including on-site inspectors providing damage assessment. OEM also holds a statewide emergency response exercise pertaining to the possible Cascadia subduction zone earthquake.
Research & Inventories	Earthquake & Landslide	Portland State University, Geology Department	Department of Geology, Portland State University, PO Box 751, Portland, OR 97207-0751, 503.725.3022, geology@pdx.edu, http://www.geol.pdx.edu	Portland State University conducts research and prepares inventories and reports for communities throughout Oregon.
Geologic Information & Mapping Capabilities	Earthquake & Landslide	Oregon Department of Geology & Mineral Industries	DOGAMI, 800 NE Oregon St., Suite 965, Portland, OR 97232, 503-731-4100, web: http://www.oregongeology.com	DOGAMI's mission is to serve a broad public by providing a cost-effective source of geologic information for Oregonians and to use that information in partnership to reduce the future loss of life and property due to geologic hazards.

State Resources and Programs (continued)

Program	Hazard	Agency	Contact Information	Type of Assistance
Emergency Management & Mitigation Programs	Flood	OSP – OEM	OEM Hazard Mitigation Officer, 503-378-2911, ext. 22247	OEM administers FEMA’s hazard mitigation grant program, which provides monies for acquisition, elevation, relocation, and demolition of structures located in the floodplain. OEM also administers FEMA’s Flood Mitigation Assistance Program.
Emergency Management & Mitigation Programs	Landslide	OSP – OEM	OEM Hazard Mitigation Officer, 503-378-2911, ext. 22247	In relation to Senate Bill 12 and rapidly moving landslide hazards, OEM coordinates state resources for rapid and effective response to landslide-related emergencies
Landslide / Debris Flow Warning & Fire Protection	Landslide & Wildfire	Oregon Department of Forestry (ODF)	ODF, 2600 State St., Salem, OR 97310, 503-945-7200, info.odf@state.or.us http://www.odf.state.or.us	The mission of the Department of Forestry is to serve the people of Oregon through the protection, management, and promotion of a healthy forest environment, which will enhance Oregon’s livability and economy for today and tomorrow.
Emergency Management & Mitigation Programs	Multi-Hazard	OSP – OEM	OEM, P.O. Box 14370 Salem, OR 97309-5062, 503-378-2900, http://egov.oregon.gov/OOHS/OEM/index.shtml	The purpose of OEM is to execute the Governor’s responsibilities to maintain an emergency services system as prescribed in Oregon Revised Statutes Chapter 401 by planning, preparing and providing for the prevention, mitigation and management of emergencies or disasters that present a threat to the lives and property of citizens of and visitors to the State of Oregon
State Land Use Planning Program	Multi-Hazard	Department of Land Conservation & Development (DLCD)	DLCD, 635 Capitol St. NE, Suite 150, Salem, OR 97301-2540, 503-373-0050, lane.shetterly@state.or.us , http://egov.oregon.gov/LCD/contact_us.shtml	DLCD administers the state’s Land Use Planning Program. DLCD serves as Oregon’s federally designated agency to coordinate floodplain management. DLCD conducts various landslide-related mitigation activities.

State Resources and Programs (continued)

Program	Hazard	Agency	Contact Information	Type of Assistance
Hazard-Related Publications	Multi-Hazard	Nature of the Northwest Information Center (NNIC)	NNIC, 800 NE Oregon St., Suite 177, Portland, OR 97232, 503-872-2750, info@naturenw.org , http://www.naturenw.org/	DOGAMI and the USDA Forest Service, Pacific Northwest Region operate the NNIC jointly. It offers a selection of maps and publications from state, federal and private agencies.
Climate Information	Multi-Hazard	Oregon Climate Service (OCS)	OCS, Strand Agriculture Hall 326, OSU, Corvallis, OR 97331-2209, 541-737-5705, oregon@coas.oregonstate.edu , http://www.ocs.oregonstate.edu/	OCS is the state repository for weather and climate information. OCS collects, manages and maintains Oregon weather and climate data; and performs independent research related to weather and climate issues.
Building Codes	Multi-Hazard	Oregon Dept. of Consumer & Business Services (DCBS) – Building Codes Division	BCD, 1535 Edgewater St. NW, P.O. Box 14470 Salem, OR 97309-0404, 503-378-4133, dcbs.director@state.or.us , http://www.cbs.state.or.us/external/bcd/	BCD of DCBS is responsible for administering statewide building codes. Responsibilities include adoption of statewide construction standards that help create disaster-resistant buildings, particularly for flood, wildfire, wind, foundation stability, and seismic hazards.
Water Resources	Multi-Hazard	Oregon Department of State Lands (DSL)	DLS, 775 Summer St. NE, Suite 100, Salem, OR, 97301, 503-378-3805, http://www.oregonstatelands.us/	DSL is a resource manager and a regulatory agency, responsible for administration of Oregon's Removal-Fill Law, which is intended to protect, conserve and allow the best use of the state's water resources.
Economic Development	Multi-Hazard	Oregon Economic & Community Development Department (OECDD)	OECDD, 775 Summer St. NE, Suite 200, Salem, OR 97301, 503-986-0123, http://www.econ.state.or.us/	OECDD provides economic and community development throughout the state, and administers programs that assist businesses, communities and people. Oregon's economic development system is designed to meet the state's changing economy, provide flexibility in funding statewide and regional needs, and focus on funding economic and community development services for rural and distressed communities

State Resources and Programs (continued)

Program	Hazard	Agency	Contact Information	Type of Assistance
Fire Protection & Prevention	Wildfire	Office of the State Fire Marshal (OSFM)	OSFM, 4760 Portland Road NE, Salem, OR 97305-1760, 503-378-3473, oregon.sfm@state.or.us , http://egov.oregon.gov/OOHS/SFM/	The Fire & Life Safety Services of OSFM contains 15 Deputy State Fire Marshals. Each deputy's responsibilities varies depending upon the region; however, basic responsibilities that each has in common are (1) Resource for and assistance to the local fire jurisdictions and their communities, (2) Public education for the local fire jurisdictions, (3) Inspections of businesses, public assemblies, schools, day care centers, residential care facilities and prisons, (4) Fire investigations, (5) Conflagration management.

Federal Resources and Programs

Program	Hazard	Agency	Contact Information	Type of Assistance
National Earthquake Hazards Reduction Program	Earthquake	FEMA, DOI – USGS, OEM	Oregon Earthquake Program Coordinator, 503-378-2911, ext. 22237	Training, planning and technical assistance under grants to states or local jurisdictions. Technical and planning assistance for activities associated with hazards mitigation. Seismic mapping for U.S.
Water Resources	Flood	US Army Corps of Engineers (ACE), Floodplain Management Services Program (FPMS)	USACE-Portland District, FPMS Special Assistant, P.O. Box 2946, Portland, OR 97208-2946, 503-808-4874, http://www.nwp.usace.army.mil	The purpose of the FPMS is to provide flood plain information to public agencies and private sectors for the reduction of flood damage. The objective is to support comprehensive flood plain management planning with technical services and planning guidance at all appropriate government levels; and to encourage and guide toward prudent use of the Nation's flood plains for the benefit of the national economy and welfare.

Federal Resources and Programs (continued)

Program	Hazard	Agency	Contact Information	Type of Assistance
Aquatic Ecosystem Restoration	Flood	USACE	USACE, Portland District, Planning, Continuing Authorities Program Manager, P.O. Box 2946, Portland, OR 97208-2946, 503-808-4733, http://www.nwp.usace.army.mil/Pm/planning/cap/206/home.asp	Section 206 of the Water Resources Development Act of 1996, provides authority for the Corps to restore aquatic ecosystems. The Corps performs restoration projects in areas that affect water, such as rivers, lakes, and wetlands. They evaluate projects that benefit the environment through restoring, improving, or protecting aquatic habitat for plants, fish and wildlife.
Stream Gauging & Flood Forecasting	Flood	U.S. Geological Survey (USGS) & National Weather Service (NWS)	USGS, Office of Surface Water, 413 National Center, Reston, VA 22092, 703-648-5977 NWS, Office of Hydrology, 1325 East-West Highway, Silver Spring, Maryland 20910, 301-713-0006	NWS is the responsible agent for forecasting weather, issuing storm warnings, displaying weather and flood signals for the benefit of agriculture. The NWS uses many sources of data when developing its flood forecasts, and the USGS is the principal source of data on river depth and flow. The USGS operates and maintains more than 85% of the Nation's stream-gauging stations, which includes 98% of those that are used for real-time river forecasting.
Partners for Fish & Wildlife Program	Flood	U.S. Fish & Wildlife Service (USFWS)	Division of Fish & Wildlife Mgt & Habitat Restoration, 4401 N. Fairfax Dr., Arlington, VA 22203, 703-358-2201	The Service's Partners for Fish and Wildlife program offers technical and financial assistance to private (non-federal) landowners to voluntarily restore wetlands and other fish and wildlife habitats on their land.
Cooperating Technical Partners Program	Flood	Federal Emergency Management Agency (FEMA)	FEMA, Federal Insurance and Mitigation Administration, Hazard Mapping Division, 500 'C' Street SW, Washington, DC 20472 Attn: FEMA G&S Coordinator	An innovative approach to creating partnerships between FEMA and participating NFIP communities, regional agencies, and state agencies that have the interest and capability to become more active participants in the FEMA Flood Hazard Mapping Program.

Federal Resources and Programs (continued)

Program	Hazard	Agency	Contact Information	Type of Assistance
Wetlands Program Development Grants	Flood	Environmental Protection Agency (EPA)	US EPA Region 10, 1200 Sixth Avenue, Seattle, WA, 98101, 206-553-6219, kulman.david@epa.gov	Provides eligible applicants an opportunity to conduct projects that promote the coordination and acceleration of research, investigations, experiments, training, demonstrations, surveys, and studies relating to the causes, effects, extent, prevention, reduction, and elimination of water pollution.
Clean Water Act TMDL Mini Grants	Flood	EPA	EPA-Office of Water/Office of Wetlands, Oceans and Watersheds, Assessment and Watershed Protection Division/Watershed Branch, 401 M Street SW (4503F), Washington, DC 20460, 202-260-7074	The mini-grants provide narrowly defined grants of \$5,000 to \$15,000 to regions/states/tribes for undertaking TMDL development on high priority watersheds using a holistic watershed approach. Mini-grants also are often oriented toward innovative or progressive uses of the TMDL concept that may become routine in future TMDLs
Mitigation Grant Programs	Flood	FEMA	FEMA Region X, 130 – 228 th St. SW, Bothell, WA, 98021, www.fema.gov	Funding for the program is provided through the National Pre-Disaster Mitigation Fund to assist States and local governments (to include Indian Tribal governments) in implementing cost-effective hazard mitigation activities that complement a comprehensive mitigation program. All Applicants and sub-applicants must be participating in the National Flood Insurance Program (NFIP)
Flood Hazard Mapping	Flood	FEMA – Map Service Center (MSC)	FEMA – MSC, P.O. Box 1038, Jessup, MD 20794-1038, 1-800-358-9616, FEMA-MSCservice@dhs.gov .	The Map Service Center (MSC) provides Flood Insurance Rate Maps indicating a community's flood hazard areas and the designated flood zone and elevations, if applicable.

Federal Resources and Programs (continued)

Program	Hazard	Agency	Contact Information	Type of Assistance
Watershed Protection & Flood Prevention	Flood	USDA-Natural Resources Conservation Service (NRCS)	NRCS, Financial Assistance Programs Division, National Watershed Program Leader, 14th and Independence Ave., SW Room 6103A-S, Washington, DC 20250, 202-720-8770	NRCS cooperates with states and local agencies to implement soil conservation and other actions including flood prevention; conservation, development, utilization and disposal of water; and conservation and proper utilization of land
Wetlands Reserve Program	Flood	USDA-NRCS	Leslie Deavers, 202-720-1062, http://www.nrcs.usda.gov/programs/farmbill/2002/	Voluntary program offering landowners the opportunity to protect, restore, and enhance wetlands on their property The NRCS provides technical and financial support to help with wetland restoration efforts.
National Dam Safety Program	Flood, Earthquake	FEMA	FEMA Region X, 130 – 228 th St. SW, Bothell, WA, 98021, www.fema.gov	Addresses safety and security for dams through the coordination by FEMA of federal programs and initiatives for dams and the transfer of federal best practices in dam security to the states.
Volcano Hazards Program	Volcanic Eruptions	DOI-USGS	U.S. DOI, U.S.G.S., Menlo Park, California, vhpweb@usgs.gov , http://volcanoes.usgs.gov/ ,	Volcano hazard warnings and operation of five volcano observatories to monitor and assess volcano hazard risk.
Wildfire Mitigation	Wildfire	U.S. Fire Administration	U.S.F.A., 16825 South Seton Avenue, Emmitsburg, MD 21727, 301-447-1000 http://www.usfa.fema.gov/index.shtm	The mission of the USFA is to reduce life and economic losses due to fire and related emergencies, through leadership, advocacy, coordination, and support. USFA serves independently, in coordination with other Federal agencies, and in partnership with fire protection and emergency service communities. The USFA provides public education, training, technology and data initiatives

Federal Resources and Programs (continued)

Program	Hazard	Agency	Contact Information	Type of Assistance
National Wildland /Urban Interface (WUI) Fire Program	Wildfire	National Fire Protection Association (NFPA)	National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101	The National WUI Fire Program is a long-term commitment to a simple vision and mission: VISION: Wildland fires can occur in areas of residential development without the occurrence of disastrous loss. MISSION: To promote community-wide responsibility in the use of technology, policy and practices that minimize the loss of life and property to wildland fire independent of fire fighting efforts
Environmental Stewardship	Multi-Hazard	National Oceanic & Atmospheric Administration (NOAA)	Office of Policy and Strategic Planning, NOAA, Room 5805, Herbert C. Hoover Building, 14th & Constitution Avenue N.W., Washington, D.C. 20230, 202-482-5916, Strategic Plan@PSP@NOAA	NOAA's mission is to describe and predict changes in the Earth's environment, and conserve and manage wisely the nation's coastal and marine resources to ensure sustainable economic opportunities. Through strategic planning, NOAA evaluates how best to accomplish this mission.
Climate Information	Multi-Hazard	National Weather Service (NWS)	NWS, Western Region Headquarters, 125 South State Street, Salt Lake City, UT 84103, http://www.wrh.noaa.gov/	NWS provides weather, hydrologic, and climate forecasts and warnings for the U.S., its territories, adjacent waters and ocean areas, for the protection of life and property and the enhancement of the national economy.
Disaster Mitigation Planning	Multi-Hazard	Economic Development Administration (EDA)	Disaster Mitigation Planning, Technical Assistance, Economic Recovery Grants, EDA Disaster Recovery Coordinator 202- 482-6225	EDA addresses the economic dislocations caused by major catastrophic natural disasters by providing post-disaster program assistance for long-term economic recovery to impacted communities in areas eligible under a Presidential disaster declaration. EDA provides grants for planning, technical assistance, revolving loan funds and infrastructure to support long-term recovery and mitigation activities of communities to help accelerate recovery and insulate the local economy from the impacts of future disasters in hazard-prone areas

Federal Resources and Programs (continued)

Program	Hazard	Agency	Contact Information	Type of Assistance
Indian Housing Assistance	Multi-Hazard	U.S. Housing & Urban Development (HUD)	Office of Public & Indian Housing (PID), HUD, 451 7th Street S.W., Washington, DC 20410, 202-708-1112	The Office of PIH ensures safe, decent, and affordable housing, creates opportunities for residents' self-sufficiency and economic independence, and assures the fiscal integrity of all program participants.
Land Acquisition	Multi-Hazard	USFWS	USFWS, Division of Realty, 703-358-1713, realty@fws.gov	Acquires or purchased easements on high-quality lands and waters for inclusion into the National Wildlife Refuge System.
Federal Lands to Parks	Multi-Hazard	National Parks Service (NPS)	Federal Lands to Parks, Pacific West Region, NPS, 1111 Jackson St., Suite 700, Oakland, CA 94607, 510-817-1445, nps_flpwest@nps.gov , http://www.ncrc.nps.gov/flp/flp_contact.html	Identifies, assesses, and transfers surplus Federal lands to communities for state and local parks and recreation, such as open space.
National Mapping Program	Multi-Hazard	U.S. Geological Survey	Earth Science Information Center, USGS, 1-888-275-8747, ask@usgs.gov , http://geography.usgs.gov/standards/	Makes available maps, imagery, spatial data, remotely sensed data, and related information; and distributes maps of the National Atlas. It coordinates Federal topographic mapping and digital cartographic activities.
Emergency Management Institute	Multi-Hazard	FEMA	FEMA Region X, 130 – 228 th St. SW, Bothell, WA, 98021, www.fema.gov	EMI serves as the national focal point for development and delivery of emergency management training to enhance the capabilities of federal, state, local, and tribal governments, volunteer organizations, and public/private sectors to minimize the impact of disasters on the American public.

Federal Resources and Programs (continued)

Program	Hazard	Agency	Contact Information	Type of Assistance
Hazard Mitigation Grant Program (HMGP)	Multi-Hazard	FEMA	FEMA Region X, 130 – 228 th St. SW, Bothell, WA, 98021, www.fema.gov	HMGP provides grants to States and local governments to implement long-term hazard mitigation measures after a major disaster declaration.
Public Assistance Program	Multi-Hazard	FEMA	FEMA Region X, 130 – 228 th St. SW, Bothell, WA, 98021, www.fema.gov	Disaster aid to repair, replace, or supplement parts of a community's infrastructure
Disaster Recovery Assistance	Multi-Hazard	HUD – Community Planning & Development	Portland Field Office, 400 S.W. Sixth Avenue, Suite 700, Portland, OR 97204-1632, 503-326-2561	Provides critical housing and community development resources to aid disaster recovery, including mortgage assistance.
HOME Investment Partnerships Program	Multi-Hazard	HUD - Community Planning & Development	Office of Affordable Housing Programs, 1-800-998-9999, www.hud.gov/progdesc/cpdindx.html	Provides funds to states and local governments for permanent and transitional housing acquisition, rehabilitation, new construction, and rental-based tenant assistance for low-income households
Community Development Block Grant - Small Cities and Insular Areas Program	Multi-Hazard	HUD, Oregon Economic & Community Development Department (OECDD)	Community Planning & Development Specialist, State & Small Cities Division, Office of Block Grant Assistance, Office of Community Planning & Development, Room 7184, HUD, 451 Seventh Street, SW., Washington, DC 20410-7000, 202-708-1322	Through the CDBG program, HUD allocates funds by formula among eligible state and local governments, and also makes funds available to insular areas, for activities which principally benefit low- and moderate-income persons, aid in the elimination of slums or blighting conditions, or meet other community development needs having a particular urgency.

Federal Resources and Programs (continued)

Program	Hazard	Agency	Contact Information	Type of Assistance
Emergency Conservation Program	Multi-Hazard	USDA - Farm Service Agency (FSA)	USDA FSA Service Center, Marion County FSA 3867 Wolverine St NE, Salem, OR 97305-4266, 503-399-5741, http://disaster.fsa.usda.gov/ecp.htm	Provides emergency funding and technical assistance for farmers and ranchers to rehabilitate farmland damaged by natural disasters and for carrying out emergency water conservation measures in periods of severe drought.
Disaster Loan Programs	Multi-Hazard	U.S. Small Business Administration (SBA)	SBA, Disaster Area 4 Office, P. O. Box 419004, Sacramento, CA 95841-9004, 1-800-488-5323, http://www.sba.gov/disaster_recov/loaninfo/dloanassit.html	SBA s disaster loans are the primary form of Federal assistance for non-farm, private sector disaster losses. Disaster loans from SBA help homeowners, renters, businesses of all sizes, and nonprofit organizations fund rebuilding.
Environmental Quality Incentives Program	Multi-Hazard	USDA-NRCS	Marion County NRCS 3867 Wolverine St NE, Salem, OR 97305-4266, 503-399-5741, www.or.nrcs.usda.gov/contact/marion.html	Technical, education, and limited financial assistance to encourage environmental enhancement.
Soil Survey	Multi-Hazard	USDA-NRCS	Marion County NRCS 3867 Wolverine St NE, Salem, OR 97305-4266, 503-399-5741, www.or.nrcs.usda.gov/contact/marion.html	Maintains soil surveys of counties or other areas to assist with farming, conservation, mitigation or related purposes.

Federal Resources and Programs (continued)

Program	Hazard	Agency	Contact Information	Type of Assistance
Emergency Watershed Protection	Multi-Hazard	USDA-NRCS	Marion County NRCS 3867 Wolverine St NE, Salem, OR 97305-4266, 503-399-5741, www.or.nrcs.usda.gov/contact/marion.html	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 hazards.
Land Protection	Multi-Hazard	USDA-NRCS	Marion County NRCS 3867 Wolverine St NE, Salem, OR 97305-4266, 503-399-5741, www.or.nrcs.usda.gov/contact/marion.html	Technical assistance for runoff retardation and soil erosion prevention to reduce hazards to life and property.
Rural Development Disaster Assistance	Multi-Hazard	USDA Rural Development	1201 NE Lloyd Blvd., Suite 801, Portland, OR, 97232, 503-414-3300 or 1-866-923-5626, http://www.senate.gov/cgi-bin/exitmsg?url=http://www.rurdev.usda.gov	Rural Development helps borrowers who are victims of a disaster to recover from the financial hardship, to minimize the potential delinquency or liquidation, and to protect the Government's interest. Rural Development can consider the servicing options available to assist the affected borrower, i.e. repayment moratorium. Housing programs available in rural areas with a population of 10,000 or less.
Emergency Preparedness	Multi-Hazard	U.S. Department of Homeland Security, FEMA, Response Division, Operations Branch	National Disaster Medical System (NDMS), http://ndms.dhhs.gov/index.html	NDMS is responsible for supporting Federal agencies in the management and coordination of the Federal medical response to major emergencies and Federally declared disasters

Additional Resources and Programs

Program	Hazard	Agency	Contact Information	Type of Assistance
Business Education & Resources	Multi-Hazard	Institute for Business & Home Safety (IBHS)	IBHS, 1408 N. Westshore Blvd, Suite 208, Tampa, FL, 33607, 813-286-3400, www.ibhs.org/ibhs2	The IBHS is a nonprofit association that engages in communication, education, engineering and research. Their mission is to reduce deaths, injuries, property damage, economic losses and human suffering caused by natural disasters.
Insurance Information	Multi-Hazard	Insurance Information Service of Oregon and Idaho (IISOI)	IISOI, 503-241-1757 or 1-800-457-8713, iisoi@teleport.com	IISOI is a non-profit consumer education/communications organization supported by the property-casualty insurance industry in Oregon & Idaho. Its primary purpose is to explain the function and services of the insurance industry, to inform the public of the many factors that regulate the cost of the protection they buy, and to improve relations with the public through a well-planned consumer education program
Risk Management	Multi-Hazard	Public Entity Risk Institute (PERI)	Public Risk Management Association, 1815 N. Fort Myer Drive, Suite 1020 Arlington, VA 22209, 703-528-770, 1info@primacentral.org	PERI serves the risk management needs of local governments, small businesses, and small nonprofit entities.
Contingency Planning	Multi-Hazard	Association of Contingency Planners (Business Emergency Planning)	ACP_Membership@techenterprises.net , http://www.acp-international.com/	Association of Contingency Planners is a non-profit association that fosters continued professional growth and development in effective contingency and business planning. Contingency planning is a required element for successful business and government emergency management agencies to address mitigation, response and recovery planning issues.

Additional Resources and Programs (continued)

Program	Hazard	Agency	Contact Information	Type of Assistance
Planning for Landslides	Landslide	American Planning Association (APA)	Principal Investigator, Landslides Project, Research Department, APA, 122 South Michigan Ave., Suite 1600, Chicago, IL 60603, 312-431-9100, landslides@planning.org , http://www.planning.org/landslides/	APA's research department's program brings together solutions from multiple disciplines into a single source. It helps serve local planning efforts in identifying landslide hazards early in the planning process to minimize exposure to landslide risks.
Landslide Mitigation	Landslide	Washington Department of Ecology	Department of Ecology, P.O. Box 47600, Olympia, WA 98504, http://www.ecy.wa.gov/programs/sea/landslides/	Department of Ecology's landslides Website contains tips for reducing risk, warning signs, and maps.
Emergency Prevention, Preparedness & Response	Multi-Hazard	American Red Cross	ARC – Oregon Trail Chapter, P.O. Box 3200, Portland, OR 97208, 503-284-1234, infor@redcross-pdx.org , http://www.redcross-pdx.org	The Oregon Trail Chapter serves Portland Metro counties and Yamhill County. Services provided by the American Red Cross include emergency assistance, disaster relief, and health and safety courses.
Emergency Manager Certification	Multi-Hazard	International Association of Emergency Managers	http://www.iaem.com/	IAEM is a non-profit educational organization dedicated to promoting the goals of saving lives and protecting property during emergencies and disasters.
Emergency Management Information & Assistance	Multi-Hazard	National Emergency Management Association (NEMA)	NEMA, P.O. Box 11910, Lexington, KY 40578, 859-244-8000, http://www.nemaweb.org/index.cfm	NEMA provides national leadership and expertise in comprehensive emergency management.
Voluntary Organizations Pre-Disaster Coordination	Multi-Hazard	National Voluntary Organizations Active in Disasters	NVOAD, PO Box 151973, Alexandria, VA 22315, 703.339.5596 http://www.nvoad.org/	NVOAD coordinates planning efforts by many voluntary organizations responding to disaster. Member organizations provide more effective and less duplicative service by getting together before disasters strike.

Appendix B:

Public Participation Process

Public participation is vital to the value, effectiveness, and usefulness of any plan. To produce a plan that fits the needs of Yamhill County agencies, businesses, and residents, Yamhill County engaged the public in three primary ways. A steering committee comprised of individuals representing different Yamhill County departments worked together to produce the plan. The plan's project managers conducted stakeholder interviews to target the specialized knowledge of individuals whose work may be affected by natural hazards and whose work deals with natural hazards on a regular basis. The project managers held a community open house to inform the public about natural hazards that occur in Yamhill County and to identify potential hazard mitigation strategies.

Steering Committee

The Steering Committee was the guiding force behind the Natural Hazards Mitigation Plan. The knowledge and background information provided by this committee laid a foundation and structure for the project. The steering committee assisted the project managers with major decisions including goal setting and identifying pertinent action items.

Methodology

Steering Committee members possessed familiarity with the Yamhill County community and how it is affected by natural hazard events. The steering committee guided the plan through several steps including goal formation, action item development, stakeholder identification, and information sharing to make the plan as comprehensive as possible. The steering committee met on the following dates:

- September 20, 2004
- October 18, 2004
- December 6, 2004
- January 10, 2005
- January 31, 2005
- February 22, 2005
- March 14, 2005

The steering committee formed under the guidance of Bob Maca, Yamhill County Emergency Management Coordinator, with input from Mark Fancey, the plan’s project manager. The steering committee invested considerable time into the plan. Members of the steering committee include:

Yamhill County Steering Committee

Name	Organization
Fancey, Mark	Project Manager, MWVCOG
Ingram Moore, Judith	Project Manager, MWVCOG
Bender, Dean	Polk County Emergency Manager
Brandt, Mike	Yamhill County Planning Director
Caputo, John	Yamhill County GIS Analyst
Friday, Ken	Yamhill County Planning Division Manager
George, Kathy	Yamhill County Commissioner
Gille, Bill	Yamhill County Public Works Director
Johnson, Chris	Yamhill County Public Health & Human Services
Krawczyk, John	Yamhill County Administrator
Lewis, Leslie	Yamhill County Commissioner
Lilly, Jay	McMinnville Fire Department Chief
Maca, Bob	Yamhill County Emergency Management Coordinator

Stakeholder Interviews

The second form of public participation was stakeholder interviews. The interviews offered alternative ways for Yamhill County residents and interested groups and organizations to participate in the plan’s development. The project managers telephoned and interviewed individuals who possess knowledge of natural hazards issues in Yamhill County. These individuals provide insight into the various natural hazard events that occur in Yamhill County, what factors make a given hazard particularly damaging, which mitigation activities are already established, which activities proved successful in the past, and what future actions might work well to lessen the impacts of natural hazards events on the county.

Methodology

The project managers conducted stakeholder interviews from September 2004 through April 2005. The project managers telephoned the stakeholders and asked a series of standard questions. The questions are as follows:

1. How have natural hazards affected your organization historically?
2. What issues regarding natural hazards may you confront in the future?
3. Is your facility designed to withstand damages from natural hazards (i.e. is the building in a floodplain, does it meet seismic standards, etc.)
4. Has your organization ever been involved in natural hazard mitigation projects?
5. What types of mitigation activities would assist in reducing risk and preventing loss from future natural hazard events?
6. How can your organization contribute to regional coordination to reduce risk from natural hazards?
 - a. Does your organization have facilities that could be used as shelter sites? Do you have the necessary safety equipment to support community members during a disaster (generator, etc.)?
 - b. Do you conduct public outreach programs?
 - c. Are there any partnership opportunities for implementing mitigation projects that would benefit your organization as well as the community as a whole?
7. Which hazards do you (your organization) feel vulnerable to and why?

The project managers compiled the information received from these interviews into various sections of the plan, particularly each of the hazard-specific sections. Paper copies of the interview outcomes were compiled into a standard form and are available by contacting:

Mid-Willamette Valley Council of Governments
105 High Street SE
Salem, OR 97301-3667
tel: 503-588-6177
fax: 503-588-6094
email: jingram@mwvcog.org

Note: The information recorded in the stakeholder interviews was memorialized by the plan's project managers as accurately as possible. The Mid-Willamette Valley Council of Governments makes no

representations, express or implied, as to the accuracy of the information. This information is provided with the understanding that it is not guaranteed to be correct or complete, and conclusions drawn from such information are the sole responsibility of the reader.

Yamhill County Natural Hazards Mitigation Plan Stakeholders

Last Name	First Name	Agency/Affiliation
Anderson	David	Fish Biologist, Boise Cascade
Bauer	Gary	Government Relations, Northwest Natural
Beckner	Bob	Newberg High School
Bennett	Jim	Manager, City of Newberg
Brierly	Barton	Director, Planning & Building Division, City of Newberg
Buchanan	Hugh	Safety Coordinator, Weyerhaeuser
Bunch	Allen	Risk Management, Chemeketa Community College
Disch	Donna	Office of State Fire Marshall
Durfee	Roy	Principal, Carlton Elementary School
Eddings	Chuck	Chief, West Valley RFPD
Eichorn	Ernie	Chemawa District, BPA
Foote	Eve	Administrator, City of Dundee
Ford	Dave	Manager, Portland General Electric
Holstein	Bill	Chief, Sheridan RFPD
Horner	David	Director, Business Services, McMinnville School District
Howard	Richard	Public Works Superintendent, City of Yamhill
Hubbard	Bruce	Chief, Amity RFPD
Jensen	Brian	Chief, Yamhill Fire Protection District
Johnston	Doris	Regional Community Manager, Pacific Power
Lucich	Terry	Chief, Lafayette and Carlton Fire Districts
Montague	Ellen	Communications, Willamette Education Service District
Nepstad	Jeff	Natural Resources Division, Confederated Tribes of the Grand Ronde
Palmer	Rick	Maintenance Director, Dayton School District
Plett	John	Campus Director, Chemeketa Community College – McMinnville Campus
Putnam	Bret	Chief, Dayton RFPD
Sheahan	Jamie	Watershed Coordinator, Yamhill Basin Council
Shepard	Rod	Harvesting Unit Manager, Boise Cascade
Sherman	Michael	Chief, Newberg Fire Department
Skedder	Dan	George Fox University
Stieber	Tim	District Manager, Yamhill SWCD

Stakeholders (continued)

Last Name	First Name	Agency/Affiliation
Stock	John	Chief, Dundee Fire Department
Timmons	Eric	Park Manager, Willamette Mission State Park District
Walker	Ann	Coordinator, National Fire Plan, ODF

Community Open House

The third method of public participation was a community open house. The general public as well as all of the county's stakeholders was invited to participate by addressing concerns relating to natural hazards, and discussing ideas for mitigation strategies. Through involvement from the community, the plan receives greater community support and can then more specifically fit the needs of Yamhill County residents.

Methodology

The community open house was held on April 20, 2005. The open house was advertised through public announcements sent to local newspapers and radio stations. One local radio spot was aired on Salem's only FM station. Flyers were posted in fire departments, libraries, and school districts. Flyers and a newsletter were sent to government agencies and other interested groups. Personal invitations were sent to stakeholders.

Appendix C:

Economic Analysis of Natural Hazard Mitigation Projects

This appendix outlines three approaches for conducting economic analysis 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 *State Hazard Mitigation Plan*, created by the Interagency Hazards Mitigation Team (Oregon State Police – Office of Emergency Management, 2000); and FEMA Publication 331, *Report on Costs and Benefits of Natural Hazard Mitigation*.

This appendix is not intended to provide a comprehensive description of benefit/cost analysis, nor is it intended to provide the details of economic analysis methods that can be used to evaluate local projects. This appendix is intended to raise benefit/cost analysis as an important issue and to provide some background on how economic analysis can be used to evaluate mitigation projects.

Why Evaluate Mitigation Strategies?

Mitigation activities reduce the cost of disasters by minimizing property damage, injuries, and the potential for loss of life, and reduce emergency response costs. Evaluating natural hazard mitigation 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, influenced by many variables. Natural disasters affect entire communities – its individuals, businesses, and essential services such as fire, police, and utilities. While some of the direct and indirect costs of disaster damages are quantifiable, some costs are not monetary and cannot be quantified in dollars. Negative impacts of events with no true monetary value can undulate throughout the community, increasing the disaster's social and economic consequences.

While not easily accomplished, assessing the positive and negative impacts from mitigation activities and obtaining an instructive cost/benefit analysis holds value from a public policy perspective. If such assessment and analysis were not completed, then it is more

difficult to achieve an objective understanding of the reasons to pursue various mitigation options.

What Are Some Economic Analysis Approaches for Mitigation Strategies?

The approaches used to identify the benefits and costs associated with natural hazards mitigation strategies or actions fall into three general categories: benefit/cost analysis, cost-effectiveness analysis, and the STAPLE/E approach. The distinction between the three methods is how relative costs and benefits are measured. In addition, there are varying approaches to assessing the value of mitigation for public sector and private sector activities.

Benefit/Cost Analysis

Benefit/cost analysis is a key mechanism used by the Oregon Office of Emergency Management (OEM), the Federal Emergency Management Agency (FEMA), and other state and federal agencies in evaluating hazard mitigation projects. The Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 93-288 requires benefit/cost analysis, 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: (1) the frequency and severity of a hazard, (2) avoided future damages, and (3) 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. For example, if net benefits exceed net costs, then the project is worth pursuing. A project must have a benefit/cost ratio greater than 1 in order to be funded.

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, does not necessarily measure costs and benefits in terms of dollars. Determining the economic feasibility of mitigating natural hazards can be organized according to the perspective of persons or entities with an economic interest in the outcome. 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, which potentially means the benefits and costs to a large number of people and economic

entities. As previously stated, 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 that involve a diverse set of beneficiaries and non-market benefits.

Investing in Private Sector Mitigation Activities

Private sector mitigation activities tend to occur based on one of two approaches. The activity may be mandated by a regulation or standard, or it may be economically justified on its own merits. A building or land owner, 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. Real estate disclosure laws require sellers of real property to disclose to prospective purchasers known defects and deficiencies in the property, including structural weaknesses and hazards. Correcting deficiencies can be expensive and time consuming, but such deficiencies can prevent the sale of the property. The buyer and seller can negotiate conditions of the sale and price due to known defects and deficiencies in the property.

STAPLE/E Approach

Conducting detailed benefit/cost or cost-effectiveness analysis for every possible mitigation activity could be very time consuming and may not be practical. There are alternative approaches for conducting a swift evaluation of the proposed mitigation activities to identify mitigation activities that merit a more detailed assessment. One of these methods is the STAPLE/E Approach.

Using STAPLE/E criteria, steering committees can quickly and systematically evaluate mitigation activities. These criteria require the committee to assess the mitigation activities based on Social, Technical, Administrative, Political, Legal, Economic, and Environmental (STAPLE/E) constraints and opportunities of implementing the particular mitigation item in the 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 Local Natural Hazard Mitigation Plans: An Evaluation Process" outline some specific considerations in analyzing each aspect. The following are

suggestions for how to examine each element of the STAPLE/E Approach from the “State of Oregon Local Natural Hazard Mitigation Plans: An Evaluation Process.”

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

- Is the proposed action socially acceptable to the community?
- Are there equity issues involved that would result in one segment of the community being treated unfairly?
- Would the action cause social disruption?

Technical: The city or county public works staff and building department staff can help answer the following questions:

- Would the proposed action work?
- Would the proposed action create more problems than it solves?
- Does the proposed action solve a problem or only a symptom of the problem?
- Is the proposed action the most useful action in light of other community goals?

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

- Could 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 on-going administrative requirements that must be met?

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

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

Legal: Include legal counsel, land use planners, risk managers, and city council or county board of commission members, among others, in answering the following questions:

- 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 county assessor's office can help answer the following questions:

- What are the costs and benefits of this action?
- Do the benefits exceed the costs?
- Are initial, maintenance, and administrative costs considered?
- 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.)

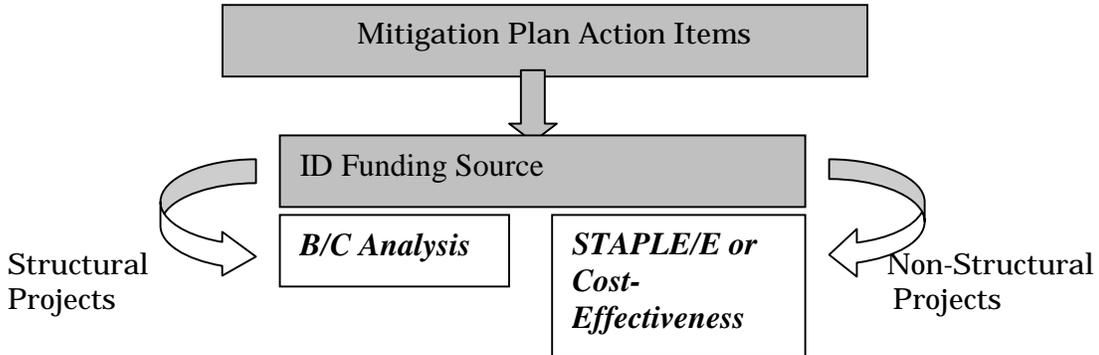
Environmental: Watershed councils, environmental groups, land use planners and natural resource managers can help answer the following questions:

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

The STAPLE/E approach is helpful for conducting a swift analysis of mitigation projects. Most projects that seek federal funding 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.



Implementing the Approaches

Benefit/cost analysis, cost-effectiveness analysis, and the STAPLE/E approach are important tools in evaluating whether or not to implement a mitigation activity. A framework for evaluating alternative mitigation activities is set forth below.

1. Identify the Alternatives

Activities to reduce the 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 accomplish this 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 alternative. Potential economic criteria with which 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 resulting from a project can be difficult. Expected future returns from the mitigation effort depend on the correct specifications of the risk and the effectiveness of the project, which may not be well known. Expected future costs depend on the physical durability and

Estimating the costs and benefits of a hazard mitigation strategy can be a complex process. Employing the services of a specialist can assist in this process.

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 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 be merely the risk-free cost of capital, but it may include the decision maker's time preference and also a risk premium. Consideration should be given for including inflation.

3. Analyze and Rank the Alternatives

Once costs and benefits have been quantified, economic analysis tools can rank the alternatives. Two methods for determining the best alternative 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 less the value of expected future cost expressed in today's dollars. If the net present value is greater than the project 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 cost 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.

How Are Benefits of Mitigation Calculated?

Economic Returns of Natural Hazard Mitigation

Estimating economic returns, which accrue to property 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 such as the following:

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

These factors can be estimated using observed prices, costs, and engineering data. The difficult part is correctly determining 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 would occur. The damages and losses should only include those borne by the owner. The salvage value of the investment could be important in determining economic feasibility. 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 indirect effects, but they can have a very direct effect on the economic value of the owner's property. 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 assets listed above are difficult to estimate and require models that are structured to estimate total economic impacts. Total economic impacts are the sum total of direct and indirect economic impacts. 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. Many communities are looking towards developing multi-objective projects. With this in mind, opportunity arises to develop strategies that integrate natural hazards 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

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

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

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Goettel, Kenneth A., and Gerald L. Horner. *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, Oregon. August 30, 1995.

Goettel, Kenneth A., and Gerald L. Horner. *Benefit/Cost Analysis of Hazard Mitigation Projects Volume V, Earthquakes*. Prepared for FEMA's Hazard Mitigation Branch. October 25, 1995.

Horner, Gerald L. *Benefit/Cost Methodologies for Use in Evaluating the Cost Effectiveness of Proposed Hazard Mitigation Measures*. Prepared for Oregon State Police, Office of Emergency Management. July 1999.

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

VSP Associates, Inc. *A Benefit/Cost Model for the Seismic Rehabilitation of Buildings, Volumes I & 2*. 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*. FEMA Publication Number 255. 1994.

Appendix D:

Driveway Construction Checklist/Inspection Form and Enabling Ordinance 514

This appendix provides information on how the county requires private driveways to be accessible for fire, life and safety vehicles.

- Insert checklist/inspection form
- Insert Ordinance 514

Appendix E:

Acronyms

The Yamhill County Natural Hazards Mitigation Plan uses the following acronyms. Appendix E contains the acronyms and their definitions for clarification purposes.

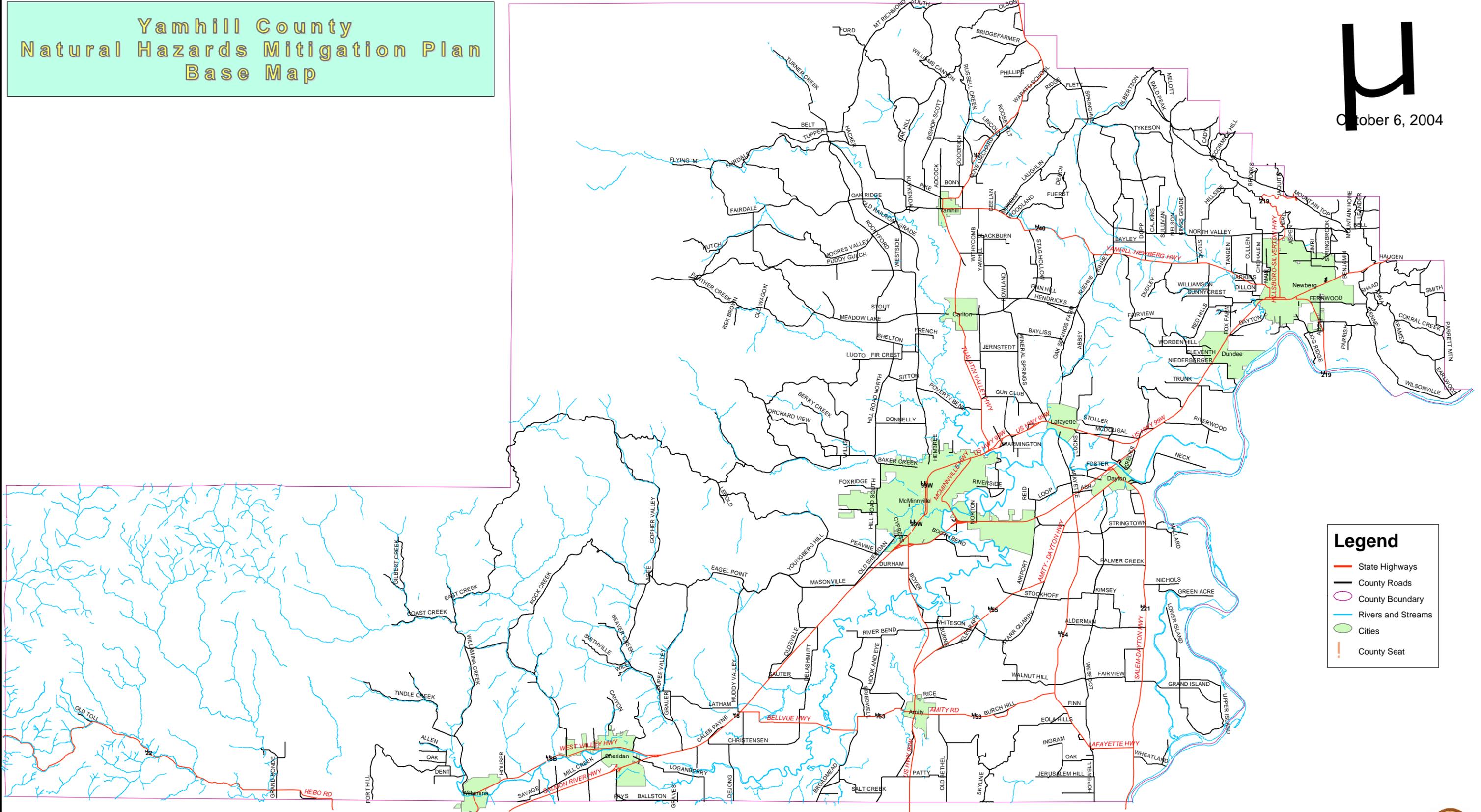
AASHTO	American Association of State Highway & Transportation Officials
AICP	America Institute of Certified Planners
AOC	Association of Oregon Counties
ARC	American Red Cross
ARES	Amateur Radio Emergency Services
BCD	Building Codes Division (Department of Consumer & Business Services – State of Oregon)
BFE	Base Flood Elevation
BLM	Bureau of Land Management (United States)
BPA	Bonneville Power Administration
CDBG	Community Development Block Grant
CERT	Community Emergency Response Team
CFR	Code of Federal Regulations
CPW	Community Planning Workshop
CVO	Cascade Volcano Observatory (USGS)
DCBS	Department of Consumer & Business Services (State of Oregon)
DEQ	Department of Environmental Quality (State of Oregon)
DLCD	Department of Land Conservation & Development (State of Oregon)
DOGAMI	Department of Geology & Mineral Industries (State of Oregon)
DSL	Department of State Lands (State of Oregon)
EDA	Economic Development Administration (United States)
EPA	Environmental Protection Agency (United States)
ESD	Education Services District
FAA	Federal Aviation Administration
FD	Fire Department
FEMA	Federal Emergency Management Agency (United States)
FHWA	Federal Highway Administration (United States)

FIRM	Flood Insurance Rate Map
FSA	Farm Services Agency (United States)
GIHMT	Governors' Interagency Hazard Mitigation Team (State of Oregon)
GIS	Geographic Information System
GNRO	Governor's Natural Resources Office (State of Oregon)
GPS	Global Positioning System
HMGP	Hazard Mitigation Grant Program
HUD	Housing & Urban Development (United States)
IBHS	Institute of Business & Home Safety
IISOI	Insurance & Information Services of Oregon & Idaho
MWVCOG	Mid-Willamette Valley Council of Governments
MWVEDD	Mid-Willamette Valley Economic Development District
NCDC	National Climate Data Center
NFIP	National Floodplain Insurance Program
NFPA	National Fire Protection Association
NHMP	Natural Hazards Mitigation Plan
NIFC	National Interagency Fire Center
NOAA	National Oceanic & Atmospheric Administration (United States)
NRCS	Natural Resources Conservation Service (United States)
NWS	National Weather Service (United States)
OAWU	Oregon Association of Water Utilities
OCS	Oregon Climate Service
ODA	Oregon Department of Agriculture
ODF	Oregon Department of Forestry (State of Oregon)
ODFW	Oregon Department of Fish & Wildlife
ODOT	Oregon Department of Transportation (State of Oregon)
OECD	Oregon Economic & Community Development Department (State of Oregon)
OEM	Office of Emergency Management (Oregon State Police)
OHIRA	Oregon Hazard Identification & Risk Assessment
ORS	Oregon Revised Statutes
OSFM	Oregon State Fire Marshal (Oregon State Police)
OSP	Oregon State Police
OSSPAC	Oregon Seismic Safety Policy Advisory Commission
OSU	Oregon State University

OWEB	Oregon Watershed Enhancement Board
PGE	Portland General Electric
PSU	Portland State University
RFPD	Rural Fire Protection District
SBA	Small Business Administration (SBA)
SEDCOR	Strategic Economic Development Corporation
SHMO	State Hazard Mitigation Officer
SWCD	Soil & Water Conservation District
UGB	Urban Growth Boundary
UO	University of Oregon
URM	Unreinforced Masonry
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USFS	United States Forest Service
USGS	United States Geological Survey
WRD	Water Resources Department (State of Oregon)
WSSPC	Western States Seismic Policy Council

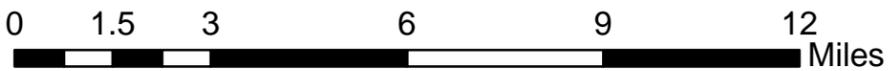
Yamhill County Natural Hazards Mitigation Plan Base Map

October 6, 2004



Legend

- State Highways
- County Roads
- County Boundary
- Rivers and Streams
- Cities
- County Seat



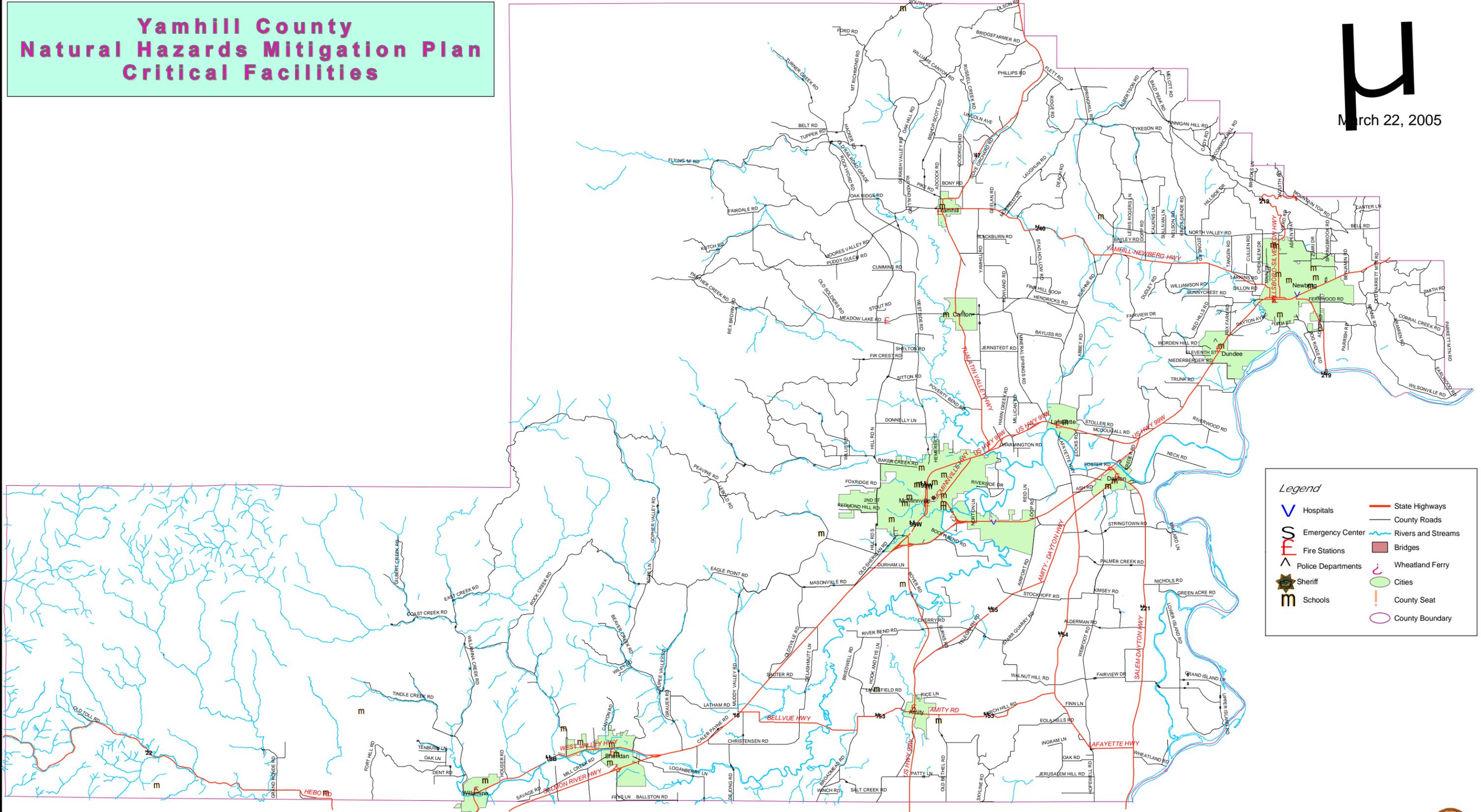
Base Map
Map 1



Prepared by
Yamhill County GIS jpc

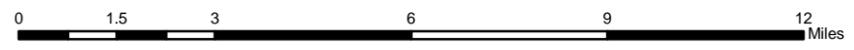
Yamhill County Natural Hazards Mitigation Plan Critical Facilities

Y
March 22, 2005



Legend

	Hospitals		State Highways
	Emergency Center		County Roads
	Fire Stations		Rivers and Streams
	Police Departments		Bridges
	Sheriff		Wheatland Ferry
	Schools		Cities
			County Seat
			County Boundary



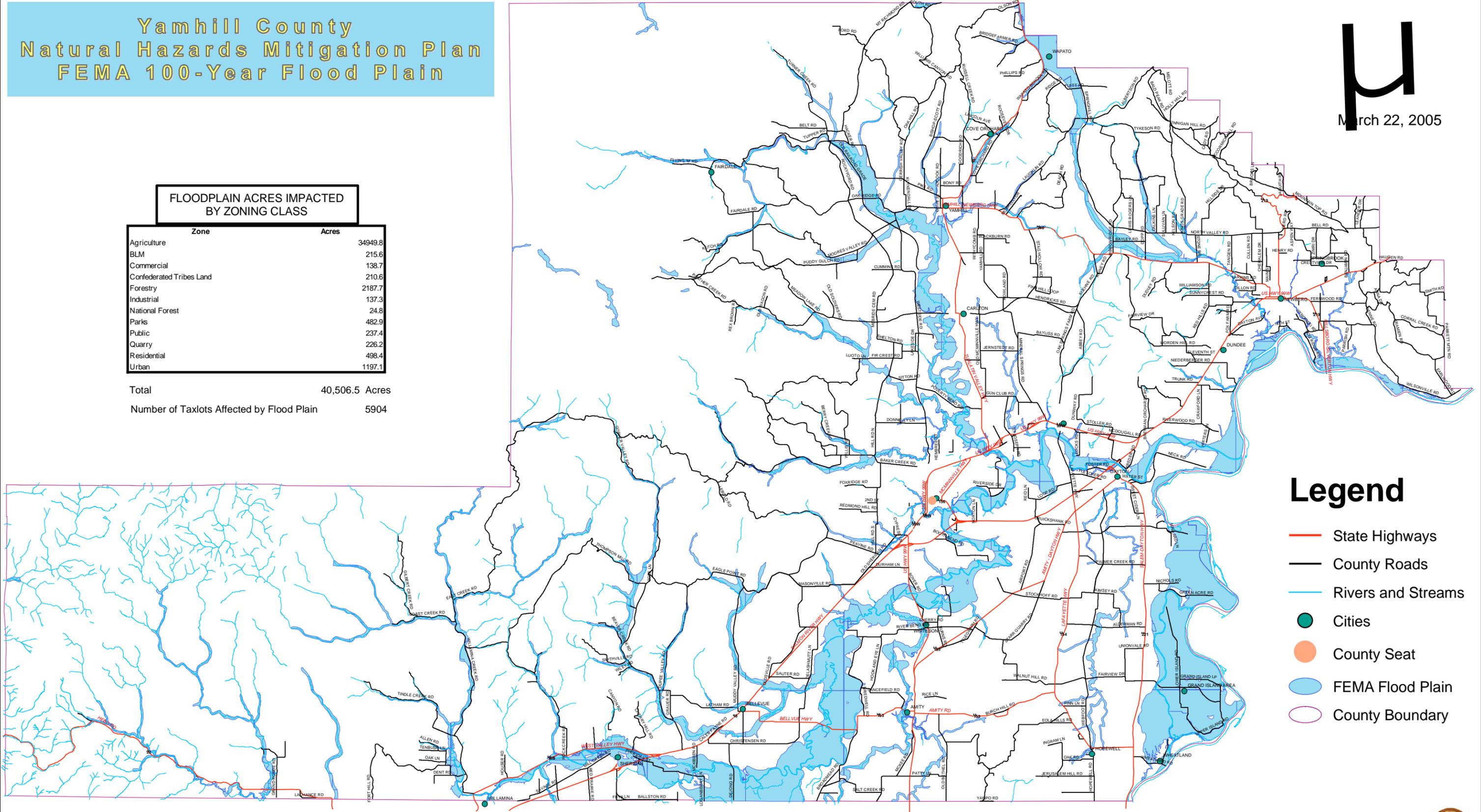
Yamhill County Natural Hazards Mitigation Plan FEMA 100-Year Flood Plain

March 22, 2005

**FLOODPLAIN ACRES IMPACTED
BY ZONING CLASS**

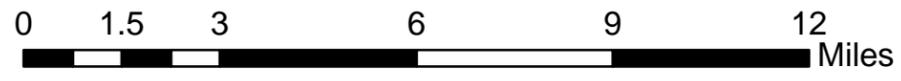
Zone	Acres
Agriculture	34949.8
BLM	215.6
Commercial	138.7
Confederated Tribes Land	210.6
Forestry	2187.7
Industrial	137.3
National Forest	24.8
Parks	482.9
Public	237.4
Quarry	226.2
Residential	498.4
Urban	1197.1

Total 40,506.5 Acres
Number of Taxlots Affected by Flood Plain 5904



Legend

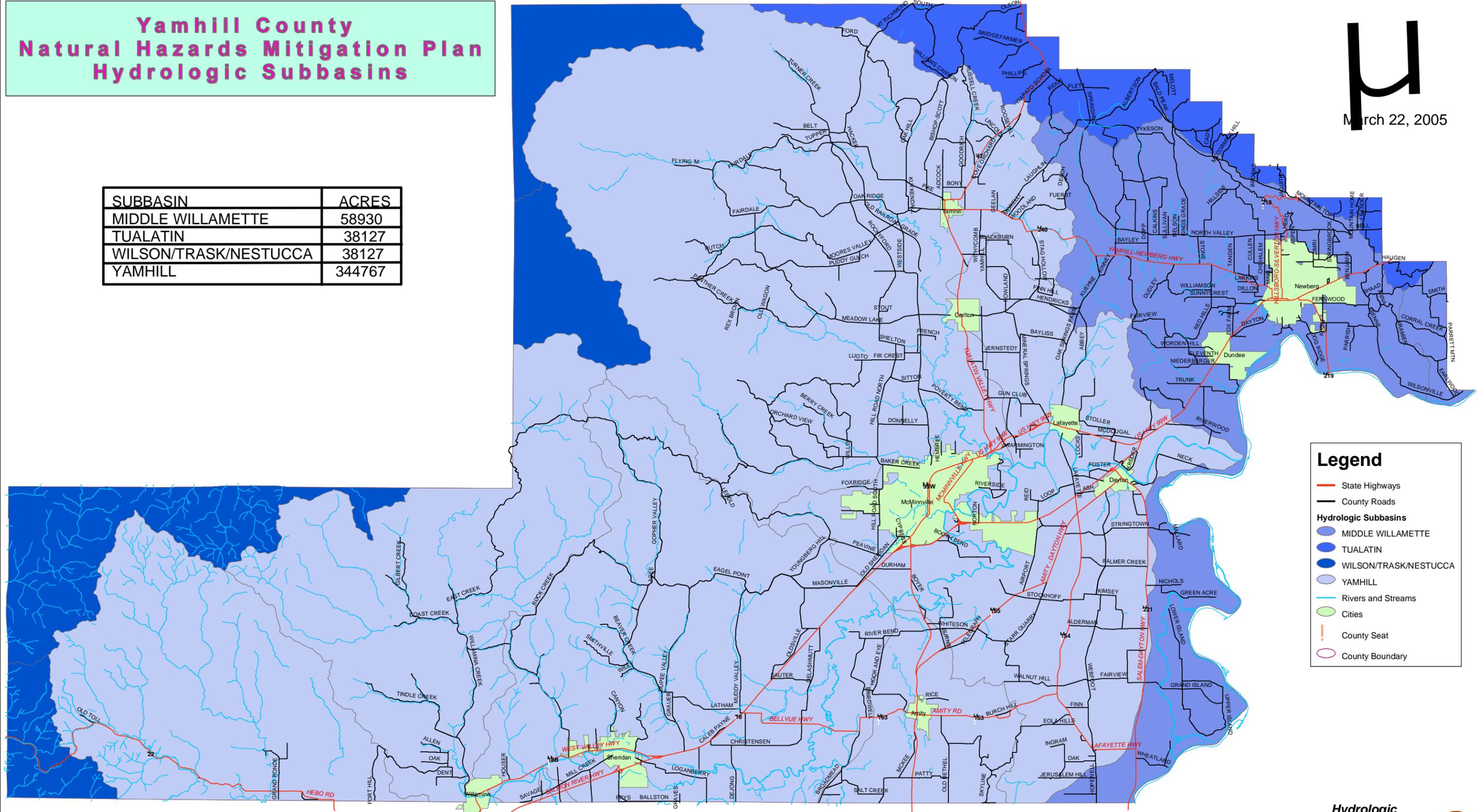
- State Highways
- County Roads
- Rivers and Streams
- Cities
- County Seat
- FEMA Flood Plain
- County Boundary



Yamhill County Natural Hazards Mitigation Plan Hydrologic Subbasins

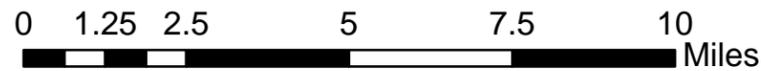

 March 22, 2005

SUBBASIN	ACRES
MIDDLE WILLAMETTE	58930
TUALATIN	38127
WILSON/TRASK/NESTUCCA	38127
YAMHILL	344767



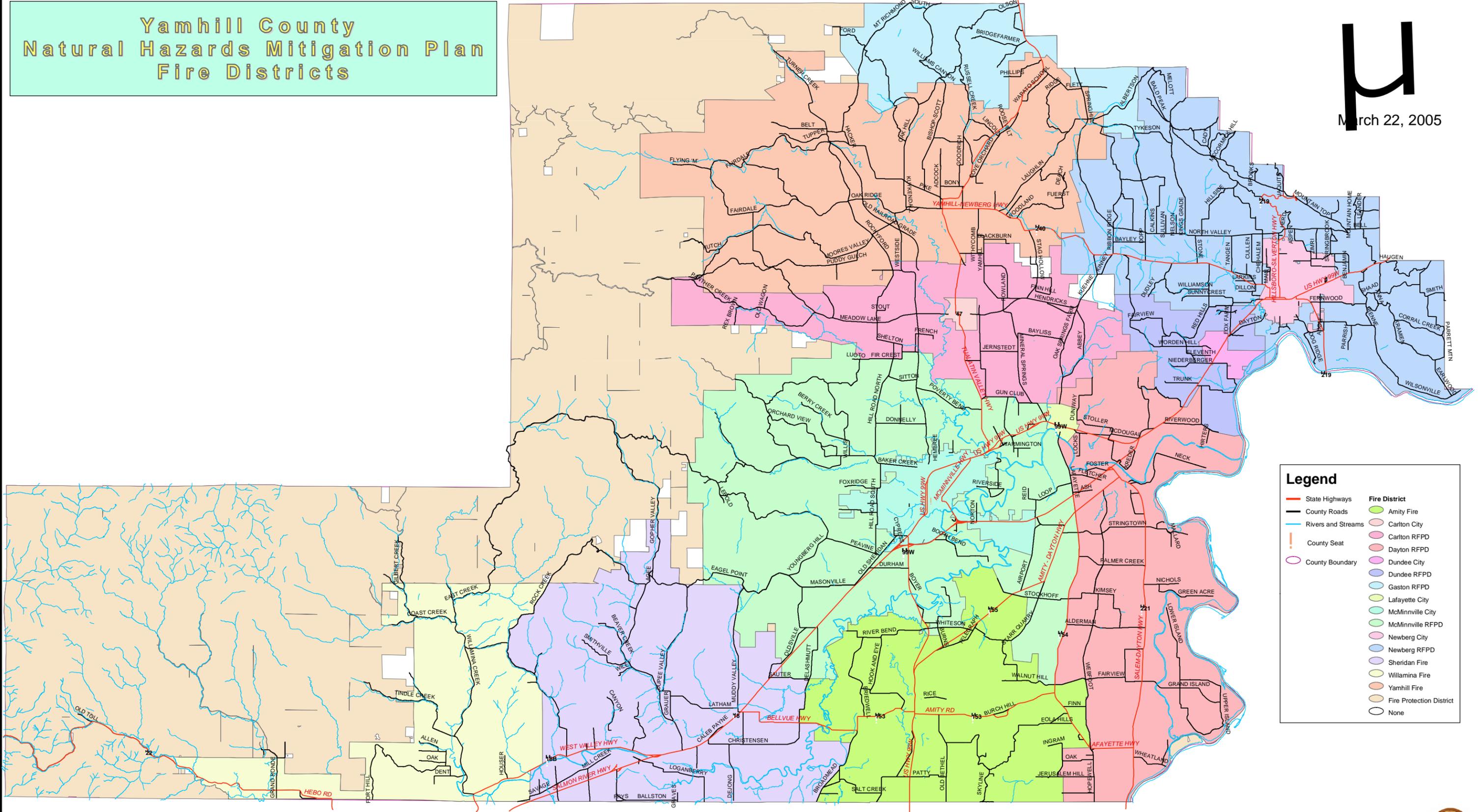
Legend

- State Highways
- County Roads
- Hydrologic Subbasins**
- MIDDLE WILLAMETTE
- TUALATIN
- WILSON/TRASK/NESTUCCA
- YAMHILL
- Rivers and Streams
- Cities
- County Seat
- County Boundary



Yamhill County Natural Hazards Mitigation Plan Fire Districts

March 22, 2005

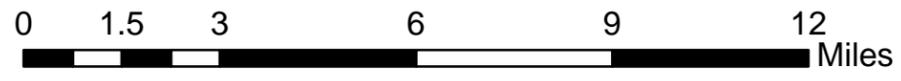


Legend

- State Highways
- County Roads
- Rivers and Streams
- County Seat
- County Boundary

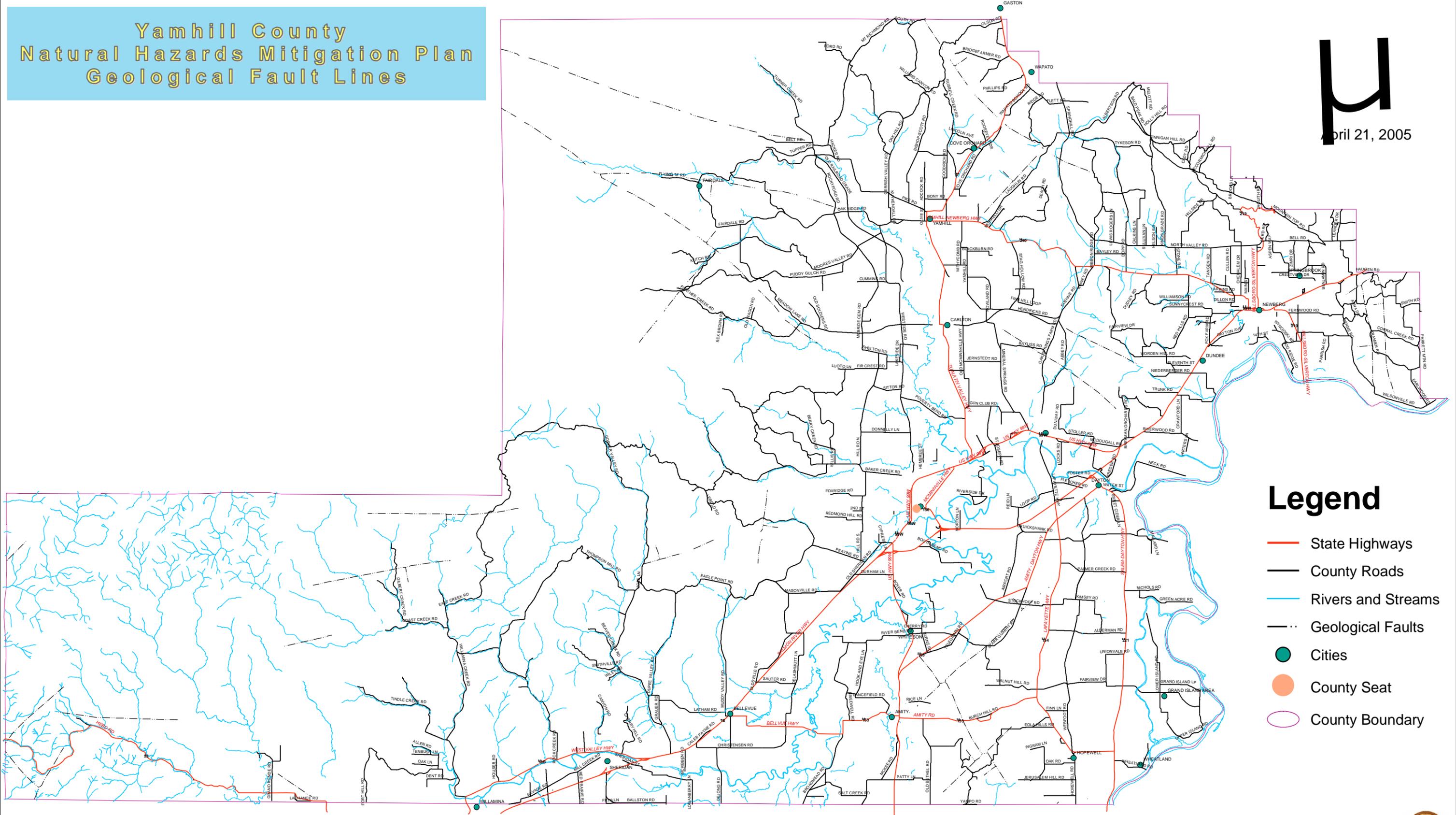
Fire District

- Amity Fire
- Carlton City
- Carlton RFPD
- Dayton RFPD
- Dundee City
- Dundee RFPD
- Gaston RFPD
- Lafayette City
- McMinnville City
- McMinnville RFPD
- Newberg City
- Newberg RFPD
- Sheridan Fire
- Willamina Fire
- Yamhill Fire
- Fire Protection District
- None



Yamhill County Natural Hazards Mitigation Plan Geological Fault Lines

April 21, 2005



Legend

- State Highways
- County Roads
- Rivers and Streams
- - - Geological Faults
- Cities
- County Seat
- County Boundary

