Polk County

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Natural Hazards Mitigation Plan

Adopted Resolution No. 06-03
FEMA Approval
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Acknowledgements

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To Contact Us:

850 Main Street
Dallas, OR 97338
503-623-9237

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BEFORE THE BOARD OF COMMISSIONERS FOR POLK COUNTY, OREGON

In the Matter of Adopting)
The Polk County Natural)
Hazards Mitigation Plan)

RESOLUTION NO. 06-03

WHEREAS, the Federal Emergency Management Agency (FEMA) issued the Disaster Mitigation Act of 2000 to require local governments to develop and complete FEMA-approved natural hazard mitigation plans to be eligible for certain federal assistance programs; and

WHEREAS, natural hazards present a threat to public and private property in Polk County, as well as to the health and safety of the county's residents; and

WHEREAS, to minimize the risk of harm to humans, property, and / or the economy, it is vital to plan for the occurrence of potential natural hazards; and

WHEREAS, Polk County conducted a collaborative planning effort between Polk County residents, public agencies, non-profit organizations, the private sector, and federal, state, and regional organizations; and

WHEREAS, the Polk County Natural Hazards Mitigation Plan addresses seven chronic hazards – flood, landslide, wildfire, severe winter storm, windstorm, drought, and expansive soils, and two catastrophic hazards – earthquakes and volcanic eruptions; and

WHEREAS, Polk County completed a draft of the Natural Hazards Mitigation Plan and that provides a set of strategies and measures the county can pursue to reduce the risk and fiscal loss to the county and its residents from natural hazard events; and

WHEREAS, the 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; and

WHEREAS, Polk County submitted the draft Natural Hazards Mitigation Plan to the Federal Emergency Management Agency and received confirmation that the plan contains the required criteria; and

NOW, THEREFORE, IT IS HEREBY RESOLVED by the Polk County Board of Commissioners:

1. The attached Exhibit "A" is hereby adopted as the Polk County Natural Hazards Mitigation Plan.

Dated: January 18, 2006, at Dallas, Oregon.

POLK COUNTY BOARD OF COMMISSIONERS

Mike Propes, Chair

Ron Dodge, Commissioner

Tom Ritchey, Commissioner

Approved as to Form:

David Doyle
County Counsel

EXHIBIT A

FULL COPY OF THE PLAN ON FILE
IN COMMUNITY DEVELOPMENT

Polk County
Natural Hazards Mitigation Plan

Report for:
Polk County
Community Development
Department
850 Main Street
Dallas, OR 97338

Prepared by:
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ONHW Oregon Natural Hazards Workgroup

January 6, 2006

060077

Polk County

Natural Hazards Mitigation Action Plan

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U.S. Department of Homeland Security
Region X
130 228th Street, SW
Bothell, WA 98021-9796

FEMA

February 15, 2006

Honorable Mike Propes
Polk County Board of Commissioners
850 Main Street
Dallas, Oregon 97338

Dear Chairman Propes:

The U.S. Department of Homeland Security's Federal Emergency Management Agency (FEMA) has approved the ***Polk County Natural Hazards Mitigation Plan*** as a local plan as outlined in 44 CFR Part 201. Polk County is now eligible to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act's hazard mitigation project grants through February 15, 2011.

The plan's approval provides eligibility to apply for mitigation project grants and does not indicate eligibility of the specific action identified within the plan for FEMA grant funding. Project grant applications will be evaluated individually by your state and FEMA according to the specific eligibility and other requirements of the particular hazard mitigation grant program. For example, a mitigation project identified in the approved plan may or may not meet the eligibility requirements for Hazard Mitigation Grant Program funding.

Over the next five years, we encourage your community to identify additional mitigation actions and follow the plan's schedule for monitoring and updating the plan. The plan must be reviewed, revised as appropriate, and resubmitted for approval within five years in order to continue project grant eligibility.

If you have questions regarding your plan's approval or FEMA's mitigation grant programs, please contact our state counterpart, Oregon Emergency Management, who coordinates and administers these efforts for local entities.

Sincerely,

Carl L. Cook, Jr., Director
Mitigation Division

cc: Dennis Sigrist, OEM

Enclosure

SL:gb

Special Thanks & Acknowledgements

Project Managers:

Mark Fancey, Mid-Willamette Valley Council of Governments

Judith Ingram Moore, Mid-Willamette Valley Council of Governments

Oregon Natural Hazards Workgroup:

Andre LeDuc, Director

Project Team: David Reesor, Manager

Robert Richardson

Alison Thayer

Tina Nunez

Geographic Information Systems (GIS) Maps:

The Mid-Willamette Valley Council of Governments GIS Department, Polk County GIS, and City of Salem 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.

Dan Rosenbalm, GIS Specialist, Polk County

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

Peter Gutowsky, Senior Planner, City of Salem Community Development Department – Natural Resources Section

The information on the maps in this plan was derived from Polk County and City of Salem 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:

Funding for this project was made possible through a Federal Emergency Management Agency Emergency Management Performance Grant.

Executive Summary

What is the Mitigation Plan?

The Polk County Natural Hazards Mitigation Plan provides a set of strategies and measures the county can pursue to reduce the risk and fiscal loss to the county and its residents from natural hazards events. The 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 Polk County in reducing risk and preventing loss from future natural hazard events. The action items address multi-hazard issues and specific activities for flood, landslide, wildfire, severe winter storm, windstorm, drought, expansive soils, earthquake, and volcanic eruption hazards.

What is the Plan's Mission?

The mission of the Polk County Natural Hazards Mitigation Plan is to assist in reducing risk, preventing loss, and protecting life, property, and the environment from future natural hazard events. The plan fosters collaboration and coordinated partnerships among public and private partners. This can be achieved by increasing public awareness and education and identifying activities to 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 Polk County residents, 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 agencies and organizations:

- Polk County Community Development Department
- Polk County Emergency Management
- Polk County Fire District #1
- Polk County Planning Commission
- Polk County Planning Division
- Polk County Public Works Department
- Polk County Sheriff's Office
- American Red Cross, Willamette Chapter
- City of Dallas
- City of Independence
- City of Monmouth
- Confederated Tribes of the Grand Ronde

- Rickreall/Glenn-Gibson Watershed Coordinator
- Luckiamute/Ash Creek Watershed Coordinator
- Marion County Emergency Manager
- Oregon Office of Emergency Management
- Southwest Polk Fire District
- Windermere Real Estate (Dallas, OR)
- Yamhill County Emergency Manager
- Mid-Willamette Valley Council of Governments

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 identified to reduce Polk County's risk from flood, landslide, wildfire, severe winter storm and windstorm, drought, expansive soils and seismic and volcanic events.

Plan goals were formulated through research, reviewing other local mitigation goals, and steering committee work sessions. Goals were further refined by the steering committee following the Polk County Natural Hazards Mitigation Plan Open House held April 19, 2005, where the county received public input.

Goal #1: PUBLIC EDUCATION AND AWARENESS

Provide public information and education/awareness to all residents of the county concerning natural hazard areas and mitigation efforts.

Goal #2: PREVENTIVE AND IMPLEMENTATION

Develop and implement activities to protect human life, commerce, property and natural systems.

Goal #3: COLLABORATION AND COORDINATION

Strengthen hazard mitigation by increasing collaboration and coordination among citizens, public agencies, non-profit organizations, businesses, and industry.

Goal #4: FUNDING AND PARTNERSHIPS

Seek partnerships in funding and resources for future mitigation efforts.

Goal #5: EMERGENCY OPERATIONS

Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

Goal #6: NATURAL RESOURCES UTILIZATION

Link land use planning, development criteria, codes, and natural resources and watershed planning with natural hazard mitigation.

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 applies to all natural hazards rather than 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 and 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 Polk 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 authority to implement, and those actions that may 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 more detailed information can be found.

Plan goals addressed identifies the plan goal(s) each action item addresses. The Polk County Natural Hazards Mitigation Plan has six plan goals; to meet the overall mission which is to: to assist in reducing risk, preventing loss, and protecting life, property, and the environment from future natural hazard events. The plan fosters collaboration and coordinated partnerships among public and private partners. This can be achieved by increasing public awareness and education and identifying activities to guide the county towards building a safer community

What are the acronyms used in the plan?

ARC	American Red Cross
ARES	Amateur Radio Emergency Services
BLM	Bureau of Land Management (United States)
BPA	Bonneville Power Administration
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
MWVEDD	Mid-Willamette Valley Economic Development District
NCDC	National Climate Data Center
NFIP	National Floodplain Insurance Program
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 (State of Oregon)
ODF	Oregon Department of Forestry (State of Oregon)
ODOT	Oregon Department of Transportation (State of Oregon)
OECDD	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)
SEDCOR	Strategic Economic Development Corporation

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)

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Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes and Page Location	Plan Goals Addressed					
						Public Education & Awareness	Preventive & Implementation	Collaboration & Coordination	Funding & Partnerships	Emergency Operations	Natural Resources Utilization
Multi-Hazard #1	Sustain an education and outreach program for local jurisdictions and assist them in developing emergency operations, public information, and hazard mitigation plans.	Emergency Management – Hazard Mitigation Team (HMT)	Planning Division, MWVCOG, city emergency mgt. agencies, Red Cross, emergency response agencies, OEM, FEMA	1 to 2 years, on-going	**4-6**	✓	✓	✓	✓	✓	
Multi-Hazard #2	Review and update the Polk 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 - (HMT) and Planning Division	Steering Committee, County Depts. city emergency mgt. agencies, Red Cross, Polk Fire Defense Board, NWS, utility companies, ODF, ODOT, ARES	1 to 5 years, on-going	**4-7**	✓	✓	✓	✓	✓	✓
Multi-Hazard #3	Evaluate the effectiveness of existing programs and identify natural hazards mitigation needs. Balance the objectives of existing programs' goals with natural hazards mitigation.	Emergency Management – HMT	Planning Division, Public Works	1 to 3 years, on-going	**4-8**		✓				
Multi-Hazard #4	Identify coordination opportunities to maximize or leverage funding opportunities that address multi-jurisdictional projects**.**	Steering Committee	Planning Division, OEM, FEMA, IISOI	1 to 2 years	**4-8**	✓	✓	✓	✓	✓	

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes and Page Location	Plan Goals Addressed					
						Public Education & Awareness	Preventive & Implementation	Collaboration & Coordination	Funding & Partnerships	Emergency Operations	Natural Resources Utilization
Multi-Hazard #5	Develop a process for the Polk County Natural Hazards Mitigation Plan Steering Committee to assist in implementing, monitoring, and evaluating countywide mitigation activities.	Steering Committee		One year – upon adoption of the plan.	**4-9**	✓	✓	✓	✓		
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 - HMT	Fire and police departments, and other first responders.	On-going (every 5 years)	**4-9**		✓	✓	✓	✓	
Multi-Hazard #7	Identify collaborative programs that recognize ways to decrease the risks of natural hazards.	Emergency Management – HMT	Planning Division, Chambers of Commerce	1 to 2 years	**4-10**	✓	✓	✓	✓	✓	✓
Multi-Hazard #8	Develop public and private partnerships to foster natural hazard mitigation program coordination and collaboration in Polk County.	Emergency Management - HMT	Planning Division	On-going	**4-10**	✓	✓	✓	✓		
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 Division, Public Works, ODOT, city planning & public works depts. utility companies, emergency response agencies, MWVCOG, ODF, BLM, USFS	1 to 2 years; on-going	**4-11**	✓	✓	✓	✓		

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes and Page Location	Plan Goals Addressed					
						Public Education & Awareness	Preventive & Implementation	Collaboration & Coordination	Funding & Partnerships	Emergency Operations	Natural Resources Utilization
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 - HMT	Planning Division, Public Works, cities, ODOT	3 to 5 years	**4-11**	✓	✓			✓	
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, Planning & Building Divisions, Health Department, emergency response agencies, Red Cross, utilities, MWVCOG, OEM, FEMA, media	On-going	**4-12**	✓	✓				✓
Multi-Hazard #12	Sustain a public awareness campaign about natural hazards.	Emergency Management - HMT	Public Works, Planning Division, Red Cross, MWVCOG, school districts, emergency response agencies, utility companies, media, FEMA, OEM.	On-going	**4-13**	✓	✓	✓	✓		
Multi-Hazard #13	Make the Polk County Emergency Operations Plan, 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	**4-14**	✓					

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes and Page Location	Plan Goals Addressed					
						Public Education & Awareness	Preventive & Implementation	Collaboration & Coordination	Funding & Partnerships	Emergency Operations	Natural Resources Utilization
Multi-Hazard #14	Promote hazard-resistant utility construction and maintenance methods.	MWVCOG	County & city emergency management agencies, ARES, utility companies	3 to 5 years	4-14	✓	✓				✓
Multi-Hazard #15	Develop a system for data collection for undeclared natural hazard events.	Emergency Management - HMT	IISOI, Building Division, GIS, farm services, insurance companies	3 to 5 years	**4-14**	✓	✓	✓	✓	✓	
Multi-Hazard #16	Improve coordination of and evaluate technical and engineering gaps in response services for natural hazards' events. Develop a long-term recovery plan for Polk County from the effects of natural hazards.	Emergency Management - HMT	USGS, DOGAMI, adjacent counties' emergency mgt., Red Cross, hospitals, Army National Guard	1 to 5 years	**4-15**			✓	✓	✓	
Short-Term Flood #1	Develop and implement better flood warning systems.	Emergency Management - HMT, Public Works	Planning Division, watershed councils, cities, OSU Extension, USGS, WRD, DSL, OEM, BLM, USACE, private river gauges	1 to 2 years	**6-20**		✓	✓	✓	✓	

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes and Page Location	Plan Goals Addressed					
						Public Education & Awareness	Preventive & Implementation	Collaboration & Coordination	Funding & Partnerships	Emergency Operations	Natural Resources Utilization
Short-Term Flood #2	Conduct workshops for target audiences on National flood Insurance Programs, mitigation activities, and potential assistance from FEMA's Flood Mitigation Assistance and Hazard Mitigation Grant Programs	Emergency Management - HMT	County Planning Division and Community Development Dept., watershed councils, Polk SWCD, Ash Creek Water Control District, Realtor's Board (Oregon Association of Realtors), DLCD, OEM, FEMA	On-going	**6-21**	✓	✓		✓		

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes and Page Location	Plan Goals Addressed					
						Public Education & Awareness	Preventive & Implementation	Collaboration & Coordination	Funding & Partnerships	Emergency Operations	Natural Resources Utilization
Short-Term Flood #3	Continue to coordinate with appropriate agencies, and maintain an inventory of all aggregate operations adjacent to or within the floodplain	Community Development Dept.	Public Works and GIS Departments, watershed councils, DOGAMI, USACE, ODFW, DEQ, DSL, aggregate industries	On-going	**6-21**		✓		✓		
Long-Term Flood #1	Update the Flood Insurance Rate Maps (FIRM) for Polk County as funding becomes available.	Community Development Department	GIS and Public Works Departments, DLCD, FEMA	3 to 5 years	**6-22**		✓	✓	✓		
Long-Term Flood #2	Enhance data and mapping for floodplain information within Polk County.	Outside UGB: Community Development and Public Works, Cities Inside UGB: Cities	Emergency Management, GIS Department, NRCS, Polk SWCD, FEMA, watershed councils, OAWU	3 to 5 years (as funding allows)	**6-22**		✓	✓			
Long-Term Flood #3	Identify surface water drainage obstructions for all parts of unincorporated Polk County.	Public Works Department	Planning Division and GIS Dept.; cities, NRCS, Polk SWCD, watershed councils	On-going	**6-23**		✓				
Long-Term Flood #4	Reduce flooding events by using stormwater best management practices (BMP).	Public Works	GIS; NRCS, Polk SWCD, water control districts, Confederated Tribes of Grand Ronde, watershed councils	3 to 5 years	**6-23**		✓				

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes and Page Location	Plan Goals Addressed					
						Public Education & Awareness	Preventive & Implementation	Collaboration & Coordination	Funding & Partnerships	Emergency Operations	Natural Resources Utilization
Long-Term Flood #5	Investigate grant-funding programs to assist the cities of Monmouth and Independence in their joint project to create a multi-use trail alongside Ash Creek.	Cities of Monmouth and Independence, Polk County	Watershed councils, FEMA, DEQ, ODFW, NRCS, Polk SWCD, Ash Creek Water Control District, ODOT	1 to 2 years	**6-24**	✓	✓		✓		
Long-Term Flood #6	Mitigate repetitive flood loss properties.	Polk County, Cities in Polk County	County Tax Assessor, FEMA, OEM	On-going	**6-24**		✓		✓		
Short-Term Landslide #1	Improve Knowledge of landslide hazard areas and understanding of vulnerability and risk to life and property in hazard-prone areas.	GIS and Public Works	Planning and Building Divisions, Emergency Management, DOGAMI, ODF, cities	2 years	**7-15**	✓	✓		✓		
Short-Term Landslide #2	Develop construction practices, site location and design that can be applied to steep slopes to reduce the potential threat of landslides.	Public Works, Community Development Department, and Building Division	Emergency Management - HMT, DLCD, cities, IBHS, timber operators	1 to 3 years	**7-15**	✓	✓	✓	✓		
Short-Term Landslide #3	Identify alternative travel routes in high-risk debris flow and landslide areas.	Public Works	Emergency Management - HMT; ODOT; adjacent counties, West Salem, Falls City, DOGAMI	2 years	**7-16**		✓		✓	✓	

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes and Page Location	Plan Goals Addressed					
						Public Education & Awareness	Preventive & Implementation	Collaboration & Coordination	Funding & Partnerships	Emergency Operations	Natural Resources Utilization
Short-Term Landslide #4	Compile Relative Landslide Risk maps for Polk County.	GIS	Emergency Management - HMT, Planning Division and Assessors Office, ODF, BLM, water systems, utilities, DOGAMI, forest industries	Depending on DOGAMI funding in this biennium	**7-17**	✓	✓	✓			
Short-Term Landslide #5	Increase public education related to landslide hazards by distributing DOGAMI landslide informational brochure.	Emergency Management - HMT	Public Works, Community Development Department; city emergency managers; DOGAMI; OEM; ODF; DLCD	1 to 2 years	DOGAMI produced an information brochure on landslide hazards. 7-17	✓			✓		
Long-Term Landslide #1	Mitigate activities in identified potential and historical landslide areas through public outreach.	Emergency Management - HMT	Planning, Building, Public Works; cities; builders; developers; property owners; mortgage companies; ODF; ODOT	3 to 5 years; on-going	**7-18**	✓	✓	✓	✓		
Long-Term Landslide #2	Maintain public and encourage property owners to maintain private drainage systems.	Public Works	GIS and Planning Divisions, cities	On-going	**7-18**	✓	✓		✓		

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes and Page Location	Plan Goals Addressed					
						Public Education & Awareness	Preventive & Implementation	Collaboration & Coordination	Funding & Partnerships	Emergency Operations	Natural Resources Utilization
Short-Term Wildfire #1	Work with Polk Fire Defense Board in the review of plans and inspection of structures, access, and water supply for fire code compliance.	Building Division	Public Works and Planning Divisions, Emergency Management, Polk Fire Defense Board, State Fire Marshal	On-going	Construction plans for commercial and industrial structures are reviewed, not residential plans. ID areas with lack of experienced fire staff for plans review may be necessary. 8-22		✓	✓	✓		
Short-Term Wildfire #2	Advocate accessible water storage facilities in developments not connected to a community water/hydrant system in the wildland/urban interface (WUI).	Community Development Department	Building and GIS Divisions, Polk Fire Defense Board, State Fire Marshal, OAWU, irrigation districts, Polk SWCD, NRCS, watershed councils, cities, ODF, Confederated Tribes of Grand Ronde	1 to 2 years; On-going	**8-22**		✓	✓		✓	✓

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes and Page Location	Plan Goals Addressed					
						Public Education & Awareness	Preventive & Implementation	Collaboration & Coordination	Funding & Partnerships	Emergency Operations	Natural Resources Utilization
Short-Term Wildfire #3	Continue to promote public awareness campaigns for individual property owners living in the WUI.	Emergency Management - HMT	Planning and Building Divisions, Public Works Dept., city emergency managers, media, Polk Fire Defense Board, OEM, FEMA, DLCD, State Fire Marshal, ODF, insurance and real estate industries, ODA, Oregon Garden, State Fair, Polk County Fair	1 to 5 years, On-going	**8-23**	✓	✓	✓	✓	✓	
Short-Term Wildfire #4	Create incentives and assist landowners in reducing fuel loads on private property.	Emergency Management	Community Development Dept., State Fire Marshal, ODF, Polk Fire Defense Board, insurance companies	1 to 2 years	**8-25**	✓	✓	✓	✓		
Short-Term Wildfire #5	Seek improved information gathering, and distribution and technology for enhancing fire identification, initial response and evacuation if necessary.	Emergency Management - HMT	GIS and Planning Divisions, Polk Fire Defense Board, ODF, State Fire Marshal, Confederated Tribes of Grand Ronde	1 to 3 years	**8-25**	✓	✓	✓	✓	✓	

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes and Page Location	Plan Goals Addressed					
						Public Education & Awareness	Preventive & Implementation	Collaboration & Coordination	Funding & Partnerships	Emergency Operations	Natural Resources Utilization
Short-Term Wildfire #6	Enhance emergency services to increase the efficiency of wildfire response and recovery activities.	Emergency Management - HMT	Public Works, Polk Fire Defense Board, State Fire Marshal, ODF, telephone companies	2 years	**8-26**		✓	✓	✓	✓	
Long-Term Wildfire #1	Look for solutions to protect structures located outside of fire districts through partnerships, grant funding, fire protection contracts, or expansion of fire district services.	Polk Fire Defense Board	County Assessor, State Fire Marshal, ODF	On-going	**8-26**		✓	✓	✓	✓	
Long-Term Wildfire #2	Reduce wildfire fuels.	Emergency Management - HMT	GIS and Community Development Departments, Polk Fire Defense Board, ODF, State Fire Marshal, BLM, USFS, ODF, Confederated Tribes of Grand Ronde	3 to 5 years	**8-27**	✓	✓	✓	✓	✓	✓
Long-Term Wildfire #3	Coordinate support of agricultural uses that reduce fuel loads in interface areas.	Polk SWCD	Planning Division, NRCS, watershed councils, ODF, DEQ, ODA	On-going	**8-28**	✓	✓	✓	✓		✓

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes and Page Location	Plan Goals Addressed					
						Public Education & Awareness	Preventive & Implementation	Collaboration & Coordination	Funding & Partnerships	Emergency Operations	Natural Resources Utilization
Long-Term Wildfire #4	Maintain and further develop interagency and private industry relationships for continuing strong fire response in Polk County.	Emergency Management - HMT	Public Works, Polk Fire Defense Board, State Fire Marshal, USFS, BLM, timber industry, jobs in the woods programs	On-going	**8-28**	✓	✓	✓	✓		
Long-Term Wildfire #5	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 - HMT	Polk Fire Defense Board, Community Development Department, school districts, OEM, ODF, interface communities (i.e. Falls City, Buell, Fort Hill, Grand Ronde)	On-going	**8-29**	✓	✓	✓	✓	✓	
Long-Term Wildfire #6	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 - HMT	GIS, Building and Planning Divisions, State Fire Marshal, Polk Fire Defense Board, ODF, DLCD, utilities	1 to 3 years	**8-30**	✓	✓	✓	✓		

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes and Page Location	Plan Goals Addressed					
						Public Education & Awareness	Preventive & Implementation	Collaboration & Coordination	Funding & Partnerships	Emergency Operations	Natural Resources Utilization
Long-Term Wildfire #7	Encourage implementation of wildfire mitigation activities consistent with the goals of promoting sustainable ecological management and community stability.	Emergency Management - HMT	Public Works, Polk Fire Defense Board, watershed councils, utilities, BLM, ODF, Confederated Tribes of Grand Ronde, land managers	1 to 5 years, On-going	**8-31**		✓	✓	✓		✓
Short-Term Severe Winter Storm #1	Enhance strategies for management of debris from severe winter storms.	Public Works' Road Maintenance Division	GIS and Planning, Departments, CAO, utilities, county residents, solid waste franchises, landfills	2 years	**9-13**	✓	✓	✓	✓	✓	✓
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 - HMT	Community Development and Public Works Departments, cities, utilities	2 years	**9-13**				✓	✓	✓
Short-Term Severe Winter Storm #3	Update the county's debris management plan.	Emergency Management - HMT	Community Development Department, cities, utilities, solid waste franchises, landfills	2 years	**9-14**				✓	✓	✓

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes and Page Location	Plan Goals Addressed					
						Public Education & Awareness	Preventive & Implementation	Collaboration & Coordination	Funding & Partnerships	Emergency Operations	Natural Resources Utilization
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 - HMT	Community Development Dept., utilities, cities, West Valley Housing Authority, American Red Cross, churches, Oregon voluntary organizations active in disaster, Polk Fire Defense Board,	1 to 2 years; on-going	**9-14**	✓	✓		✓	✓	✓
Long-Term Severe Winter Storm #2	Develop and implement programs to keep trees from threatening lives, property, and public infrastructure in severe weather events.	Emergency Management - HMT	GIS, Public Works and Community Development Depts., overhead utilities, cities	On-going	**9-15**		✓		✓		✓
Long-Term Severe Winter Storm #3	Promote the benefits of tree-trimming and tree replacement programs and help to coordinate local efforts by public and private agencies.	Public Works (Road Maintenance)	GIS, Emergency Management, ODOT, utility and telecommunications companies, city public works, owners of property adjacent to public rights-of-way	3 to 5 years	**9-16**	✓			✓		✓

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes and Page Location	Plan Goals Addressed					
						Public Education & Awareness	Preventive & Implementation	Collaboration & Coordination	Funding & Partnerships	Emergency Operations	Natural Resources Utilization
Long-Term Severe Winter Storm #4	Encourage harvesting of trees along utility and road corridors, preventing potential winter storm damage.	Public Works (Roadmaster)	Emergency Management, cities, utilities, FEMA, ODFW, DSL, ODOT, ODF, forest products industry, watershed councils, property owners of land adjacent to public rights-of-way	On-going	**9-16**		✓	✓			✓
Long-Term Severe Winter Storm #5	Encourage right-of-way coordination, education and management between property owners, utility operators, and government agencies.	Public Works (Roadmaster)	GIS, Building and Planning Divisions, CAO; USFS; BLM; ODF; ODOT; utility operators; county residents	On-going	**9-17**		✓	✓	✓		
Short-Term Windstorm #1	Develop and implement programs to keep trees from threatening lives, property, and public infrastructure during windstorm events.	Emergency Management - HMT	Public Works, Community Development and GIS Departments, cities, ODF, BLM, ODOT, utility providers	2 years	**10-15**	✓	✓		✓		✓
Short-Term Windstorm #2	Enhance strategies for debris management and/or removal after windstorm events.	Emergency Management - HMT	Public Works/Roads, ODOT, cities, regional recycling facilities	2 years	**10-16**		✓	✓	✓	✓	✓

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes and Page Location	Plan Goals Addressed					
						Public Education & Awareness	Preventive & Implementation	Collaboration & Coordination	Funding & Partnerships	Emergency Operations	Natural Resources Utilization
Short-Term Windstorm #3	Maintain tree trimming for above-ground power lines.	Public Works	Emergency Management, Community Development Department, overhead utilities, cities	On-going	**10-16**		✓	✓		✓	✓
Long-Term Windstorm #1	Map and publicize locations around Polk County that have the highest incidence of extreme windstorms.	Emergency Management - HMT	Planning and GIS Divisions, FEMA, NCDC, OCS, NWS	5 years	**10-17**		✓				
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	**10-17**		✓				
Long-Term Windstorm #3	Increase public awareness of windstorm and tornado mitigation activities.	Emergency Management - HMT	Planning Division, utilities, cities, FEMA	On-going	**10-18**	✓	✓			✓	✓

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes and Page Location	Plan Goals Addressed					
						Public Education & Awareness	Preventive & Implementation	Collaboration & Coordination	Funding & Partnerships	Emergency Operations	Natural Resources Utilization
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.	Community Development Department and Building Division	Planning Division, cities	5 years	**10-18**	✓	✓				
Long-Term Windstorm #5	Develop and implement programs to keep trees from threatening lives, property, and public infrastructure during windstorm events.	Public Works	Community Development / Planning Division, utilities, cities	On-going	**10-19**		✓				✓
Long-Term Windstorm #6	Identify trees that are potentially susceptible to wind throw.	Community Development	GIS, cities, overhead utilities	On-going	**10-19**		✓				✓
Long-Term Windstorm #7	Encourage critical facilities to secure emergency power.	Emergency Management - HMT	Community Development / Planning Division, cities, other counties, Polk Fire Defense Board, police stations, water systems	On-going	**10-19**		✓	✓	✓		

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes and Page Location	Plan Goals Addressed					
						Public Education & Awareness	Preventive & Implementation	Collaboration & Coordination	Funding & Partnerships	Emergency Operations	Natural Resources Utilization
Long-Term Windstorm #8	Encourage harvesting of trees along utility and road corridors, preventing potential windstorm damage.	Emergency Management - HMT	Planning Division, CAO, cities, utilities, FEMA, USFS, ODFW, DSL, BLM, ODOT, forest products industries	On-going	**10-20**		✓				✓
Long-Term Windstorm #9	Encourage harvesting of trees blown down during a windstorm or tornado.	Emergency Management - HMT	Planning Division, CAO, cities, utilities, FEMA, USFS, ODFW, DSL, BLM, ODOT, forest products industries	On-going	**10-20**		✓				✓
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 and increase targeting of special needs populations.	Emergency Management - HMT	Community Development Department, utilities, cities, American Red Cross, churches, Oregon voluntary organizations active in disaster, ARES, Polk Fire Defense Board	On-going	**10-21**	✓	✓		✓		
Short-Term Drought #1	Encourage dissemination of ideas by county-based agencies on effective methods of water use curtailment.	Polk County	Community Development and CAO, Polk SWCD, watershed councils, OSU Extension Service, NRCS, Water systems, WRD	2 years; on-going	**11-9**	✓	✓	✓	✓		✓

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes and Page Location	Plan Goals Addressed					
						Public Education & Awareness	Preventive & Implementation	Collaboration & Coordination	Funding & Partnerships	Emergency Operations	Natural Resources Utilization
Short-Term Drought #2	Encourage water providers to inter-tie water systems	Community Development Department	Public Works, MWVCOG, cities and rural communities, community water associations, OAWU, OECDD and Rural Development (funding sources), WRD, ODFW, PUC	2 years; on-going	**11-10**		✓	✓	✓		
Short-Term Drought #3	Provide information about emergency water rights for domestic uses.	Community Development Department	Public Works, NRCS, Polk SWCD	2 years; on-going	**11-10**	✓	✓				
Long-Term Drought #1	Support local agencies' training on water conservation measures to farmers and ranchers, including drought management practices for crops and livestock.	Polk SWCD	Community Development Dept., OSU Extension Service, NRCS, watershed councils, Farm Bureau, ODA, WRD, ODFW, cities	1 to 2 years; on-going	**11-11**	✓	✓	✓	✓		
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.	Polk SWCD	Community Development Dept., ODA, WRD, OECDD, DEQ, ODFW, DSL, NRCS, OSU Extension Service	On-going	Livestock watering systems provide options for farmers/ranches to provide drinking water, and can sometimes also improve riparian habitat. 11-11		✓	✓	✓		

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes and Page Location	Plan Goals Addressed					
						Public Education & Awareness	Preventive & Implementation	Collaboration & Coordination	Funding & Partnerships	Emergency Operations	Natural Resources Utilization
Long-Term Drought #3	Encourage storage of water, especially off-stream storage.	Community Development Department	GIS and Public Works Departments, OSU Extension Service, watershed councils, NRCS, Polk SWCD, ODA, WRD, DSL, ODFW, DEQ	On-going	**11-12**		✓	✓	✓		✓
Long-Term Drought #4	Support agencies' plan for long-range water resources development that lead to additional water supplies and help determine funding sources for the studies.	Community Development Department	Public Works and GIS Divisions, Polk SWCD, WRD, ODA, DEQ, ODFW, OECDD, DOGAMI, DLCD, OSU Extension	3 to 5 years	Studying alternative sources may reveal under-utilized water resources and other information useful to water managers. 11-13		✓	✓	✓		
Expansive Soils #1	Educate the public about expansive soils.	Community Development Department	Building and GIS divisions, building contractors, property owners with expansive soils, soils and geotechnical engineers, engineering geologists, realtors, arborists, landscapers, NRCS, OSU Extension, Polk SWCD	On-going	**12-8**		✓				✓

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes and Page Location	Plan Goals Addressed					
						Public Education & Awareness	Preventive & Implementation	Collaboration & Coordination	Funding & Partnerships	Emergency Operations	Natural Resources Utilization
Expansive Soils #2	Develop revisions for and revise the Polk County Road Standards for areas of the county with expansive soils.	Public Works (Roadmaster)	Community Development Dept., ODOT, cities	On-going	**12-9**		✓				
Expansive Soils #3	Determine the feasibility of installing hydraulic barriers or physical restraints to prevent the entry of water into expansive soils.	Public Works	Community Development Dept., ODOT, cities	On-going	**12-9**		✓				✓
Expansive Soils #4	Compact soil in a manner that reduces its suction i.e. affinity for water.	Public Works	Community Development Dept., property owners, building managers, cities	On-going	**12-10**		✓				✓
Expansive Soils #5	Remove and replace expansive subgrade soil with a non-expansive material.	Public Works	Community Development Dept., soils engineers, ODOT, cities	3 to 5 years	**12-10**		✓				✓
Expansive Soils #6	Use sub-surface drain tile or perforated pipe wrapped in fabrics or graded granular filters below the edges of pavements.	Public Works	Community Development Dept., soils engineers, ODOT, cities	3 to 5 years	**12-10**		✓				

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes and Page Location	Plan Goals Addressed					
						Public Education & Awareness	Preventive & Implementation	Collaboration & Coordination	Funding & Partnerships	Emergency Operations	Natural Resources Utilization
Short-Term Earthquake #1	Integrate new earthquake hazard mapping data for Polk County and improve technical analysis of earthquake hazards.	GIS	Emergency Management, Planning Division, OSU, USGS, BLM, DOGAMI, OEM, FEMA	2 years	**13-17**		✓	✓			
Short-Term Earthquake #2	Encourage reduction of nonstructural and structural earthquake hazards in homes, schools, businesses, and government offices.	Emergency Management - HMT	Community Development Department, Building Division, city building officials, school districts, builders' associations, IBHS, West Valley Housing Authority, Red Cross, DOGAMI, IISOI, Oregon Seismic Safety Policy Advisory Commission (OSSPAC), FEMA, OEM	1 to 2 years, on-going	**13-17**	✓	✓			✓	
Short-Term Earthquake #3	Inform residents of value of earthquake hazard insurance.	Emergency Management - HMT	Community Development Dept., IISOI through local insurance agencies, mortgage companies, insurance and real estate industries, DOGAMI	On-going	**13-18**	✓	✓	✓			

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes and Page Location	Plan Goals Addressed					
						Public Education & Awareness	Preventive & Implementation	Collaboration & Coordination	Funding & Partnerships	Emergency Operations	Natural Resources Utilization
Short-Term Earthquake #4	Identify funding sources for and implement high priority structural and nonstructural retrofits of structures identified as critical and/or essential facilities, and seismically vulnerable.	Emergency Management - HMT	Community Development Dept., IISOI, OSSPAC, local banks, credit unions, SBA, Rural Development, OECDD, FEMA, OEM, West Valley Housing Authority, Red Cross	1 to 2 years	**13-19**	✓	✓		✓		
Long-Term Earthquake #1	Promote and continue building code standards.	Building Division	Planning Division, city planning departments, builders, developers, property owners	On-going	**13-19**	✓	✓	✓			
Long-Term Earthquake #2	Encourage seismic strength evaluations of critical facilities to identify vulnerabilities and to meet current seismic standards.	Emergency Management - HMT	Planning and Building Divisions, Public Works Dept.; city planning departments; water systems; OAWU; schools; hospitals; ODOT; dam/reservoir owners/managers; Willamette ESD; Oregon Building Codes Division; OECDD; Rural Development; WRD	On-going	**13-20**	✓	✓	✓	✓	✓	

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes and Page Location	Plan Goals Addressed					
						Public Education & Awareness	Preventive & Implementation	Collaboration & Coordination	Funding & Partnerships	Emergency Operations	Natural Resources Utilization
Long-Term Earthquake #3	Identify and enhance water, sewer, electric, gas and other utilities to improve their survivability in an earthquake.	Emergency Management - HMT	Planning, Building, Public Works and GIS Departments; city planning departments; utilities	On-going	**13-21**		✓	✓	✓		
Long-Term Earthquake #4	Encourage earthquake safety promotion and drills to community groups.	Emergency Management - HMT	Planning Department, city planning departments, school districts, West Valley Housing Authority, community organizations	On-going	**13-21**	✓	✓	✓		✓	
Long-Term Earthquake #5	Improve local capabilities to perform earthquake building safety evaluations.	Emergency Management - HMT	Building and Public Works Departments, FEMA, OEM, Polk Fire Defense Board	On-going	**13-22**		✓	✓			
Short-Term Volcano #1	Increase awareness of volcanic eruptions and their potential impact to the county.	Emergency Management - HMT	Community Development, Public Health and GIS Departments; USGS-CVO; FAA; NWS; DOGAMI; DEQ; media; law enforcement offices; cities; OSU	On-going	Education is an effective way to relate how an infrequent hazard event could affect the daily life of a county resident. 14-13	✓	✓	✓	✓	✓	

Natural Hazard	Action Item	Coordinating Organization	Partner Organizations	Timeline	Action Item Notes and Page Location	Plan Goals Addressed					
						Public Education & Awareness	Preventive & Implementation	Collaboration & Coordination	Funding & Partnerships	Emergency Operations	Natural Resources Utilization
Short-Term Volcano#2	Identify critical facilities and major industries that may be affected by ash falls and collaborate with them on ash fall emergency response.	Emergency Management - HMT	SEDCOR, major industries, cities, DOGAMI, USGS-CVO, water and wastewater systems operators	1 to 2 years	Intel Corporation has taken the initiative to consult scientists on the probability of problems associated with volcanic eruptions in the Cascade region. 14-14	✓		✓			
Long-Term Volcano #1	Strengthen response and recovery programs, and develop and implement public education programs for volcanic eruption hazards.	Emergency Management - HMT	Community Development Dept., OEM, USGS-CVO, DOGAMI, Cities, Media	On-going	14-15		✓	✓	✓	✓	
Long-Term Volcano #2	Create and map hypothetical eruption scenarios to display potential eruption hazards.	Emergency Management - HMT	GIS, OSU/PSU/OIT, USGS-CVO, DOGAMI	3 to 5 years	Hypothetical eruption scenarios for area volcanoes, showing the different possible eruption hazards can help the public understand the impacts of a volcanic eruption. Pierce County, WA uses hypothetical scenarios for Mt. Rainier to show possible impacts. 14-15	✓		✓	✓		

Section 1:
Introduction

Introduction

Polk County 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, windstorms, drought, expansive soils, tornadoes, and volcanic activity. 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.

Polk County most recently experienced large-scale destruction during the severe weather events in 1996 and 1997. 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 Polk County businesses, residences, and infrastructure was estimated at about $3 million.[1]

The Willamette Valley region was hard hit again by rains and flooding in November of 1996. This flood event continued to January 5, 1997 when the County Commissioners declared a state of emergency. This event caused approximately $250,000 of damage within the county.

Phase I of the Polk County Natural Hazards Mitigation Plan

During the summer of 2003, Polk County obtained an Emergency Management Performance Grant to complete Phase I of the Polk County Natural Hazards Mitigation Plan. During this phase, the county contracted with the Mid-Willamette Valley Council of Governments (MWVCOG) and the Oregon Natural Hazards Workshop (ONHW) to identify known hazards, compile a community profile and other background information, and complete vulnerability assessments for known hazards.

In October 2003, the county joined with Marion, Yamhill, 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. The grant will provide funding to complete Phase II of the Polk County Natural Hazards Mitigation Plan.

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 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 Polk 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 Polk County Natural Hazards Mitigation Plan affects unincorporated urban areas, and the rural, unincorporated areas of Polk County. Map 1 shows cities, urban unincorporated areas, and major roads and rivers in Polk 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 saved 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 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, 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.
- **Department of Land Conservation and Development (DLCD)** is responsible for planning-based hazard management including implementation of land use planning and Goal 7 (Areas Subject to Natural Disasters and 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. ONHW at the University of Oregon conducted data research and analysis, facilitated steering committee meetings and public workshops, and developed the September 2003 draft of the mitigation plan. 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, fire districts, local watershed councils, the Confederated Tribes of the Grand Ronde, Yamhill and Marion County Emergency Managers, Polk County incorporated cities, and the American Red Cross, met eight times over the course of nine months. The steering committee developed the plan's mission statement and goals; contributed to the development of mitigation action items; and continually reviewed the plan.

Stakeholder interviews:

Stakeholders consisted of the fire districts within Polk County, all of the county's incorporated cities, Confederated Tribes of the Grand Ronde, domestic water cooperatives and associations, major employers within the county, school districts, Western Oregon University, Willamette Education Service District, Polk Soil and Water Conservation District, watershed councils, Bureau of Land Management, Oregon Department of Forestry, and public utility companies.

Stakeholder interviews were completed during Phase II of the project. Most of the interviews occurred between August 2004 and March 2005. Stakeholder interviews identified 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 nine natural hazards: flood, landslide, severe winter storm, windstorm, wildfire, earthquake, drought, expansive soils, and volcanic eruption.

Public workshops:

An open house was held on April 19, 2005, to inform the public about Polk County natural hazards. The purpose of the open house was to gather comments and ideas from residents of Polk County about natural hazards mitigation planning, to inform the public about natural hazards that occur in Polk County, and identify community priorities, and potential strategies for achieving these priorities.

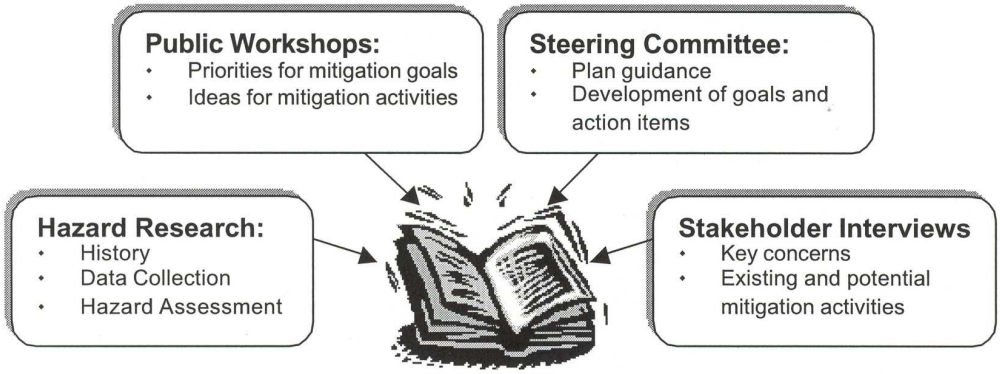
Meetings with the project steering committee, stakeholder interviews and the public open house all served as methods to obtain input and priorities in developing goals for reducing risk and preventing loss from

natural hazards in Polk 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 Polk 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 Polk County.

Executive Summary: Five-Year Action Plan

The Executive Summary can be used as a quick-reference document for the Polk 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 Polk County.

Section 2: Community Profile

This section presents the history, geography, demographics, and socioeconomics of Polk 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 Polk 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 nine 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

The *Polk County Natural Hazards Mitigation Plan* addresses seven chronic hazards and three catastrophic hazards. 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*
- *Section 12: Expansive Soils*

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

- *Section 13: Earthquake*
- *Section 14: Volcanic Eruption*

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 Polk 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 Polk 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: Polk County Basic Emergency Operations Plan

Polk County drafted the *Basic Emergency Operations Plan* and updated this plan in February 2003. The Polk County Emergency Operations Plan provides the basic framework to guide departments, agencies and organizations having emergency capabilities in their efforts to mitigate, prepare for, respond to and recover from any major emergency or disaster that may affect all or parts of Polk County. This plan is developed under the Integrated Emergency Management System concept; it is intended to address all hazards, all disciplines, all emergency phases and all jurisdictions with a role in any emergency affecting Polk County.

The Basic Emergency Operations Plan includes “annexes,” which outline specific emergency functions, assign tasks, and describe methods by which emergency functions will be accomplished. There are eighteen annexes, and they are available for downloading at http://www.co.polk.or.us/Sheriff/EM.asp.

Appendix D: 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 Polk County Natural Hazards Mitigation Plan.

Introduction – Endnotes

[1] Mid-Willamette Valley Council of Governments. 1997. *Flood Economic Recovery Coordination Project for Marion, Polk, and Yamhill, Counties, Oregon*. Salem, OR.

[2] Agency descriptions (with the exception of the ODF description) derived from Oregon Department of Geology and Mineral Industries. 1999. *Mitigating Geologic Hazards in Oregon: A Technical Reference Manual*. Special Paper 31. Portland, OR: DOGAMI.

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Section 2:
Community Profile

Why Plan for Natural Hazards in Polk County?

In 2000, the Federal Emergency Management Agency (FEMA) 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 to be eligible for certain federal assistance programs such as the Hazard Mitigation Grant Program (HMGP) and the Pre-Disaster Mitigation Grant Program.[1]

Polk County is generally described as having a mild climate and relatively steep terrain, where natural hazards do present a threat to public and private property and to the health and safety of the county's local residents. The next few chapters demonstrate how natural disasters have caused concerns related to earthquakes, floods, volcanic activity, winter storm events, windstorms, and landslides in the Polk County area. 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, property and/or the economy, it is vital to plan for the occurrence of potential natural hazards.

History of Natural Hazards in Polk County

Polk County was established from the Yamhill District in 1845, and named for U.S. president James Knox Polk.[2] While settlement patterns began to increase in Polk County during the 1840's, initial reports document hunters and fur trappers colonizing this part of Oregon prior to 1830.[3] In the 1860's, the United Stated government placed remnants of the Willamette Valley Indian Tribes as well as Native Americans from other parts of Oregon at the Grand Ronde Indian Reservation in northwest Polk County. During the pioneer period, river navigation was the primary means of transport for goods and services until the railroad was established in the 1890's. Prior to the late nineteenth century, grains, cattle and sheep were the most prominent rural industries in Polk County. These were later replaced primarily by hops production. While hops crops once covered close to 4,000 acres of land in Polk County, only about 750 acres of hop cultivation currently exist.[4] Today, the county extends from the Willamette River westward toward the Pacific Ocean. The present area of Polk County comprises 472,963 acres.[5]

Climatic conditions, geology, availability of water, and the physical limitations of the area all contribute to settlement patterns found in Polk County.[6] Examples include seasonal water shortages and marginal soils found throughout the majority of the county's land area. Historically, agriculture and forestry have primarily contributed to the county's economy, with substantial land area attributed to such land uses.[7] According to the 2001 Polk County Comprehensive Plan, sizable areas of Polk County's total land area

are geologically unsuitable for either agricultural or residential uses.

Unlike Polk County's agricultural lands, few population centers are located in the western half of the county. There, almost half of the land area is devoted to timber production, and is mostly under private ownership.[8] 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".[9] 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 the possibility of death and loss of property due to fire hazards.[10] Recent research indicates that there is potential for fire hazards in the forested area of the county due to the lack of fire breaks surrounding rural residential properties, lack of water availability and the absence of fire over the last 100 years.[11]

Almost a dozen historical flood events, half of which are recorded as "major floods," have been documented between 1861 and 1996.[12] Flood severity in the county depends on the size of drainage areas, existing moisture levels, and obstacles located within flood-prone areas. Smaller streams in the county are subject to short duration, high intensity rainfall as opposed to larger basins.[13] The most recent high water event in the Polk County area was the 1996 flood. On February 7, 1996 at 5 p.m., the Willamette River experienced a flood similar to the 1964 flood event, with the river cresting close to 35 feet and discharging 244,000 feet per second of water.[14]

Polk 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 Polk County occurred in 1962. The Columbus Day Storm of 1962 caused tree blowdowns on the average of 80 acres per square mile.

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

Polk 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

The hilly nature of Polk County along with the physical limitations described above has created the existing settlement patterns. The county extends west from the Willamette River as the eastern

border toward the Coast Range. Yamhill County is to the north and Benton County lies directly to the south.

Polk County encompasses over 470,000 acres or 745 square miles, located in the heart of the Mid-Willamette Valley. Polk County includes six incorporated cities and sixteen unincorporated communities. The Willamette River is the major river basin and is the county's eastern boundary. Other drainage basins in the Willamette watershed include the Little Luckiamute River, Ash Creek, and Rickreall Creek. While there are over 20 small tributaries in the county's drainage basin, Glenn and Gibson Creeks are considered the two main drainage channels for the Glenn-Gibson watershed.[15] Major streams in the Yamhill watershed include the South Yamhill River, located in the northern portion of Polk County. Other water bodies include Basket Slough and Willamette Slough West. There are close to half a dozen small reservoirs clustered in the northeast portion of the county and several perennial and intermittent streams scattered throughout this same area and a few located in the southern portion.[16]

Elevations in Polk County range between 325 feet at the City of Dallas to 3,450 feet in the west, near Sugarloaf Mountain.[17] During flood season in the Willamette River Basin, October through April, the months of December and January will typically experience the major flood events. Such major events are caused by heavy rainfall often combined with snowmelt and previously saturated soil conditions. After a major flood event, the Willamette River remains above bankfull stage for up to ten days with smaller tributaries receding within four to five days yet leaving floodwaters standing in the floodplain for several days after streams recede.[18] While most flood damage in Polk County occurs mainly on farmland, county roads and bridges require maintenance during annual flood events.[19]

Agriculture and forestry are the predominant land uses in Polk County. The County ranks tenth out of the 36 counties in 2004 gross farm and ranch sales ($124 million).[20]

Like other areas of Western Oregon, Douglas fir and Western Hemlock are the most widespread tree species found in Polk County. These particular tree species are found primarily in the western part of the county, while Oregon White Oak is typically found in the southern half of the county.[21] According to the 2002 edition of *Atlas of Oregon*, Douglas fir dominates after clearing activities or disturbance by logging, fires or blow downs.

Rivers and Streams

Willamette River

The Willamette River forms the eastern boundary of Polk County. The southern and central and northeast portions of Polk County are

located within the Willamette River basin. The Willamette River watershed drains approximately 7,280 square miles at Salem.

Rickreall Creek

Rickreall Creek originates in the Coast Range at an elevation of about 3,500 feet and flows eastward to an elevation of 140 feet at its confluence with the Willamette River. The watershed includes forested areas in the Coast Range, the Dallas urban area, and agricultural areas further east. The Rickreall watershed area encompasses approximately 98 square miles.

Luckiamute River

The Luckiamute River is a major drainage in the southern portion of Polk County. The basin includes both the Luckiamute River to the south and the Little Luckiamute River to the north. The watershed area encompasses approximately 368 square miles. The two primary land uses within the watershed are agriculture and forestry.

Ash Creek

Ash Creek is located in the east central portion of Polk County. The creek flows generally west to east from the foothills near Dallas to the Willamette River at Independence. The watershed drains approximately 36.4 square miles and flows through portions of Monmouth and Independence. The highest point of the drainage is about 900 feet in elevation and the lowest is at 130 feet where Ash Creek enters the Willamette River.[22]

Glenn and Gibson Creeks

Glenn and Gibson Creeks originate in the West Salem Hills. Draining an area of 10.4 square miles of West Salem, the upper reaches flow through undeveloped property and are located along steep terrain with flatter slopes near the basin outlet.[23] Streams associated with this drainage system flow down steeper gradients than on the valley floor and channels tend to be narrow and lack broad floodplain or riparian areas.[24]

South Yamhill River

Approximately one-sixth of the Yamhill River basin is located within Polk County.[25] The Bureau of Land Management claims that approximately 307 stream miles exist within the Yamhill River watershed, with mainstream tributaries generally flowing south toward the South Yamhill River.

Climate

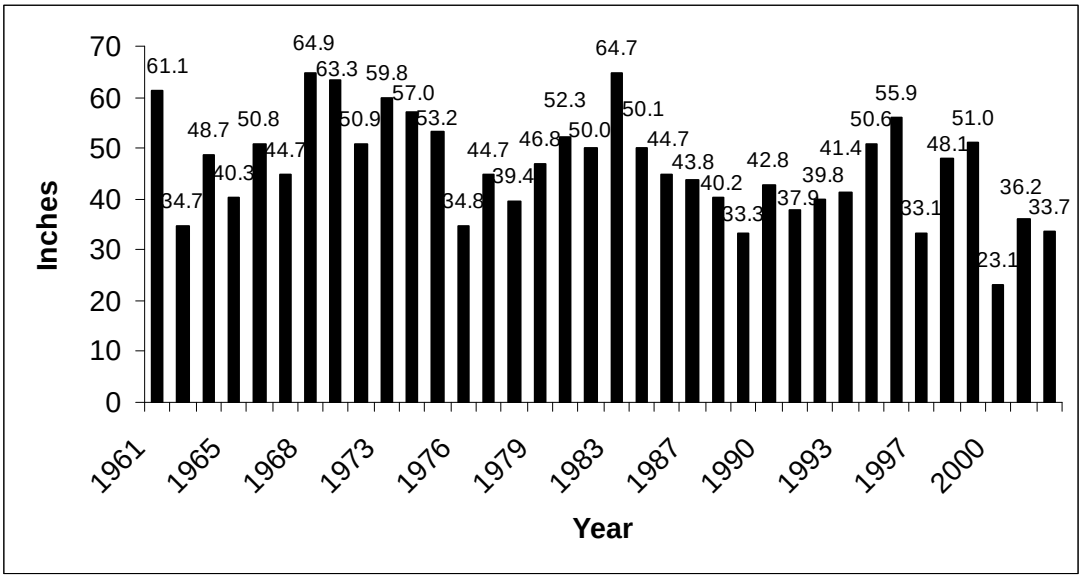
Polk County has a modified marine climate where winters are cool and wet, while summers are moderately warm and dry. Cool air flows west from the Pacific Ocean and is tempered by the Cascade Mountains to the east. From 1961 to 1990, the average annual precipitation in Polk County was approximately 51.66 inches with

most precipitation received in the Coast Range and gradually decreasing eastward toward the Willamette Valley floor.[26] Map 2 shows the range of annual precipitation levels within Polk County.

The Laurel Mountain Weather Station located at an elevation of 3,589 feet in the Coast Range west of Falls City was established in 1970. Between 1970 and 2000, average annual precipitation recorded at the station was 120.89 inches. A total of 204.12 inches was recorded during the winter of 1996-97.

Figure 1 shows the annual precipitation for Polk County over a forty-year period. In the Mid-Willamette Valley, 90 percent of the rainfall is experienced between October and the end of May.[27]

Figure 1. Annual Precipitation in Polk County, Oregon, 1961-2002



Source: Oregon Climate Service
*Data missing for the following incomplete years: 1969-1970, 1981,1985,1994

Minerals and Soils

Soil types in the Mid-Willamette Valley are well suited 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.[28] 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.[29] Class VI and VII are typically reserved for hay, pasture and rangeland grazing activities.

According to the 2002 *Atlas of Oregon*, soils in Polk County are primarily classified as Class IV, with some Class II and III soils and hydric soils found only in the eastern boundary of the county. The *Atlas of Oregon* suggests that increasing class indicates greater limitations and decreased options for use.

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

Significant Geological Factors

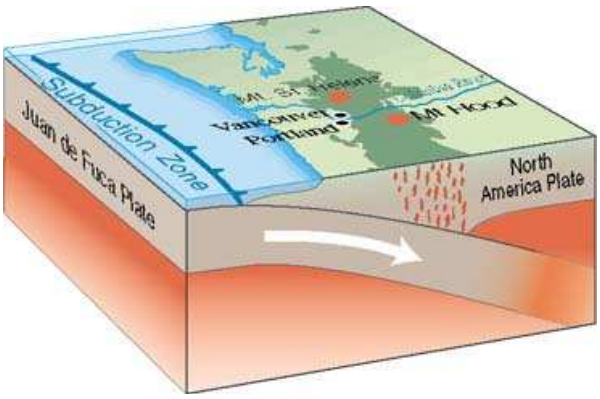


Figure 1 Cascadia Region Subduction Zone

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. Polk County lies in this area of risk. Three geological zones are found in the downtown area of Salem, and consist of basalt rock, alluvial gravels and sediments.[30] As an inland valley, the Willamette Valley was once a part of a broad continental shelf. The Eola Hills in West Salem and the Ankeny Hills to the south are examples of Columbia River Basalts or volcanic rocks uplifted along faults.[31] 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.[32]

Population and Demographics

In 2000, the population of Polk County was 62,380, representing an increase of 26% during the last ten years.[33] According to the Oregon Economic Analysis, this rapid growth rate is projected to continue by approximately 15% at a rate of 1.9% per year over the next 20 years.

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

Area	1990 Population	2000 Population	Change 1990 - 2000
Polk County	49,541	62,380	+25.9%
Oregon	2,842,321	3,421,399	+20.4%

Source: US Census

One and eight-tenths (1.8) percent is the percentage of Oregon's total population for Polk County, which ranks it as the state's 16th largest county.[34] Table 2 illustrates the populations living in incorporated and unincorporated areas of Polk County. In 2000, the six incorporated cities within the county comprise about 73 percent of the county population, with the remaining 27 percent of the population in unincorporated areas. Table 2 shows that the largest cities include Salem, Dallas, and Monmouth.

Table 2. Incorporated Cities and Unincorporated Communities in Polk County

Incorporated Cities	Population	Unincorporated Communities	
Salem (portion)	17,884	Airlie	Lincoln
Dallas	12,459	Ballston	McCoy
Falls City	970	Buell	Perrydale
Monmouth	7,741	Buena Vista	Rickreall
Independence	6.035	Derry	Suver
Willamina (portion)	716	Eola	Suver Junction
		Fort Hill	Valley Junction
		Grand Ronde	

Source: 2000 US Census; Polk County Comprehensive Plan, 2001.

Polk County has an incorporated population of 45,805, while the unincorporated population is 16,575.

Table 3 demonstrates the percent change in Polk County's incorporated cities from 1990 to 2000. During this time frame, population in incorporated and unincorporated areas increased by 46.3 percent and 8.9 percent, respectively.

Table 3. Polk County Population, Incorporated and Unincorporated

Year	Incorporated	Unincorporated
1990	34,310	15,231
2000	45,801	16,579
%Change (1990-2000)	46.3%	8.9%

Source: US Census and Oregon Office of Economic Analysis

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.[35] 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.[36]

While natural hazards do not discriminate, the impacts in terms of risk of vulnerability and the ability to recover differ among the population.[37] 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.[38]

According to the 2000 census, 5,480 Hispanics or Latinos currently reside in Polk County. This population makes up 8.8 percent of the county's total population. The 2000 US Census reports that 994 residents are Asian (1.6 percent), and 1,955 are American Indian, Alaskan Native, or other ethnic descent (3.1 percent).

In 2000, close to 6,943 (11.5 percent) of individuals lived in poverty in Polk County, of whom 5.5 percent are over 65. Approximately 1,028 (6.3 percent) are families and of that, 11.2 percent include children under 18 years old.[39] Vulnerable populations, including children, women, seniors, disabled citizens, as well as people living in poverty, may be disproportionately impacted by natural hazards in Polk 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, to make recovery centers more accessible, and to review practices and procedures to resolve any discrimination in disaster relief or assistance.[40]

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.[41] To ensure all members of the population are included in the decision-making process, a natural

hazards dialogue in Polk County should include local citizen groups, insurance companies, and other public and private sector organizations.

Land and Development

Prior to early settlement of Polk County, the area was home to "beautiful landscapes, fertile soil and lush plants".[42] 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. Historically, agriculture and forestry were central to the county's economy and the majority of land dedicated to these activities.[43] 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, Polk County is composed of fertile valleys from the Willamette River to the timbered foothills of the Coast Range[44] and is a community of residential, commercial, and agricultural land uses.

Table 4 shows the acres by various zoning categories within Polk County. The figures include land use designations within incorporated cities as well as lands under the county's zoning jurisdiction. More than 90 percent of the lands within Polk County are zoned for agricultural or forest (timber) uses.

Table 4. Acres by Zoning Designation

Land Use Designation	Acres	Percent of Total Acres
Timber Conservation	225,722	46.5
Agriculture	178,447	36.8
Farm/Forest	36,109	7.4
Residential	18,658	3.8
Public	4,229	0.8
Industrial	1,493	0.3
Commercial	955	0.2
Mineral Extraction	477	0.1
No Zoning Assigned	19,133	3.9
Total	485,223	99.8[1]

Sources: Polk County Assessor, MWVCOG GIS Department, 2003.

[1] Less than 100 percent due to rounding.

The 2001 Comprehensive Plan for Polk County includes a growth management component to ensure that urban and rural development occurs in a way that will help protect agricultural land and other natural lands from premature development.

Development Regulations

There are a number of current regulations regarding development in areas subject to natural hazards. The comprehensive plan addresses specific development standards for the region, including stream setbacks as well as residential, commercial, industrial, public and resource zone development standards. Overlay zones included in the plan are related to the following: Greenway Management, Mineral and Aggregate, Mineral Extraction, Timber Conservation, Significant Resource Areas and Floodplains.

With respect to natural hazards, the Timber Conservation Zone includes Fire Siting Standards for Dwellings and Structures, while the Floodplain Overlay includes provisions for Flood Hazard Reductions.[45]

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 infrastructure and service needs, specific engineering standards, and building codes.[46] Discontinuing or decreasing development in floodplains may potentially reduce an area's vulnerability to hazards. While Oregon has adopted 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, over 6,000 housing structures were built in Polk County over the last decade as shown in Table 5.

Table 5. Housing Age-Structure in Polk County

Year	Number	Percent
1999 - March 2000	851	3.5
1995 to 1998	3,047	12.5
1990 to 1994	2,225	9.1
1980 to1989	2,664	10.9
190 to 1979	6,066	24.8
1960 to 1969	2,973	12.2
1940 to 1959	3,920	16
1939 or earlier	2,715	11.1

Source: U.S. Census 2000

Between 1960 and 1979, roughly 37 percent of Polk County's houses were built, followed by another 36 percent between 1980 and the year 2000.[47] Less than four percent of the total land area in Polk County is in high-density development and close to two percent is allocated to future low-density residential development.[48] These estimations suggest more pressure on land resources in the county related to low-density residential development.

The year-built date is important for mitigation because the older the home, the greater risk of damage from a natural disaster. For example, structures built after the late 1960's in the Northwest and California used earthquake resistant designs and construction techniques.[49] 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.

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 Polk County was $42,311. This is slightly above the national average of $41,433 and the state's average of $40,916.

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 6 describes the county's employment by industry for the year 2000. It appears the highest percentage of worker's in Polk County are employed in, the educational/health/social services, manufacturing and retail trade sectors.

Table 6. Employment by Industry for Polk County

Industry	Number	Percent
Agriculture/Fishing/Forestry	1,575	5.4
Construction	1,705	5.8
Manufacturing	3,511	12
Wholesale Trade	769	2.6
Retail Trade	2,931	10
Transportation/Warehousing	952	3.3
Information	479	1.6
Finance/Insurance	1,512	5.2
Mgmt/Scientific/Waste	1,865	6.4
Educational/Health/Social Services	7,002	23.9
Arts/Entertainament/Recreation	2,464	8.4
Misc.	1,442	4.9
Public Administration	3,040	10.4

Source: U.S. Census, 2000

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. Prior to a natural hazard event, 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.[50] 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 Polk County, approximately 75 percent of workers over the age of 16 commute to work alone by automobile and a little over 0.8 percent use public transportation.[51] Other modes of transportation in Polk County include carpooling (14.1 percent), working at home (5.2 percent), walking (3.9 percent), and using other means (1.4 percent).

The county is well served by Interstate 5, Highways 22 and 99W, tying the region to the Salem Metropolitan Area. The region's north-south access is served by Interstate 5 and Highway 99W, while Highway 22 runs east west, and can be used to travel to the coast. The county's largest city, Salem, is located near all major transportation corridors. As the second largest city, Dallas has access to both Highway 22 and Highway 99W. As daily transit rises, there is an increased risk that a natural hazard event would disrupt the travel plans of residents across the region and even shut down the local transit systems.

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 3 and Table 7 show critical facilities in Polk County.

Table 7. Critical Facilities in Polk County

	Number
Hospitals	
Number of hospitals	1
Number of beds	36
Police Stations	4
Fire and Rescue Stations	3
School Districts & Colleges	2 districts, portions of 3 districts, 1 university
Power Plants	0
Dams	
Number of dams	59
Significant Hazard	9

Source: Oregon Department of Health, Local Sheriff Offices, Oregon Department of Education, Oregon Department of Energy, Oregon Department of Water Resources.

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. The number for dams in Table 8 are those registered with the Oregon Water Resources Department (WRD). There are many more unregistered dams in Polk County. According to Mr. Jon Falk, Dam Safety Coordinator for the 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.

Mr. Falk stated that within the WRD 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.[52]. Dam types, purposes, and sizes are available from the Oregon 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 should be detailed in the local and regional mitigation plans.

Community Profile – Endnotes

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[25] Yamhill Basin Council. September 2000. *Lower South Yamhill-Deer Creek Watershed Assessment*.
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Section 3:
Risk Assessment

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 and intensity of the hazard, the intensity of the hazard, and the probability of its occurrence. Maps are frequently used to display hazard identification data. Polk County identified nine major hazards that can affect this geographic area: floods, landslides, wildfires, earthquakes, severe winter storms, windstorms, drought, expansive soils, and volcanoes. The geographic extent of each of the identified hazards has been identified by the using the best available data, and is illustrated by the maps listed in Table 3-1.

2) ***Profiling Hazard Events*** describes the causes and characteristics of each hazard, how it has affected Polk County in the past, and what part of Polk 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 section.

3) ***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 the 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.

4) ***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 in 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.

5) ***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 Polk 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 Polk County can help identify 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 Polk County	Section 1: Introduction
2	Precipitation	Section 2: Community Profile
3	Critical Facilities	Section 2: Community Profile
4	River Subbasin Map	Section 6: Flood
5	County 100-Year Flood plain	Section 6: Flood
6	Landslide & Debris Flow Areas	Section 7: Landslides
7	Landslide Hazards West Salem	Section 7: Landslides
8	Fire Districts	Section 8: Wildfire
9	Expansive Soils	Section 12: Expansive Soils
10	Earthquake Hazard Areas	Section 13: Earthquake

Hazard assessments are subject to the availability of hazard-specific data. Gathering data for a hazard 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.

Polk 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: drought, expansive soils, landslides, severe winter storms, windstorms, wildfires, and volcanic eruptions.

Regardless of the data available for hazard 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. This risk assessment requirement is intended to provide information that will help communities to identify and prioritize mitigation activities that will reduce losses from the identified hazards. There are nine hazards profiled in the mitigation plan, including drought, expansive soils, floods, landslides, wildfires, earthquakes, winter storms, windstorms, and volcanic eruptions. The Federal criteria for risk assessment and information on how the Polk County Natural Hazard Mitigation Plan meets those criteria is outlined in Table 3-2 below.

Table 3-2. Federal Criteria for Risk Assessment

Section 322 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 GIS data are available, the county developed maps identifying the location of the hazard in the county. The Executive Summary and the Risk 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 Risk 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 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.

Section 4:
Mitigation Plan Mission, Goals and Action Items

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 Polk 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 county and 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 Polk County Natural Hazards Mitigation Plan is: *to assist in reducing risk, preventing loss, and protecting life, property, and the environment from future natural hazard events. The plan fosters collaboration and coordinated partnerships among public and private partners. This can be achieved by increasing public awareness and education and identifying activities to guide the county towards building a safer community.*

Mitigation Plan Goals

Mitigation plan goals are broad statements of direction that Polk 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 Polk 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: PUBLIC EDUCATION AND AWARENESS

Provide public information and education/awareness to all residents of the county concerning natural hazard areas and mitigation efforts.

Goal #2: PREVENTIVE AND IMPLEMENTATION

Develop and implement activities to protect human life, commerce, property and natural systems.

Goal #3: COLLABORATION AND COORDINATION

Strengthen hazard mitigation by increasing collaboration and coordination among citizens, public agencies, non-profit organizations, businesses, and industry.

Goal #4: FUNDING AND PARTNERSHIPS

Seek partnerships in funding and resources for future mitigation efforts.

Goal #5: EMERGENCY OPERATIONS

Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

Goal #6: NATURAL RESOURCES UTILIZATION

Link land use planning, development criteria, codes, and natural resources and watershed planning with natural hazard mitigation.

Natural Hazard Mitigation Plan Action Items

Action items are detailed recommendations for mitigating the impacts of natural hazard events in Polk 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 specified 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 Polk County from natural hazards. Each action item includes information regarding timeframe during which the action should occur, the responsible parties that should be involved, and what resources are needed to implement the activity.

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 emphasize incorporating the actions of the mitigation plan into existing programs and other planning mechanisms such as land use and capital improvement plans where appropriate.

Mitigation plan activities or action items may be considered for funding through state and federal grant programs, including 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(s).
2. Partner organizations (Internal and External).
3. Timeline.
4. Notes and implementation ideas.
5. Plan goals addressed.

The sections of this plan that address the seven chronic hazards and two catastrophic hazards 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 my 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 were not necessarily contacted during plan development. Partner organizations should be contacted by the coordinating organization to establish commitment of time and resources to activities

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. The internal and external partner organizations listed in the Mitigation Plan are potential partners recommended by the project steering committee, but not necessarily contacted during the development of the plan. The coordinating organization should contact the identified partner organizations to see if they are capable of and interested in participation. This initial contact is also to gain a commitment of time and or resources towards completion of the action items.

Timeline:

Action items include both short- and long-term activities. Each action item includes an estimate of the timeline for implementation. *Short-term action items* (ST) are activities that may be implemented with existing resources and authorities within one to two years. *Long-term action items* (LT) may require new or additional resources and/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 would 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 items includes a list of the plan goals that the activity addresses. 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 in the planning process, noted deficiencies in local planning and response processes, or issues identified through risk assessment

Public Participation

In addition to the Steering Committee meetings, an open house was held on April 19, 2005, to inform the public about Polk County natural hazards. The purpose of the open house was to gather comments and ideas from the residents of Polk County about natural hazards mitigation planning, to inform the public about natural hazards that occur in Polk County, identify community priorities, and identify 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 from natural hazards in Polk County.

Multi-Hazard Action Items (MH)

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

Natural systems are in a constant state of flux, which creates unpredictability where unforeseen and unplanned natural hazard events happen. The Polk County Natural Hazards Mitigation Plan, through the use of multi-hazard action items, can address natural hazards outside of the nine hazards identified by the county. Such additional natural hazard events would be considered a *force majeure* ("Act of a Higher Power").

All of the action items contained in this document, both hazard specific and multi-hazard, complement each other and prepare our communities to better cope with natural hazards.

Multi-Hazard Action Item 1: Sustain an education and outreach program for local jurisdictions and assist them in developing emergency operations, public information, and hazard mitigation plans.

NOTE: County Emergency Management is responsible for helping local jurisdictions develop plans that are compatible and well coordinated with other agency plans.

Ideas for Implementation:

- Develop workshops and outreach materials with Oregon Natural Hazards Workgroup (ONHW), MWVCOG, Polk County Emergency Management, and Polk County Planning to assist in developing Natural Hazard Mitigation Plans for incorporated communities in Polk County.
- Incorporate completed, approved mitigation plans with the Polk County Natural Hazard Mitigation Plan as addenda.
- 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:	Incorporated communities in Polk County, city emergency management agencies, Red Cross, emergency response agencies, MWVCOG, OEM, FEMA
Timeline:	1 to 2 years, On-going
Plan Goals Addressed:	Public Education & Awareness, Preventive & Implementation, Collaboration & Coordination;

Funding & Partnerships, Emergency Operations

Multi-Hazard Action Item 2: Review and update the Polk County Emergency Operations Plan and the Natural Hazards Mitigation Plan on an annual basis. Conduct a complete review and update of the plans and have them officially promulgated by the Polk County Board of Commissioners (BOC) every five years.

Idea for Implementation:

- Polk County Emergency Management will coordinate plan updates annually and complete reviews at least every five years. During the complete reviews, the plans will be evaluated with respect to the county's Zoning Ordinance and Comprehensive Land Use Plan.
- Consider the goals and action items from the Polk County Natural Hazard Mitigation Plan for implementation in other county documents and programs, where appropriate.
- Review the Natural Hazards Mitigation Plan for opportunities to update the county's Comprehensive Land Use Plan and supporting plans and documents. 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.
- Integrate goals and action items into the county's stormwater management program.

Coordinating Organizations:	Emergency Management and Planning Division
Internal Partners:	County departments, Steering Committee
External Partners:	City emergency management agencies, Red Cross, Polk Fire Defense Board, NWS, utility companies, ODF, ODOT, ARES
Timeline:	1 to 5 years, On-going
Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships; Emergency Operations; Natural Resources Utilization

Multi-Hazard Action Item 3: Evaluate the effectiveness of existing programs and identify natural hazards mitigation needs. Balance the objectives of existing programs' goals with natural hazards mitigation.

Coordinating Organization: Emergency Management
Internal Partners: Public Works and Planning Division
Timeline: 1 to 3 years, On-going
Plan Goals Addressed: Preventive & Implementation

Multi-Hazard Action Item 4: Identify coordination opportunities to maximize or leverage funding opportunities that address multi-jurisdictional projects.

Ideas for Implementation:

- Develop incentives that encourage local governments, special districts, residents, and businesses to consider hazard mitigation projects.
- Consider identifying funding sources that assist in completing mitigation projects when possible.
- Develop partnerships among organizations and agencies in Polk County to identify grant programs and foundations that support mitigation activities.

Coordinating Organization: Steering Committee
Internal Partner: Planning Division
External Partners: OEM, FEMA, IISOI
Timeline: 1 to 2 years
Plan Goals Addressed: Public Education & Awareness; Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships; Emergency Operations

Multi-Hazard Action Item 5: Develop a process for the Polk 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;
- Present an annual progress report to Board of Commissioners on mitigation action items to see which have been completed, which need to be added, deleted, postponed, etc.
- Conduct a review of the Natural Hazard Mitigation Plan at least every 5 years, evaluating mitigation successes and areas that were not addressed.

Coordinating Organization: Steering Committee
Timeline: One year – upon adoption of the plan
Plan Goals Addressed: Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships

Multi-Hazard Action Item 6: Determine the impact that each natural hazard could have on the county's 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: Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships; Emergency Operations

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 benefits of mitigation activities to reduce risk from hazards.
- Encourage communication and dissemination of natural hazards mitigation information utilizing available technology and resources.

Coordinating Organization: Emergency Management
Internal Partner: Planning Division
External Partner: Chambers of Commerce
Timeline: 1 to 2 years
Plan Goals Addressed: Public Education & Awareness, Preventive & Implementation, Collaboration & Coordination, Funding & Partnerships;

Emergency Operations; Natural Resources Utilization

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

Ideas for Implementation:

- Identify all organizations within Polk County that have programs or interests in natural hazards mitigation planning.
- Involve private businesses throughout the county in mitigation planning activities and education/outreach; as well as applicable emergency response and recovery.

Coordinating Organization:	Emergency Management
Internal Partner:	Planning Division
Timeline:	On-going
Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships

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

Ideas for Implementation:

- Prioritize mitigation projects.
- Identify critical facilities at risk from natural hazards events.
- Develop strategies to mitigate risks 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 earthquakes.
- Enhance evacuation route system capacities and identify alternative measures.

Coordinating Organization:	Emergency Management
Internal Partner:	Public Works and Planning Division, GIS
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:	Public Education & Awareness; Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships

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 (e.g., the county cannot plow private driveways).
- Encourage private property owners to upgrade private roadways to accommodate emergency vehicles.
- Encourage individual and family preparedness through public and private education projects.
- Encourage coordination of emergency transportation routes between the Polk County Sheriff's Office, Polk County Public Works, city jurisdictions, and ODOT.
- Utilize communication technology and equipment to provide the public with emergency/natural hazards information during events.
- 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 Partner:	Public Works, Planning Division
External Partners:	Cities, ODOT
Timeline:	3 to 5 years
Plan Goals Addressed:	Public Education & Awareness, Preventive & Implementation; Emergency Operations

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

Ideas for Implementation:

- Develop outreach programs to Polk County business organizations emphasizing the need to prepare for natural hazard events.
- Develop adult and child public service announcements (PSA) or press releases adapted for communities to be used by local radio and cable stations.

- Utilize recognized "National Weeks" for fire prevention, public works, and other such events.
- Utilize county events such as the county fair and other county-sponsored events to disseminate and provide natural hazards information.
- Utilize county Web site and programs during annual outreach programs by various county divisions and agencies.
- Coordinate with school programs and adult education on reducing risk and preventing loss from natural hazards through education.
- Utilize community resources such as libraries, phone books, etc.
- Conduct natural hazards 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, Willamette ESD
Internal Partner:	Emergency Management, Planning and Building Divisions, Health Department
External Partners:	Emergency response providers, Red Cross, utilities, MWVCOG, OEM, FEMA, media
Timeline:	On-going
Plan Goals Addressed:	Public Education & Awareness, Preventive & Implementation, Natural Resources Utilization

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

Ideas for Implementation:

- Survey the public to determine level of preparedness and find out what deters people from taking preventive actions
- Inform and educate the public about potential natural hazards in Polk County, personal preparedness, mitigation activities and opportunities, and options available when natural hazards events occur. The public awareness campaign could includes some of the following activities:

- Present hazard-specific information at public workshops.
- Distribute preparedness and mitigation information at community fairs and events.
- Maintain a natural hazards display on historical hazard events at the Polk County Museum and Historical Society facility.
- Use public service announcements (PSA) to educate people about emergency procedures.
- Develop a hazards information Web site that contains or links to 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 Partner:	Public Works and Planning Division
External Partners:	Red Cross, MWVCOG, school districts, emergency response agencies, utility companies, media, FEMA, OEM
Timeline:	On-going
Plan Goals Addressed:	Public Education & Awareness, Preventive & Implementation, Funding & Partnerships, Collaboration & Coordination

Multi-Hazard Action Item 13: Make the Polk County Emergency Operations Plan, the Natural Hazards Mitigation Plan, and other resources on hazards planning and mitigation available to the public electronically.

Note: Publishing the Emergency Operations Plan and the Natural Hazards Mitigation Plan electronically can foster dissemination of hazards-related information and raise public awareness of natural hazards.

Coordinating Organization:	Emergency Management and Planning Division
Internal Partner:	County Webmaster
Timeline:	1 to 2 years
Plan Goals Addressed:	Public Education & Awareness

Multi-Hazard Action Item 14: Promote hazard-resistant utility construction and maintenance methods (Best Management Practices – BMP).

Ideas for Implementation:

- Support/encourage utility and telecommunications companies to use construction and maintenance methods that reduce service and power outages from various natural hazards.

Coordinating Organizations: MWVCOG, Emergency Management
External Partners: City emergency management agencies, ARES, utility companies
Timeline: 3 to 5 years
Plan Goals Addressed: Public Education & Awareness, Preventive & Implementation, Natural Resources Utilization

Multi-Hazard Action Item 15: Develop a system for data collection for undeclared natural hazard events.

NOTE: All disasters are local, and cause cumulative effects for the community. If a natural hazard event is not declared by the state, but the event impacts the county, costs to deal with the event are borne by the county.

Ideas for Implementation:

- Establish a data collection system that collects and stores damage information, and link the information to a GIS database that can provide mapping of the impacted areas of the county.
- Include countywide damage totals and distribution for each event. Over time, this data will show the geographic patterns of occurrence and vulnerability.
- Utilize this data in hazards mitigation planning and prioritizing mitigation projects.

Coordinating Organization: Emergency Management
Internal Partners: Building Division, GIS
External Partners: City emergency management agencies, IISOI, farm services, insurance companies
Timeline: 3 to 5 years
Plan Goals Addressed: Public Education & Awareness, Preventive & Implementation, Collaboration & Coordination, Funding & Partnerships, Emergency Operations

Multi-Hazard Action Item 16: Improve coordination of and evaluate technical and engineering gaps in response services (e.g., communication equipment/systems) for natural hazards

event response. Develop a long-term recovery plan for Polk County from the effects of natural hazards events.

Ideas for Implementation:

- Coordinate with other entities after a seismic event, and identify what limitations exist that inhibit a coordinated response.
- Where possible, develop mutual aid agreements for assistance after catastrophic natural events.
- Develop a long-term recovery plan that identifies how and where Polk County's unincorporated rural communities would rebuild after a catastrophic event.
- Identify likely scenarios for rebuilding structures, transportation routes, and infrastructure conduits.

Coordinating Organization:	Emergency Management
External Partner:	USGS, DOGAMI, adjacent counties' emergency management, Red Cross, hospitals, Army National Guard
Timeline:	1 to 5 years
Plan Goals Addressed:	Collaboration & Coordination, Funding & Partnerships, Emergency Operations

Section 5:
Plan Implementation, Maintenance and Public Participation

Overview

The plan implementation and maintenance section of this document details the formal process to ensure that the Polk County Natural Hazards Mitigation Plan (NHMP) 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 Polk 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 Polk County to review and update sections as new data becomes available. New data can be easily incorporated, resulting in a natural hazards mitigation plan that remains current and relevant to Polk 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 Polk County NHMP was developed and will be implemented through a collaborative process. After the Polk 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 Polk County Hazard Mitigation 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. Polk County Community Development Department 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 Polk County NHMP includes a range of action items that, if implemented, would reduce loss from hazard events in Polk County. The action items in the Polk County NHMP provide the framework for activities that divisions within the county's Community Development, Public Works and Sheriff's Departments can choose to implement over the next five years. The Hazard Mitigation Steering Committee prioritized the plan's goals and identified actions, which will be implemented, as resources permit, through existing plans, policies, and programs.

Coordinating Body

The Polk County Community Development Department will be the coordinating body for the mitigation plan.

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

Convener

The county has designated Polk County Community Development Department as the responsible agency for the implementation and maintenance of the plan. Community Development's joint convener shall be the Emergency Management Division of the Sheriff's 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 Polk County. Within the framework of the plan, FEMA requires the identification of existing programs that might be used to implement these action items. Polk County currently addresses statewide planning goals and legislative requirements through its comprehensive land use plan, capital improvement plan, transportation systems plan, mandated standards and building codes. To the extent possible, Polk County will work to incorporate the recommended mitigation action items into existing programs and procedures.

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, and 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.

Polk County Community Development and the county's Emergency Management will use FEMA-approved cost benefit methodology as a tool for identifying and prioritizing mitigation action items when applying for federal mitigation funding. For other projects and funding sources, Community Development and Emergency Management 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, please see Appendix C.

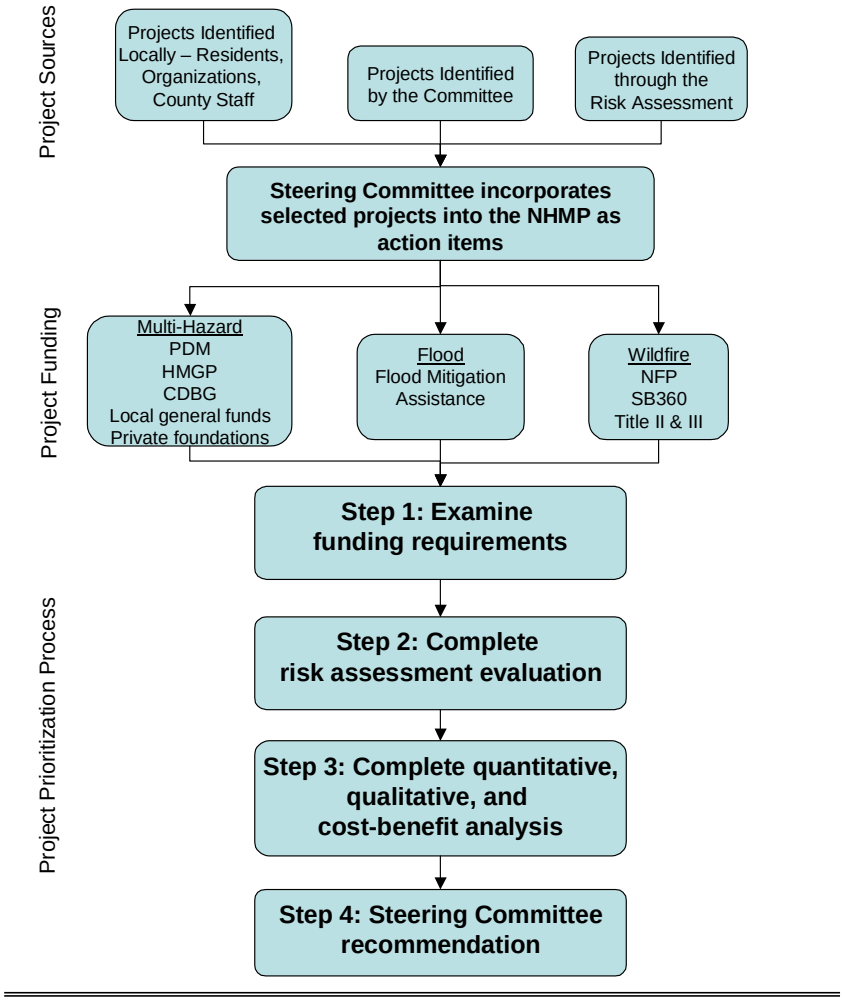
Project Prioritization Process

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: Hazards Mitigation 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

Methodology for Prioritizing Plan Action Items

To initially prioritize the plan's action items, Polk County utilized a multi-tiered approach. First, the plan goals were prioritized. Second, the Hazards Mitigation Steering Committee prioritized the community hazards.

Using the outcome of these two activities, the Hazards Mitigation Steering Committee proceeds with the four steps outlined in Figure 5.1 in order to determine an action item's relative priority within the

plan. The 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 Hazards Mitigation Steering Committee and the Polk 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 Hazards Mitigation Steering Committee to initially prioritize the plan's goals and action items will also be used by the Polk County Community Development Department to maintain the list.

Polk County Community Development Department 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.

Prioritizing Plan Goals

To accomplish this task, the Hazards Mitigation Steering Committee examined and voted on the importance of each of the plan's six goals. The steering committee was led through a prioritization activity to determine the relative priority of each goal. Steering committee members were instructed to prioritize the goals from highest to lowest, thereby ranking the importance of each goal in making Polk 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 was asked to rank the goals regardless of how each goal would be to accomplish. After the vote, their priorities were tallied and the results are as follows:

1. Provide public information and education/awareness to all residents of the county concerning natural hazard areas and mitigation efforts.
2. Develop and implement activities to protect human life, commerce, property and natural systems.
3. Strengthen hazard mitigation by increasing collaboration and coordination among citizens, public agencies, non-profit organizations, businesses, and industry.
4. Seek partnerships in funding and resources for future mitigation efforts.

5. Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.
6. Link land use planning, development criteria, codes, and natural resources and watershed planning with natural hazard mitigation.

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

Prioritizing Community Hazards

The second step in prioritizing the plan's action items was to examine which hazards they are associated with and where these hazards rank in terms of community risk.

To rank the hazards, each steering committee member completed a "relative priority" matrix like the one shown below.

Natural Hazard Prioritization – Relative Priority Matrix*

Natural Hazard	Frequency +	Area of Impact x	Magnitude of Damages =	Total
Flood				
Landslide				
Wildfire				
Severe winter storm				
Windstorm /Tornado				
Drought				
Earthquake				
Volcanic Eruption				

* Although one of Polk County's identified natural hazards, 'expansive soils' was excluded from the priority matrix.

The Steering Committee scored frequency, area of impact, and magnitude of damages from 1 to 5, with 1 being a low score and 5 the highest. The Frequency and Area of Impact scores were then added together and the result multiplied by the Magnitude of Damages score to calculate the Total score.

The rank ordering of hazards by risk follows:

1. Earthquake
2. Severe Winter Storm
3. Flood
4. Windstorm

5. Wildfire
6. Drought
7. Volcanic Eruption
8. Landslide

Each of the action items in the plan addresses risk from one or more of these hazards.

Prioritizing and Implementing Action Items

Polk County's Community Development Department will review, guide and promote the implementation of action items. The Hazards Mitigation Steering Committee and Polk 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?

Step 1: Examine Funding Requirements

The Hazards Mitigation Steering Committee will examine the selected funding stream's requirements to ensure that the mitigation activity would be eligible through the funding source. The Hazards Mitigation Steering Committee may consult with the funding entity, Oregon Emergency Management, or other appropriate state or regional organization about the project's eligibility.

Step 2: Complete Risk Assessment Evaluation

The second step in prioritizing the plan's action items is to examine which hazards they are associated with and where these hazards rank in terms of community risk. 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.

Step 3: Complete Quantitative, Qualitative Assessment, and Economic Analysis

Depending on the type of project and the funding source, either a quantitative or qualitative assessment of cost effectiveness will be completed to assist in prioritizing potential actions.

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 the process required for Step 3.

Step 4: 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, Polk County Community Development Department 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 Polk 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 Hazards Mitigation 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 convener 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. Polk County Community Development staff will be responsible for updating any deficiencies found in the plan based on the questions above.

Formal Review Process

This section presented Polk County's method to ensure that regular review and updating of the Polk County Natural Hazards Mitigation Plan occurs. In summary, Polk County Community Development Department is responsible for monitoring and evaluating the progress of the mitigation strategy in the plan. Community Development, as convener, will also organize plan review meetings on a regular basis.

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, the county Website and the media.

Community Development is the responsible party for incorporating the changes and updates to the plan. On an annual basis, Community Development will present to the Polk 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.

Continued Public Involvement

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

A copy of the plan will be made available to the public at the Polk County Community Development Department. In addition, access to the plan and notices of all updates and changes will be maintained on the Polk County Community Development Department Website. The Website will also provide the public with an e-mail address and phone number so that they may submit comments and questions about the plan.

A public meeting will be held for each annual evaluation when deemed necessary by the Polk County Community Development Department. The meetings will provide a public forum for expressing concerns, opinions, or ideas about the plan. The Community Development Department will be responsible for publicizing public meetings and maintaining public involvement.

Section 6:
Flood

Why are Floods a Threat to Polk County?

Floods are common events in Oregon and usually fall into one of four categories: flash floods, rain-on-snow floods, snowmelt floods and debris flow floods[1]. Any of these floods can be extremely dangerous and destructive, damaging property and crops and resulting in injury or death. Flood effects may disrupt communities for months and the financial costs of addressing damaged infrastructure can be great.

Floods in Western Oregon have historically occurred during winter months when upper atmosphere winds blow from the southwest. These winds, originating above the Pacific Ocean near the equator, form a "subtropical jet stream" that is a deep and wide mass of warm moist air. Sometimes referred to as the Pineapple Express, the warm air mass will drop above average amounts of rain and melt snow on the west facing slopes of the Cascades Mountains. This combination can create rain-on-snow floods in the Willamette Valley. In fact, this type of event was behind the February 1996 flood that caused severe flooding throughout the Willamette Valley, including Polk County where the Luckiamute River at Suver crested at 33 feet and the Willamette River at Salem crested at 35 feet.[2]

The 1996 floods caused a statewide loss of $400 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.[3]

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.[4]

Residents in Polk County share a statewide concern about flood issues. According to the National Flood Insurance Program (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.

As of September 2002, Oregon had 26,273 NFIP policies with an annual premium total of $11,999,383 – 21.422 for single-family dwellings, 1,023 for two to four-family structures; 1,820 for other residential; and 2,008 for nonresidential. The average premium for all building types was $457. For residential, the average premium was $408 and for nonresidential is $1,051.

History of Flooding in Polk 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 when the largest flood on record on the Willamette River occurred in 1861. Since then, however, the construction of dams

in the 1940s and 1950s changed the pattern of flooding significantly. Polk County has seen two major floods and three lesser floods during the last 35 years. 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-January 1964

The “Christmas” flood of 1964 was the largest flood to occur since the major dam construction on the upper Willamette. 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, which exacerbated near record early season snow depths. The flooding caused 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."[6]

Monetary loss due to sedimentation and other damages to agricultural lands resulting from the 1964 flood amounted to approximately $355,000 (1964 dollars) in Polk County.[7]

January 1974

Heavy snow and freezing rain, and a series of mild storms caused snowmelt and rapid runoff in mid-January 1974. Nine counties in Oregon were declared disaster areas, including Polk County. Several roads were closed due to high water and damage to bridges and stream banks from the storms and flooding cost and estimated $575,000. This figure did not include damage to homes, pastures, livestock or crops.[8]

January 1987

In a 24-hour period between January 31 and February 1, 1987 three and a half inches of rain fell on the Dallas area. The heavy rains caused the Willamette and Luckiamute Rivers and Rickreall Creek to swell their banks causing mudslides and damaging homes and highways. Two hundred and sixty five residents of Rickreall lost power and 20 experienced water outages. The erosion of a stream bank that caused a tree to fall and break a water main caused the disruption in water supply.[9]

February 1996

Residents of Polk County experienced more than one flood during 1996. In February 1996, a combination of snow-pack, warm temperatures, and record-breaking rains caused streams to rise to all-time flood record levels.[10] Much of the reason for the record flood levels was that in 1996, Mt. Laurel, fifteen miles northwest of Falls City received a record breaking 17 feet of rain, more than any other location in Oregon’s recorded history. Much of this rainfall flowed into the Luckiamute River and eventually Rickreall Creek where flooding occurred.[11]

This event caused nearly $3 million in damages within Polk County and resulted in one flood related death. The Willamette River rose from 14 to 34 feet in Independence forcing dozens of residents to evacuate their homes. Edgewater Street in Salem was flooded and a highway to the coast was closed because of rockslides.[12]

November 1996

The Willamette Valley region was hard hit again by rains and flooding in November of 1996. Once again, Polk County escaped the storms relatively unscathed, with the exception of a 70-foot section of Parker road near Independence that was wiped out by a torrent of floodwaters, which left a 15-foot deep hole. Four motorists drove vehicles, including a semi-truck, into the hole. There were no deaths, but one motorist was severely injured.[13]

January 1997

The flood event that began in December 1996 and continued to January 5, 1997, prompted County Commissioners to declare a state of emergency and caused approximately $250,000 of damage to the county. The Willamette River rose to 28.8 feet and the Luckiamute River rose to 27.8 feet, both nearly one foot above flood stage.[14] Two hundred and fifty Dallas residents lost power. Flooding and high water closed many county roads, especially in the Monmouth/Independence area. In Independence, the bandstand in Riverview Park was submerged.[15]

Polk County Flood: Wallace Bridge of the Yamhill River, 1964 (Polk County)

Repetitive Flood Losses in Polk County

The properties in and near the floodplains of Polk 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 experienced flood damage tend to 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 the home, or by elevating the structure.

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.[16] Polk County residents have received approximately $4,200 in repetitive loss payments.[17]

In Polk County, there were three documented repetitive loss properties. Two of the properties were not located in the floodplain, but were located near enough to Rickreall Creek that due to the creek's banks eroding, the dwellings were significantly damaged. The property owners were compensated for abandoning their property, which is now used as parkland in the City of Dallas. The third property along Mill Creek repeatedly flooded. The county assisted the property owners in replacing the dwelling located in the floodplain with a manufactured dwelling located outside of the Mill Creek floodplain.[18]

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 Polk County, geography and climate combine to create chronic seasonal flooding conditions.

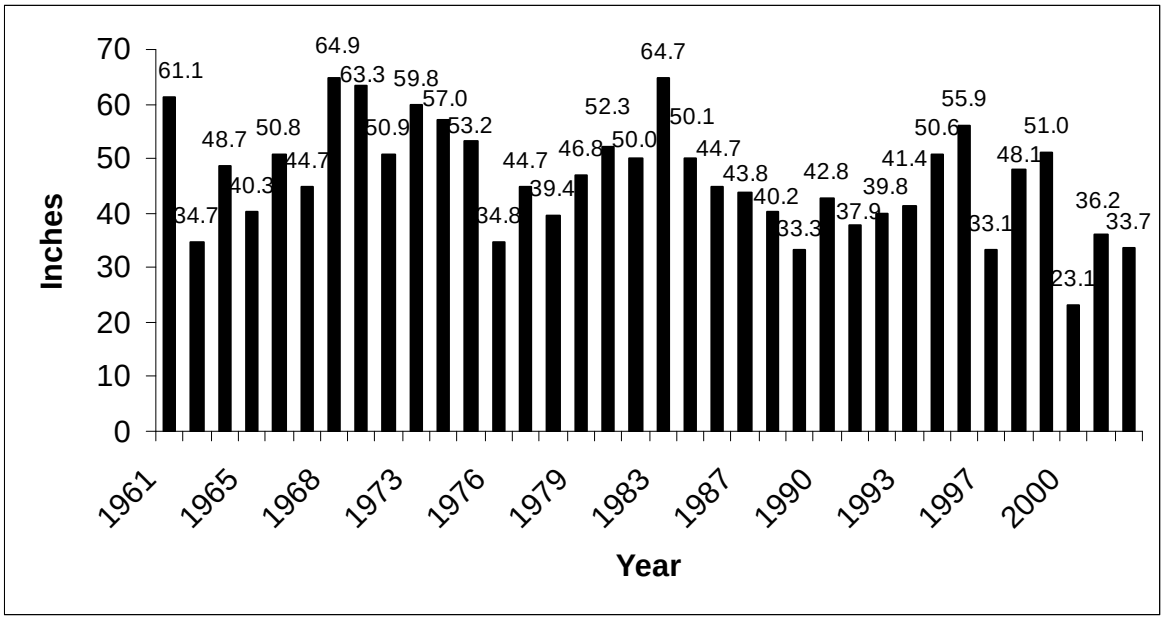
Precipitation

Because Polk 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 Polk County ranges from 3,725 feet on Laurel Mountain to 125 feet on the Willamette River floodplain. As is typical for the west side of the Cascades, precipitation is not spread evenly over the calendar year but falls during the winter and spring months in a water year that runs from October to May or June. Likewise, there is a corresponding precipitation range with an approximately 150 inches per year falling on the Coast Range to 40 inches in the lower elevations of the county.[19] Map 2 in Section 2 shows precipitation throughout Polk County.

The amount of precipitation is not the only factor that influences peak flows. They are also influenced by withdrawals for irritation and drinking water, stream and wetland modifications, changes in land use and water-related technology, and the removal of vegetation.[20] 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.

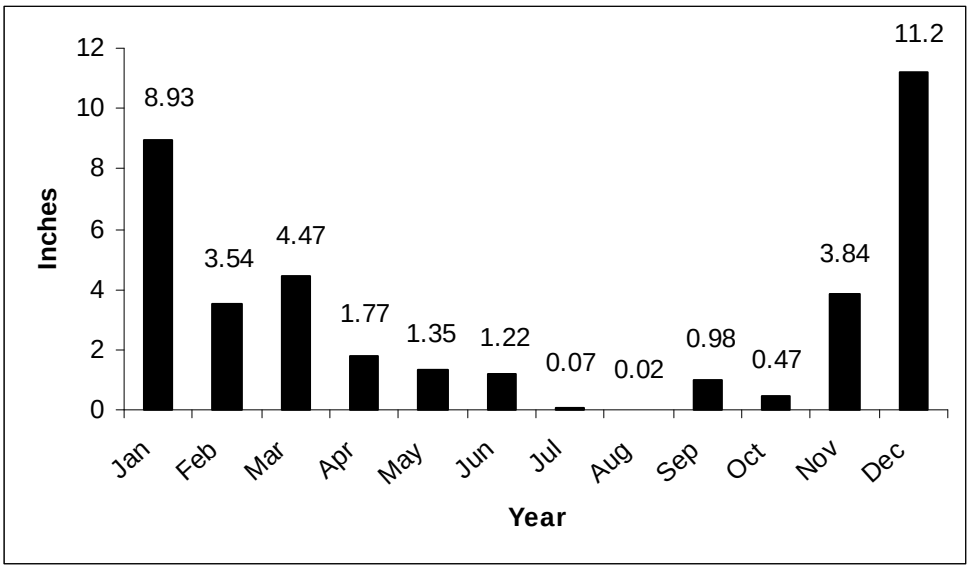
Flooding is most common from October through April, when storms from the Pacific Ocean, 60 miles away, bring intense rainfall to the area.[21] Polk County receives approximately 51 inches of rain on average each year (see Figure 6.1 & 6.2). During the rainy season, monthly rainfall totals average far 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.[22]

Figure 6.1 Annual Precipitation in Polk County, Oregon, 1961-2002



Source: Oregon Climate Service
*Data missing for the following incomplete years: 1969-1970, 1981,1985,1994

Figure 6.2 Average Monthly Precipitation Salem, OR 2002



Oregon Climate Service, Zone 2 Climate Data Archives. Webpage: http://www.ocs.orst.edu/

Geography

Polk County is located in the Mid-Willamette Valley in northwest Oregon. It is comprised of 735 square miles and extends west from the Willamette River, to the crest of the Coast Range. The eastern part of the county sits on the main valley floor and on an alluvial floodplain. Polk County has a modified marine climate that varies widely from east to west.

Floodplain Terminology

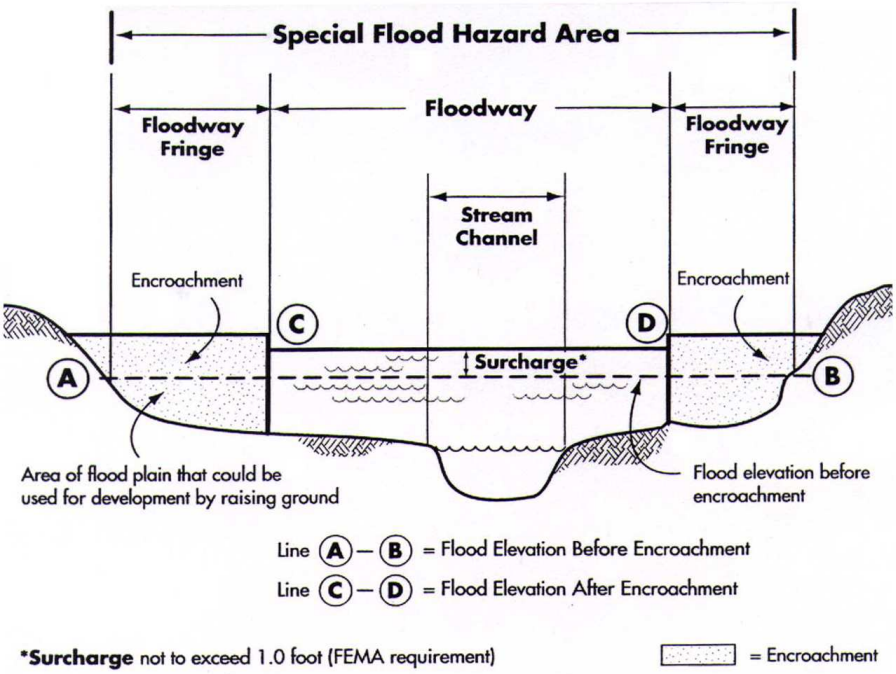
Floodplain

A floodplain is a land area adjacent to a river, stream, lake, estuary, or other water body that is subject to flooding (see Figure 6.3). 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 (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 6.3 Floodplain Schematic



Source: Missouri Emergency Management Agency. March 1999. *Floodplain Management in Missouri*.

Flood Fringe

The flood fringe refers to the outer portions of the floodplain, beginning at the edge of the floodway and continuing outward. This is the area where development is most likely to occur, and where precautions to protect life and property need to be taken. While the Polk County Zoning Ordinance does not define the flood fringe, it does set forth a flood overlay zone that, with some exceptions, prohibits subdivisions, storage of materials and equipment and residential and non-residential development.[23]

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.[24] FEMA completed a vertical datum conversion from the National Geodetic Vertical Datum of 1929 to the North American Vertical Datum of 1988, by adding 3.4 feet to all flooding sources in Polk County.[25] This revision includes floodplain maps showing areas that would be inundated by the base (100-year) flood.

Base flood elevations can be set at levels other than the 100-year flood. 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.[26]

Characteristics of Flooding in Polk County

Two types of flooding primarily affect Polk 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.[27]

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. Adding these elements to the hydrological systems can result in floodwaters that rise very rapidly and peak with violent force.

A large portion of urban areas has a high concentration of impermeable surfaces that either collect water, or concentrate the flow of water in 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 causing additional localized flooding.

Riverine Flooding

Riverine flooding is the over-bank flooding of rivers and streams. 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.[28] Map 4 shows the river subbasins within Polk County.

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 flood ways to assure minimization of any encroachments in the floodway or floodplain. This can be 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 through regulations that focus on building codes and "sound floodplain management."[29] In Polk County, the NFIP and related building code regulations went into effect in 1974. 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.[30] In Polk 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 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 (BFE) 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. These studies and maps represent flood risk at the point in time when FEMA completed the studies. 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. Artificial and natural changes to the environment have changed the course of many of the rivers in the county, as well as their associated floodplain boundaries.[31]

FEMA provided Polk County with a preliminary Flood Insurance Study (FIS) and preliminary Flood Insurance Rate Maps (FIRMs) dated February 17, 2005 for Ash Creek and the North Fork Ash Creek, and an overflow channel of Ash Creek. The county is reviewing the report and maps, and will be meeting with FEMA in April 2005.

Revised Flood Insurance Rate Maps (FIRM) will be used by lending institutions and insurance agents in determining who must purchase flood insurance and in determining the cost of the insurance. Polk County and the cities of Dallas, Falls City, Independence and Monmouth will use the maps for floodplain management and permitting purposes.

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 artificially caused flooding.

In order to address this lack of data, many jurisdictions have taken efforts to develop more localized flood hazard maps. One method that has been employed by some jurisdictions 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 has 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 5 shows 100-year floodplains within Polk 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 Polk 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. As such, it builds upon the hazard identification and vulnerability assessment.

A flood risk analysis for Polk 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 Polk 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 damage from the 1996 flood events.[32]

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.[33] Water saturating materials susceptible to loss e.g., wood, insulation, wallboard, fabric, furnishings, floor coverings, and appliances cause most flood damage.

Manufactured Homes

Statewide, the 1996 floods destroyed 156 housing units. Of those units, 61 percent were manufactured homes and trailers.[34] 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 pre-fabricated 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.[35]

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 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 can include funding to assist owners in elevating or relocating flood-prone business structures.[36]

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 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.

Power transmission can also be disrupted during a flood because when debris piles up around structures, the power poles sometimes collapse and cause power outages.[37]

Buildings and Roads

In the wake of the 1996 flood events, damage to public buildings statewide represented 34 percent of total public losses.[38] 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. Roads systems in Polk 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 roads at risk from flooding.

Bridges

There are 121 bridges maintained by Polk County.[39] A complete inventory of county bridges is available at the County Public Works Department.[40]

Bridges 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.

Stormwater System

Local drainage problems are common throughout the region. Some communities have drainage master plans, and local public works staff and water control districts are often aware of local drainage threats. The 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 as a result of storms 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.[41]

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.

Riparian Areas

Riparian areas are important transitional areas, which 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 amounts of water such as willow and cottonwood trees. Healthy vegetation in riparian buffers can reduce streamside erosion.[42] During flood events, high water can cause significant erosion. Well-managed riparian areas can reduce the amount of erosion and help to protect water quality during flood events.

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.[43] 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.[44]

Mitigation Plan Goals and Existing Activities

Existing Mitigation Activities

County Programs

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

Polk County Codes, Ordinances and Regulations

Polk County uses building codes, zoning ordinances, 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:** Dwellings shall have the top of the lowest floor, including basement, elevated one (1) foot above base flood elevation and the bottom of the lowest habitable floor constructed a minimum of two (2) feet above grade. Developers must complete a Floodplain Development Permit Application as outlined in Chapter 178 of the Polk County Zoning Ordinance (PCZO).
    - **Affected Properties:** All development in the floodplain.
- **Mitigation Requirements:** Greenway Management Overlay Zone (PCZO Chapter 173), Significant Resource Areas Overlay Zone (PCZO Chapter 182).
    - **Affected Properties:** Development in areas that could be prone to flooding, and/or within riparian areas and wetlands.

Polk County Public Works, Placement of "High Water" Signs

Appropriately placed "High Water" warn motorists of flooding on roadways and adjacent right-of-way. Posting signs provides motorists and opportunity to find alternative routes of travel before they encounter a flooded road, or before their vehicle is disabled in the high water.

Polk County Public Works maintains 51 "high water" signs throughout the county – 32 permanent and 19 temporary signs. Nineteen of the signs are posted within the Yamhill River Basin; eighteen signs are posted within the Luckiamute River Basin; nine are posted within the Rickreall Creek Basin; and the county maintains four "high water" signs within the (mainstem of the) Willamette Basin.

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 a total of 59 dams in Polk County registered with the Oregon Water Resources Department holding millions of gallons of water in reservoirs. The largest reservoirs in Polk

County include the following, none of which are primarily used for flood management:

- Mercer Reservoir (City of Dallas, OR) – 1,550 acre feet usable storage (Rickreall Creek)
- DeRaeve Dam #1(private) – 325 acre feet storage (Ash Creek Swale)
- Morgan Brothers Reservoir (USFWS) – 310 acre feet storage (Basket Slough)

State Programs

State of Oregon Floodplain and Floodway Removal/Fill Law

The Oregon Removal/Fill Law, ORS 196.795-990, 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).

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 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.[45]

Federal Programs

National Weather Service

The National Weather Service provides flood watches, warnings, and informational statements for rivers throughout Polk County. http://www.nws.noaa.gov

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.

http://www.fema.gov

National Flood Insurance Program (NFIP)

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. Oregon's Department of Land Conservation and Development 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 receive reduced NFIP flood insurance premiums if their city implements floodplain management practices that qualify for a CRS rating. Polk County's CRS rating as of December 2001 is '8'. 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: PUBLIC EDUCATION AND AWARENESS

Provide public information and education/awareness to all residents of the county concerning natural hazard areas and mitigation efforts.

Goal #2: PREVENTIVE AND IMPLEMENTATION

Develop and implement activities to protect human life, commerce, property and natural systems.

Goal #3: COLLABORATION AND COORDINATION

Strengthen hazard mitigation by increasing collaboration and coordination among citizens, public agencies, non-profit organizations, businesses, and industry.

Goal #4: FUNDING AND PARTNERSHIPS

Seek partnerships in funding and resources for future mitigation efforts.

Goal #5: EMERGENCY OPERATIONS

Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

Goal #6: NATURAL RESOURCES UTILIZATION

Link land use planning, development criteria, codes, and natural resources and watershed planning with natural hazard mitigation.

Flood Mitigation Action Items

The Polk County Natural Hazards Mitigation Plan Steering Committee formulated the following mitigation action items. Additional action items were formulated through 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 at which the county received comments from the public.

The flood mitigation action items provide direction on specific activities that organizations and residents in Polk 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 Polk County. These action items are designed to meet the 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 and implement 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;

- Distribute information regarding flooding to the general public efficiently; and

- Obtain and install more accurate precipitation stations; and

- Take steps towards becoming a National Weather Service "Storm Ready" community.

Coordinating Organization:	Emergency Management – Hazard Mitigation Team, Public Works
Internal Partner:	Planning
External Partners:	Watershed councils, cities, OSU Extension Service, USGS, WRD, DSL, OEM, BLM, USACE, private river gauges
Timeline:	1 to 2 years
Plan Goals Addressed:	Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships; Emergency Operations

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ST-FL #2: Conduct workshops periodically for target audiences on National Flood Insurance Programs, mitigation activities, and potential assistance from FEMA's Flood Mitigation Assistance and Hazard Mitigation Grant Programs.

Ideas for Implementation

- Include information about the financial aspects of building (and rebuilding) in the floodplain;
- Present information on how other communities have addressed building in the floodplain; and
- Selected audiences can include: realtors, lending institutions, surveyors, engineers, and government agencies.

Coordinating Organization:	Emergency Management – Hazard Mitigation Team
Internal Partner:	Community Development
External Partners:	Watershed councils, Polk SWCD, Ash Creek Water Control District, Realtor's Board (Oregon Association of Realtors), DLCD,OEM, FEMA
Timeline:	On-going

Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Funding & Partnerships

ST-FL #3: Continue to coordinate with appropriate agencies, and maintain an inventory of all aggregate operations adjacent to or within the floodplain.

Coordinating Organization:	Community Development
Internal Partners:	GIS, Public Works
External Partner:	DOGAMI, Watershed Councils, USACE, ODFW, DEQ, DSL, Aggregate Industries
Timeline:	On-going
Plan Goals Addressed:	Preventive & Implementation; Funding & Partnerships

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: Seek funding to update the Flood Insurance Rate Maps (FIRM) for Polk County as funding becomes available.

Ideas for Implementation

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

- Suggest to FEMA to incorporate 'ground-truthing' models with updates to FIRM.

Coordinating Organization:	Community Development
Internal Partners:	GIS, Public Works
External Partners:	DLCD, FEMA, cities
Timeline:	3 to 5 years
Plan Goals Addressed:	Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships

LT-FL #2: Enhance data and mapping for floodplain information within Polk County.

Ideas for Implementation

- Apply for FEMA's cooperative technical partnership using the two-foot contour interval floodplain mapping data acquired by Polk County GIS;

- Maintain existing elevation reference marks and survey any new information concerning flooding reference marks;
- Identify and map areas where flood probability/frequency can be economically reduced or eliminated.
- Identify local water systems, both municipal and those of rural community providers, that could be at risk during flood events.
- Maintain maps of covered streams and creeks;
- Identify mapped culverts that historically create flooding problems and target them for replacement;
- Prepare an inventory of rural drainage problems;
- Coordinate with local agencies and organizations to obtain flood data and mapping resources; and
- Integrate the Capital Improvement Plan process with GIS.

Coordinating Organization:	Outside UGB: Community Development, Public Works, Cities Inside UGB: Cities
Internal Partners:	Emergency Management – Hazard Mitigation Team, GIS
External Partners:	NRCS, Polk SWCD, FEMA, Watershed Councils, Oregon Association of Water Utilities (OAWU), Water Associations
Timeline:	3 to 5 years (as funding allows)
Plan Goals Addressed:	Preventive & Implementation; Collaboration & Coordination

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LT-FL #3: Identify surface water drainage obstructions for all parts of unincorporated Polk County.

Ideas for Implementation

- Prepare an inventory of culverts that historically create flooding problems and target them for replacement; and
- Prepare an inventory of major drainage problems, and identify causes and potential mitigation actions for drainage problem areas.

Coordinating Organization:	Public Works
Internal Partners:	Planning, GIS
External Partners:	Cities, NRCS, Polk SWCD, Watershed Councils
Timeline:	On-going
Plan Goals Addressed:	Preventive & Implementation

LT-FL #4: Reduce flooding events by using stormwater best management practices (BMP).

Ideas for Implementation

- Support development and land management practices that improve upon existing infiltration systems and provide infiltration of water rather than creating stormwater runoff and increasing hydrologic impacts;
- Encourage practices that reduce sedimentation in drainage ways;
- Continue maintenance on stormwater systems to increase capacity;
- Verify storm drain separation from sanitary sewer lines; and
- Consider stormwater detention/retention facilities where necessary

Coordinating Organization:	Public Works
Internal Partner:	GIS.
External Partners:	NRCS, Polk SWCD, Water Control Districts, Confederated Tribes of Grand Ronde, Watershed Councils
Timeline:	3 to 5 years
Plan Goals Addressed:	Preventive & Implementation

LT-FL #5: Investigate grant-funding programs to assist the cities of Monmouth and Independence in their joint project to create a multi-use trail alongside Ash Creek

Ideas for Implementation

- Investigate grant-funding programs at the state, local, federal and private level for ways to fund this project, which would provide local residents a hands-on understanding of Ash Creek's hydrologic cycles.

Coordinating Partners:	Cities of Monmouth and Independence, County
External Partners:	Watershed Councils, FEMA, DEQ, ODFW, NRCS, Polk SWCD, Ash Creek Water Control District; ODOT
Timeline:	1 to 2 years
Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Funding & Partnerships

LT-FL #6: 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 Polk County, Polk County
Internal Partner:	County Tax Assessor
External Partners:	FEMA, OEM
Timeline:	On-going
Plan Goals Addressed:	Preventive & Implementation; Funding & Partnerships

Flood Mitigation Resources

The following resource directory lists the resources and programs that can assist county communities and organizations. The resource directory provides contact information for local, county, regional, state and federal programs that deal with natural hazards.

County Resources

Watershed Councils

Luckiamute Watershed (WS) Council
Contact: Eve Montanaro, Coordinator
345 N Monmouth Avenue
Western Oregon University
Monmouth, OR 97631
Phone: 503-838-8804
Facsimile: 503-838-8222
Email: lwc@wou.edu

Rickreall, Glen and Gibson Creeks WS Council
Contact: Charles Redon
580 Main Street Suite A
Dallas, OR 97338
Phone: 503-623-9680 (x 112)
Facsimile: 503-623-6335

Water Control Districts

Ash Creek Water Control District
Contact: Todd Whitaker
Phone: 503-838-4033
Email: todd@whit-engr.com

Polk Soil & Water Conservation District
580 Main Street, Suite A
Dallas, OR 97338
Phone: 503-623-9680
Facsimile: 503-623-6335
Email: mailto:polk.swcd@oacd.org
Website: http://polkswcd.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 conduct 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

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 Ave 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 watermaster 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: Water Resources Department
Address: 775 Summer St NE, Salem, OR 97301-1271
Phone: 503-986-0900
Website: http://www.wrd.state.or.us/index.shtml
http://www.co.washington.or.us/dptmts/wtr_mstr

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 (NFIP). 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: 228th St. SW, Bothell, WA 98021-9796
Phone: 425-487-4678
Website: http://www.fema.gov

To obtain FEMA publications:
Phone: 1-800-480-2520

To obtain FEMA maps:
Contact: Map Service Center
Address: P.O. Box 1038, Jessup, Maryland 20794-1038
Phone: 1-800-358-9616
Fax: 1-800-358-9620

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.

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

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: 333 SW First Ave, 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. 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 that one property.

Contact: USDA-NRCS, Dallas Service Center
Address: 580 Main Street, Suite A, Dallas OR 97338-1911
Phone: 503-623-2396 ext. 105
Fax: 503-623-6335
Website: http://www.or.nrcs.usda.gov

National Weather Service, Portland Bureau

The National Weather Service provides flood watches, warnings, and informational statements for rivers in Polk County. The NWS is the sole United States official voice for issuing warnings during life threatening weather situations. The majority of Polk

County are within the NWS "Central Willamette Valley" region. The western portions of the county, which includes areas around Falls City, Pedee, and Airlie, are within the "Central Coast Range" region. The NWS Portland office provides river level information online and by phone.

Contact: National Weather Service, Portland Bureau
Address: 5241 NE 122nd Avenue, P.O. Box 2946, Portland, OR 97208-2946
Phone: 503-326-2340
Fax: 503-808-4875
Website: http://www.nws.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 handles 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

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 upcoming 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

Insurance Services Offices, Inc. (ISO)

The Building Code Effectiveness Grading Schedule (BCEGS), developed and operated by the Insurance Services Offices, Inc. (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. Polk County has a BCEGS classification of 3/3 and receives credit for this rating under FEMA's CRS program.

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: mailto:info.sanfrancisco@iso.com%20

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

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: 1-800-480-2520 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: 1-800-480-2520
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 which 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: 1-800-480-2520
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
Phone: 503-373-0050

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

Flood – Endnotes

[1] Taylor, George and Raymond Hatton. 1999. *The Oregon Weather Book: A State of Extremes*. Corvallis, OR: Oregon State University Press.

[2] Id.

Flood Endnotes

[3] Interagency Hazard Mitigation Team, *State Hazard Mitigation Plan.* 2000. Oregon Emergency Management.

[4] Id.

[5] Marion County Emergency Management. Available on the World Wide Web (http://www.publicworks.co.marion.or.us/emergencymanagement/).

[6] Carlson, Kathleen. "Christmas Week Flood Brings Major Flooding, December 1964." *Salem Online History Project*, <http://www.salemhistory.net/home.htm>.

[7] Polk County. 2001. *Polk County Hazard Mitigation Plan.*

[8] *Itemizer Observer*. January 23, 1974: vol. 99 no. 44, page 1.

[9] "Polk Recovers from Weather Beating." *Itemizer Observer*: February 4, 1987.

[10] Taylor, George and Raymond Hatton. 1999. *The Oregon Weather Book: A State of Extremes*. Corvallis, OR: Oregon State University Press.

[11] *Itemizer Observer*. January 15, 1997: Page 20a.

[12] *Itemizer Observer*. February 7, 1996: Page 13a.

[13] *Itemizer Observer*. November 27, 1996: Page 1.

[14] *Itemizer Observer*. January 8, 1997.

[15] *Itemizer Observer*. January 1, 1997: Page 7a.

[16] National Flood Insurance Program. Available on the World Wide Web http://www.fema.gov/nfip. Accessed April 2002.

[17] Oregon Office of Emergency Management.

[18] Clemens, Gene. Polk County Community Development Director. Personal Interview. February 14, 2005.

[19] U.S.D.A - Natural Resources Conservation Service. 1982. *Soil Survey Report of Polk County Oregon.* Washington, D.C: U.S. Government Printing Office. Available on the World Wide Web (http://www.or.nrcs.usda.gov/pnw_soil/oregon/or053.html)

[20] Yamhill Basin Council. June 2001. *Chehalem Watershed Assessment.*

[21] Interagency Hazard Mitigation Team. 2000. *State Hazard Mitigation Plan.* Oregon State Police, Oregon Emergency Management.

[22] Taylor , George and Chris Hannan. 1999. *The Climate of Oregon*. Corvallis, OR: Oregon State University Press.

[23] *Polk County Zoning Ordinance*, Section 178 (Flood Overlay Zone), subsection 178.040(A)-(C2). Available on the World Wide Web (http://www.co.polk.or.us/ComDev/ZoningOrd.asp

[24] Federal Emergency Management Agency. June 2003. Available on the World Wide Web (http://www.fema.gov/fhm/fq_term.shtm#frequt4).

[25] Atkinson, Denise. FEMA. Personal Interview. April 5, 2005.

[26] Department of Land Conservation and Development. July 2000. *Planning for Natural Hazards: The Oregon Technical Resource Guide*, Ch. 4.

[27] G&E Engineering Systems Report 32.07.01, Revision 0. September 23, 1998. *All Hazard Mitigation Plan*. Clackamas County, Oregon.

[28] Department of Land Conservation and Development. July 2000. *Planning for Natural Hazards: The Oregon Technical Resource Guide,* Ch. 4.

[29] FEMA, Region 10. *Floodplain Management: a Local Administrator's Guide to the National Flood Insurance Program*.

[30] Id.

[31] G&E Engineering Systems Report 32.07.01, Revision 0. September 23, 1998. *All Hazard Mitigation Plan*. Clackamas County, Oregon.

[32] Interagency Hazard Mitigation Team. *State Hazard Mitigation Plan*. 2000. Oregon State Police, Oregon Emergency Management.

[33] Id.

[34] Id.

[35] Id.

[36] Id.

[37] Ernie Eichhorn, Bonneville Power Administration, Chemawa District. Telephone interview November 10, 2004.

[38] Id.

[39] James, Brenda. Polk County Public Works. Personal interview. February 16, 2005.

[40] Id.

[41] Metro. June 1999. *Regional Hazard Mitigation Policy and Planning Guide*. Portland, OR: Metro.

[42] Tualatin River Watershed Council. February 2001. Available on the World Wide Web (http://www.trwc.org/).

[43] Oregon Department of State Lands. May 2001. *Wetlands Functions and Assessment*. Available on the World Wide Web (http://statelands.dsl.state.or.us/fact5.pdf).

[44] Id.

[45] Oregon Wetlands Joint Venture. May 2001. Available on the World Wide Web (http://www.dfw.state.or.us/ODFwhtml/Wetlands/about.htm).

Section 7:
Landslide

Why are Landslides a Threat to Polk 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 Industry (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 near Salem 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 Polk County. The storms of 1996, however, give a brief illustration of landslide damage that can occur in the county. The road damage that occurred during the February 1996 storm contributed to a total cost of $478,472.[5] Much of this damage was a result of landslides caused by floodwaters.

Polk County homeowners were also hit by landslide damage during the February 1996 storm. Examples include one property owner who incurred damages of over $98,000, and another who incurred damages over $144,000. These damage costs were due to landslide events caused by floodwater undercutting.[6] The county purchased property from two owners whose houses were damaged or in danger of sliding into Rickreall Creek because the costs to stabilize were well over value. In one instance, the county paid to tear down the house and locate the replacement dwelling away from the creek bank, out of the floodplain.[7]

Historically, landslides have affected both public and private property owners. Damage has affected both buildings and infrastructure. Several roads in the county have known slide areas: Black Rock Road, Mill Creek Road, James Howe Road, and Liberty Road possess a higher

frequency for slides.[8] Other roads in the county with known slides, but a lower frequency are Buena Vista Road, Pioneer Road and Pedee Creek.[9]

Landslide Characteristics

What is a Landslide?

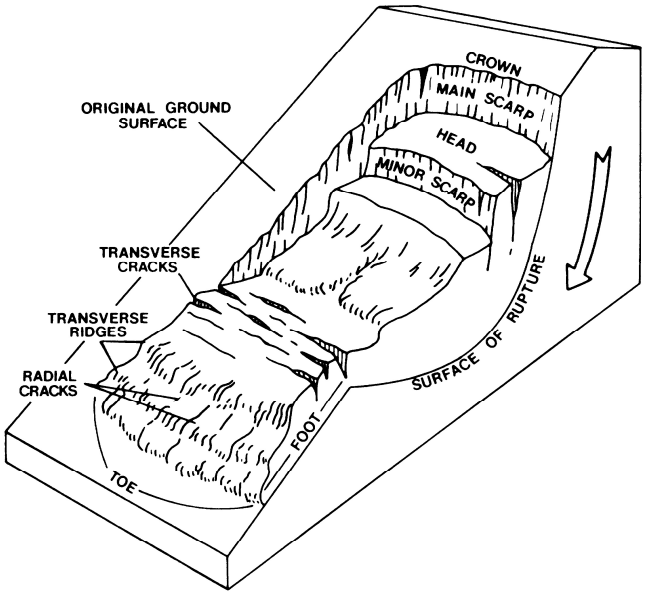
Landslides are downhill or lateral movements of rock, debris, or soil mass. The size of a landslide usually depends on the geology and the landslide triggering mechanism. Landslides initiated by rainfall tend to be smaller, while those initiated by earthquakes may be very large. Slides associated with 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. Some characteristics that determine the type of landslide are slope of the hillside, moisture content, and the nature of the underlying materials. 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, runoff from the slopes is inhibited during periods of precipitation. This causes the runoff 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.

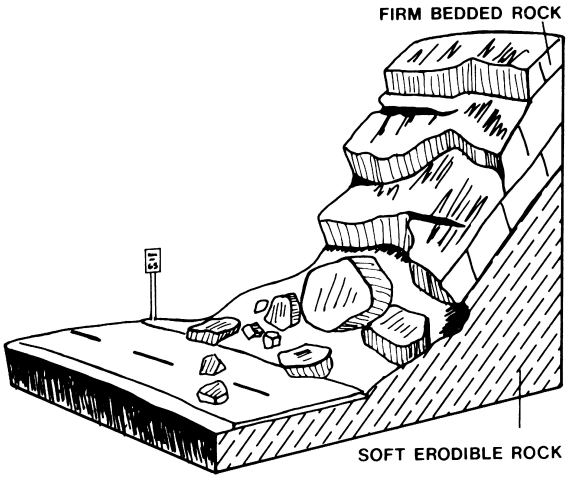
Figure 5.1. Rotational Slide



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.

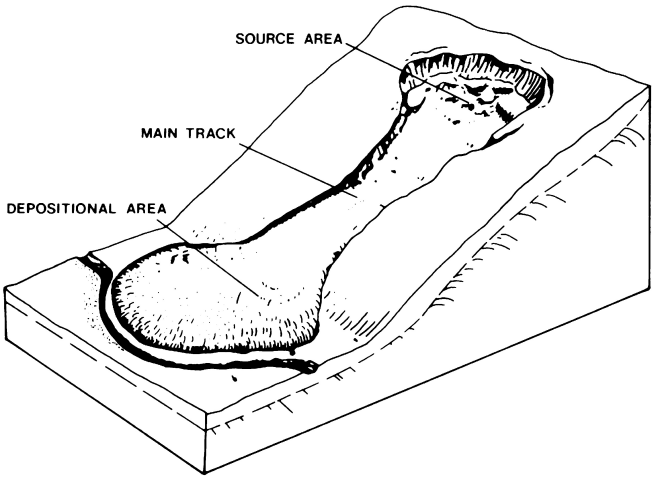
Figure 5.2. Rock Fall



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. 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 of logging) may cause 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 miles per hour. 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). Map 6 shows the debris flow hazard areas for Polk County from the ODF. Map 7a shows the debris-flow, rapidly moving landslide hazard for the City of Salem/Polk County UGB area. Map 7b shows the water-induced landslide hazard for the City of Salem/Polk County UGB area. Map 7c shows the earthquake-induced landslide hazard for the City of Salem/Polk County UGB area.

(Note: These maps are provided for general informational purposes only. The areas delineated are not to be considered as exact references for any or all potential hazard areas. The City of Salem does not confirm the accuracy of these maps, its applicability in any specific circumstance, or the timeliness of the maps.)

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 Polk 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. 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.

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.

DOGAMI recently assisted the City of Salem by developing maps of potential landslide areas within the city that are potentially susceptible to landslide conditions. Maps 7a through 7C show areas of West Salem in Polk County that are potentially susceptible to landslide conditions.

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

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 identified to reduce Polk County's risk from flood, landslide, wildfire, severe winter storm and windstorm, drought, expansive soils and seismic and volcanic events.

Goal #1: PUBLIC EDUCATION AND AWARENESS

Provide public information and education/awareness to all residents of the county concerning natural hazard areas and mitigation efforts.

Goal #2: PREVENTIVE AND IMPLEMENTATION

Develop and implement activities to protect human life, commerce, property and natural systems.

Goal #3: COLLABORATION AND COORDINATION

Strengthen hazard mitigation by increasing collaboration and coordination among citizens, public agencies, non-profit organizations, businesses, and industry.

Goal #4: FUNDING AND PARTNERSHIPS

Seek partnerships in funding and resources for future mitigation

efforts.

Goal #5: EMERGENCY OPERATIONS

Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

Goal #6: NATURAL RESOURCES UTILIZATION

Link land use planning, development criteria, codes, and natural resources and watershed planning with natural hazard mitigation.

Existing Mitigation Activities

State

Oregon State Senate Bill 12

The 1997 Legislature passed Senate Bill 12 to address problems caused by landslides and debris flows. 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]

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, were used to derive slope steepness and

then to develop polygons for assigned hazards. Note that actual slopes are steeper than these 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, and the Oregon Department of Transportation).
- 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 of Forestry'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

The debris flow warning system was initiated in 1997 and involves collaboration between ODF, DOGAMI, the Oregon Department of Transportation (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 through the media. ODOT provides warning signs to motorists in landslide-prone areas during high-risk periods.[30]

Landslide Brochure

DOGAMI developed a landslide public outreach brochure in cooperation with several other state agencies. Forty thousand copies were printed in November1997 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).[31]

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 ground water 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 code, 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.[32]

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 more 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.[33]

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 relative 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, both the geological assessment and the geotechnical report are required. Defining the roles was an important part of this process.

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?

The percentage of vacant land in landslide areas underscores the necessity of developing landslide hazard mitigation activities. The potential for future development necessitates strong regulation to reduce risk from potential landslide events.

The 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, DLCD, 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 landslide mitigation action items were formulated through researching regional mitigation plans, and 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 landslide mitigation action items provide direction on specific activities that organizations and residents in Polk 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 Polk 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;
- Extend the mapping of 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; and
- 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 Organizations:	GIS, Public Works
Internal Partners:	Emergency Management –Hazard Mitigation Team, Building, Planning,
External Partner:	DOGAMI, ODF, cities
Timeline:	2 years
Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Funding & Partnerships

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

Ideas for Implementation

- Where appropriate, reduce the number of building sites and corresponding disruption of the natural contour and vegetation;

- Encourage potential builders to seek professional advice prior to construction on or near steep slopes;

- Reduce driveway cuts into the hillside;

- Establish and maintain driveway standards countywide;

- Adjust the building setback from property lines to minimize building site cuts and fills;

- Discourage removal of significant vegetation and encourage retention of vegetation on hillside lots;

- 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;

- 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;

- Develop public information to emphasize economic risk when building on potential or historical landslide areas; and

- Increase communication and coordination between Polk County's Public Works and Building Departments.

Coordinating Organizations:	Public Works, Community Development Department, Building Division
Internal Partner:	Emergency Management – Hazard Mitigation Team
External Partners:	DLCD, cities, Institute for Business and Home Safety (IBHS), timber operators
Timeline:	1 to 3 years

Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships

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

Ideas for Implementation

- Identify potential public and/or private debris removal resources;

- 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 – Hazard Mitigation Team
External Partners:	ODOT, adjacent counties, West Salem, Falls City, DOGAMI
Timeline:	2 years
Plan Goals Addressed:	Preventive & Implementation; Funding & Partnerships; Emergency Operations

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ST-LS #4: Compile Relative Landslide Risk maps for Polk 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 – Hazard Mitigation Team, Planning, Assessor's Office
External Partners:	DOGAMI, ODF, BLM, water systems, utilities, forest industries
Timeline:	Depending on DOGAMI funding in this biennium

Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Collaboration & Coordination

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 – Hazard Mitigation Team
Internal Partners:	Community Development, Public Works
External Partners:	City emergency managers, DOGAMI, OEM, ODF, DLCD
Timeline:	1 to 2 years
Plan Goals Addressed:	Public Education & Awareness; Funding & 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: Mitigate activities in identified potential and historical landslide areas through public outreach.

Ideas for Implementation

- Educate at-risk home sites and high-risk populations about climatic and soil conditions that are conducive to landslides; and

- Develop mitigation and evacuation information and procedures for at-risk home sites; and

- Coordinate with property owners to reduce risk in landslide hazard areas;

- Provide information on hazard location to future residents;

- Analyze existing regulations regarding development in landslide prone areas;

- Distribute landslide educational materials to the public; and

- Identify and use existing mechanisms for public outreach (e.g., Polk SWCD, NRCS, watershed councils, etc.); and

- Provide information to residents on landslide prevention. Publications such as FEMA's *Homeowners Landslide Guide for Landslide Control, Hillside Flooding, Debris Flows, Soil Erosion,* and FEMA's *Hillside Drainage* flier have some ideas about reducing landslide susceptibility;

Coordinating Organization:	Emergency Management – Hazard Mitigation Team
Internal Partners:	Planning, Building, Public Works
External Partners:	Cities, builders, developers, property owners, mortgage companies, ODF, ODOT
Timeline:	3 to 5 years and On-going
Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships

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LT-LS #2: Maintain public and encourage property owners to maintain 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

Coordinating Organization:	Public Works
Internal Partners:	GIS, Planning
External Partner:	Cities
Timeline:	On-going
Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Funding & Partnerships

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Landslide Resource Directory

County Resources

Polk County Public Works Department

The Public Works Department is responsible for approximately 500 miles of County roads and 120 County bridges. Within the

Public Works Department there are five sections: Administrative, Engineering, Road Maintenance, Shop, and Surveys. There are fourteen Road Maintenance personnel who perform many activities that include road rocking and grading, mowing, brush cutting, noxious weed eradication, asphalt paving and patching, snow and ice removal, culvert maintenance and installation, bridge maintenance, and road sign installation and maintenance.

Contact: Polk County Public Works Department
Address: 820 SW Ash Street, Dallas, OR 97338-2112
Phone: 503-623-9287
Fax: 503-623-0897

Regional Resources

Polk Soil and Water Conservation District (Polk SWCD)

The staff employed by the Polk 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. The mission of the Polk SWCD is to provide for the conservation of the renewable natural resources of Polk County through control and prevention of soil erosion, degradation of water quality, and flooding; conservation and development of natural resources, water resources, natural beauty, and recreation; and the promotion of the health, safety, and general welfare of the people of Polk County, Oregon.

Contact: Polk Soil and Water Conservation District
Address: 580 Main Street, Suite A, Dallas, OR 97338-1911
Phone: 503-623-9680
Fax: 503-623-6335

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 that 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, OR 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 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: Oregon Department of Geology and Mineral Industry
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
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 in Portland.

Contact: Portland State University, Department of Geology
Address: 17 Cramer Hall; 1721 SW Broadway, Box 751, Portland, OR 97201
Phone: 503-725-3022
Fax: 503-775-3025
E-mail: geology@pdx.edu
Website: http://www.geol.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 who 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 S.W. 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 page 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. 1999. *Disasters by Design: A Reassessment of Natural Hazards in the United States*. Washington, D.C.: 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. 1996. Planning for Hillside Development. 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. & J. David Rogers. 1987. Unstable Ground: Landslide Policy in the United States. Ecology Law Quarterly.

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

Federal Emergency Management Agency. *Public Assistance Debris Management Guide.* 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 *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

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

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: 800-654-4966
Web: http://geohazards.cr.usgs.gov/

Nuhfer, Edward B., Richard J. Proctor, and Paul H. Moser. 1993. *The Citizens' Guide to Geologic Hazard: A Guide to Understanding Geologic Hazards Including Asbestos, Radon, Swelling Soils, Earthquakes, Volcanoes.* American Institute of Professional Geologists.

Written by professionals for lay readers, this book combines solid, practical content with easy readability. Contains specific sources for help in the appendices. Each chapter is followed by references and bibliographies of videotapes.

Contact: American Institute of Professional Geologists
Address: 1400 W. 122nd Avenue, Suite 250, Westminster, Colorado 80234.
Phone: 303-412-6205
Fax: 303- 253-9220
Web: http://www.aipg.org/

Landslide – 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.

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[13] Department of Land Conservation and Development. July 2000. *Planning for Natural Hazards: The Oregon Technical Resource Guide,* Ch. 5. Salem, OR: DLCD.

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[15] Federal Emergency Management Agency. March 5, 1997. *Homeowner's Landslide Guide for landslide control, hillside flooding, debris flows, soil erosion.*

[16] Oregon Department of Forestry. 1999. *Storm Impacts and Landslides of 1996 Final Report.* Salem, OR: Oregon Department of Forestry.

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[19] Nuhfer, Edward B., Richard J. Proctor, and Paul H. Moser. 1993. *The Citizens' Guide to Geologic Hazard: A Guide to Understanding Geologic Hazards Including Asbestos, Radon, Swelling Soils, Earthquakes, Volcanoes.* American Institute of Professional Geologists.

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

[22] Burby, Raymond J., ed. *Cooperating with Nature.*

[23] Id.

[24] Goettel & Associates. February 1998. *Regional All Hazard Mitigation Master Plan for Clackamas County*.

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Section 8:
Wildfire

Why are Wildfires a threat to Polk 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 contains 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 that 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.[1] Polk County contains such communities.[2]

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 30 percent of wildland fires 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 Polk County. Suppression of fire has contributed as much to the current vegetation pattern as historically intentional burning.

History of Oregon Wildfires

Wildfires have been a feature of the Oregon landscape for thousands of years. Fires in Polk 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, wildland 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.

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 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 2003.

Table 8.1. Historic Fires in Oregon (1848-2003)

Year	Fire Name	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	Unknown
1939	Saddle Mountain	Tillamook/Yamhill	190,000
1945	Wilson River / Salmonberry	Tillamook	180,000
1951	North Fork/Elkhorn	Tillamook/Yamhill	33,000
1966	Oxbow	Lane	44,000
1987	Silver	Josephine	97,000
1992	Lone Pine	Klamath	30,727
1996	Skelton	Deschutes	17,700
2002	Biscuit	Josephine/Curry	500,000
2003	B&B Complex	Jefferson/Linn/Deschutes/Marion	80,000

Sources: (1) *Atlas of Oregon*, William G. Loy, et al, University of Oregon Books, 1976.
(2) Oregon Department of Forestry, Tillamook Burn to Tillamook State Forest, revised 1993.
(3) Oregon Department of Forestry,
http://www.odf.state.or.us/DIVISIONS/protection/fire_protection/stats/histfire.asp?id=307010
(4) Oregon Emergency Management, State Hazard Risk Assessment, 2003.

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.[8] 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.[9] Table 8-2 illustrates the fire suppression costs for state, private, and federal lands protected by the Oregon Department of Forestry between 1985 and 2002.

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	10,4936,951

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 $150 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 wildfire 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.[10]

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.[11] 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.[12]

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, Washington 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.[13]

Wildfire in Polk County

Several significant wildfires have occurred in Polk County.[14]

In the fall of 1934, a series of wildfires nearly bankrupted the Lincoln Fire Protective Association. Records do not indicate the number of acres affected.

In 1945, a 12,785-acre wildfire bankrupted the Polk County Fire Protection Association. As a result, the Oregon Department of Forestry had to assume wildfire protection in the county.

Two large wildfires occurred in Polk County in 1987. The Rockhouse Fire impacted 5,000 acres and the Shady Lane Fire impacted 1,000 acres.

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.[15] 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.[16] 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, if escalates, spreads in the direction toward which the wind is blowing.[17] Additionally, when burning occurs on uneven terrain, the fire spreads upslope to eventually form itself into broad ellipses.[18]

> "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

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.[19] 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.[20] Despite its beneficial values to ecosystems, however, 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:[21]

- The classic wildland-urban interface exists where well-defined urban and suburban development presses up against open expanses of wildland 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).[22] 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.[23] 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.

Fuel[24]

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.[25] 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.[26]

Because of the many different possible "fuels" found in the interface landscape, firefighters have a difficult time predicting how fires will react or spread.

Topography[27]

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.

Weather[28]

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.[29] 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.

The last statewide drought emergency in Oregon was in September 1992.[30]

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."[31]

On average over the last several years, Polk 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."[32] 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."[33]

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.[34]

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. [35]

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.[36] 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 (the zone surrounding a building where the property owner manages vegetation in order to reduce the risk of a wildfire igniting the structure);
- 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.

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.[37] Data that includes the location of interface areas in Polk 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 Polk 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:[38]

- 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.

Map 8 shows the coverage area for fire districts within Polk County.

Mitigation Plan Goals and Existing Activities

Mitigation 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 identified to reduce Polk County's risk from flood, landslide, wildfire, severe winter storm and windstorm, drought, expansive soils and seismic and volcanic events.

Goal #1: PUBLIC EDUCATION AND AWARENESS

Provide public information and education/awareness to all residents of the county concerning natural hazard areas and mitigation efforts.

Goal #2: PREVENTIVE AND IMPLEMENTATION

Develop and implement activities to protect human life, commerce, property and natural systems.

Goal #3: COLLABORATION AND COORDINATION

Strengthen hazard mitigation by increasing collaboration and coordination among citizens, public agencies, non-profit organizations, businesses, and industry.

Goal #4: FUNDING AND PARTNERSHIPS

Seek partnerships in funding and resources for future mitigation efforts.

Goal #5: EMERGENCY OPERATIONS

Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

Goal #6: NATURAL RESOURCES UTILIZATION

Link land use planning, development criteria, codes, and natural resources and watershed planning with natural hazard mitigation.

Existing Mitigation Activities

County Programs

Fire Districts within Polk County

The fire service in Polk County is an integrated force trained to respond to emergencies that can range from the small house fire to an earthquake. The fire services of Polk County coordinates its efforts through mutual aid agreements, Fire Defense Board, State Fire Marshals Office and the State Conflagration Act.

Polk County Zoning Ordinance – Fire-Siting Standards

Section 177.090 of the Polk County Zoning Ordinance sets for "Fire-Siting Standards for Dwellings and Structures." These standards reflect siting standards set froth in Oregon Administrative Rules (OAR) OAR 660-06-035, and apply to structures in the county's Farm/Forest and Timber Conservation Zones. The standards discuss water supply, road access and fuel breaks.

Regional Programs

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.

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, the program was developed in response to the city's "Skelton Fire" of 1996, which burned over 17,000 acres and damaged or destroyed 30 homes and structures.[39] 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:

- 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.

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 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 hazarhazards 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.

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.

(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, amphitheaters, 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 agency of the city or county 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.[40]

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."

Oregon Department of Forestry

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.[41]

ODF has been involved with emergency managers to provide support during non-fire events and for years, ODF has worked with industrial partners (big timber companies) to share equipment in the case of extremely large fires.[42]

"New data from National For Deleted: <sp>
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

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.[43]

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.[44]

States must have an approved hazard mitigation plan in place to receive either a Fire Suppression Assistance Grant or a Hazard Mitigation Grant.

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.[45]

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.

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.[46] This will especially be an important issue as Polk County cities consider any annexations of land in the wildland-urban interface in the future.

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. The city 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.[47] Treatment has included thinning of tree stands, removing highly flammable noxious weeds (i.e. Scotch or Scot's 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.[48] 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. [49]

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.[50]

Wildfire Mitigation Action Items

The wildfire mitigation action items were formulated through researching regional mitigation plans and 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 wildfire mitigation action items provide direction on specific activities that organizations and residents in Polk 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 the steering committee and local decision makers in pursuing strategies for implementation.

This section lists action items identified to reduce the risk from wildfires in Polk 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 Polk 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.*

Ideas for Implementation

- Tie into the permit process when the landowner applies for building permits.

Coordinating Organization:	Building
Internal Partners:	Emergency Management – Hazard Mitigation Team
External Partner:	Polk Fire Defense Board, State Fire Marshal
Timeline:	On-going
Plan Goals Addressed:	Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships

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ST-WF #2: Advocate accessible water storage facilities in developments that are not connected to a community water/hydrant system in the wildland/urban interface.

Ideas for Implementation

- Make such storage facilities accessible by standard firefighting equipment and adequate for the needs of the structure(s) built;

- Identify funding for and develop an inventory of alternative firefighting water sources and encourage the development of additional sources;

- Encourage the use of fire-resistant pump systems so water can be replenished during use;

- 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:	Community Development
Internal Partners:	Building Department, GIS

External Partners:	Polk Fire Defense Board, State Fire Marshal, Oregon Association of Water Utilities (OAWU), Irrigation Districts, Polk SWCD, NRCS, Watershed Councils, Cities, ODF, Confederated Tribes of Grand Ronde
Timeline:	1 to 2 years, On-going
Plan Goals Addressed:	Preventive & Implementation; Collaboration & Coordination; Emergency Operations; Natural Resources Utilization

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ST-WF #3: Continue to promote public awareness campaigns for individual property owners living in wildland/urban interface areas.

Ideas for Implementation

- 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;

- Require fire district notification of new business applications to ensure that appropriate fire plans have been developed;

- Focus on individual community outreach through:

    - Working demonstrations of risk reduction awareness measures (i.e., survivable space around structures [at the County and State Fairs]; driveway, road and bridge specifications; and landscaping);

    - Voluntary site visits i.e., fire surveys by local fire jurisdictions in residential homes to increase awareness among homeowners and potential fire responders, and to reduce risk to homeowners' property and to identify properties that would not be saved if a wildfire event occurred;

    - Public service announcements in the media;

    - Advise prospective buyers to ask about the level of fire protection available and fire insurance rating for properties in Polk County;

    - Encourage single-family residences in wildfire hazard areas to evaluate access routes to rural homes for fire-fighting vehicles and to develop passable routes if they do not exist;

    - Providing education and training to the public to assess if their homes meet fire safety performance standards; and

- Encourage the use of hazard-specific information to identify wildfire hazard areas, and promote the use of mitigation strategies and opportunities to reduce risks;

- Adopt and enforce driveway, road and bridge standards in the Timber Conservation zoned areas of the County;

- Provide fire hazards handouts for urban interface areas;

- Promote the concepts embraced by "Firewise" and FireFree" programs;

- 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 height, 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;

- Partner with the Oregon Garden and other counties 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; and

- Assess available fire suppression assistance and disseminate information about opportunities to the public.

Coordinating Organization:	Emergency Management – Hazard Mitigation Team
Internal Partner:	Planning, Building, Public Works
External Partners:	City Emergency Managers, Media, Polk Fire Defense Board, OEM, FEMA, DLCD, State Fire Marshal, ODF, Insurance and Real Estate Industries, ODA, Oregon Garden, State Fair, Polk County Fair
Timeline:	1 to 5 years, On-going
Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships; Emergency Operations

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ST-WF #4: 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 – Hazard Mitigation Team
Internal Partner:	Community Development
External Partners:	State Fire Marshal, ODF, Polk Fire Defense Board, Insurance Companies
Timeline:	1 to 2 years
Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships

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ST-WF #5: 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 – Hazard Mitigation Team
Internal Partners:	GIS, Planning
External Partners:	State Fire Marshal, ODF, Polk Fire Defense Board, Confederated Tribes of Grand Ronde
Timeline:	1 to 3 years
Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships; Emergency Operations

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ST-WF #6: 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 Polk County in order to contact them during evacuations;

- Coordinate among city police departments, sheriff's department, fire districts, and county public works when directing traffic away from wildfires;

- Identify households that may need assistance (i.e., special needs) during recovery activities or evacuations; and

- Maintain and inventory of public bridges on evacuation routes, assess the bridges for their ability to support fire apparatus ingress, and encourage replacement of unstable bridges.

Coordinating Organization:	Emergency Management – Hazard Mitigation Team
Internal Partner:	Public Works

External Partners:	Polk Fire Defense Board, State Fire Marshal, ODF, Telephone Companies
Timeline:	2 years
Plan Goals Addressed:	Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships; Emergency Operations

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: Look for solutions to protect structures located outside of fire districts through partnerships, grant funding, fire protection contracts, or expansion of fire district services.

Ideas for Implementation

- Promote the expansion of rural fire districts; and

- Form community partnerships that are equipped and trained by fire district personnel to combat fires in those areas.

Coordinating Organization:	Polk Fire Defense Board
Internal Partner:	County Assessor
External Partners:	State Fire Marshal, ODF
Timeline:	On-going
Plan Goals Addressed:	Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships; Emergency Operations

LT-WF #2: 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.);

- Update the debris disposal plan in the county emergency plan;

- Adapt a program similar to the Firefree spring-cleaning program in Bend;

- Seek funding and labor opportunities to staff fuel-reduction projects throughout wildfire hazard prone areas in Polk County;

- Work on Wildfire Hazard mapping of Polk 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 – Hazard Mitigation Team
Internal Partners:	GIS, Community Development
External Partners:	Polk Fire Defense Board, State Fire Marshal, ODF, BLM, US Forest Service, Confederated Tribes of Grand Ronde
Timeline:	3 to 5 years
Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships; Emergency Operations; Natural Resources Utilization

LT-WF #3: Coordinate support of agricultural uses that reduce fuel loads in interface 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:	Polk SWCD
Internal Partner:	Planning
External Partners:	NRCS, watershed councils, ODF, DEQ, ODA
Timeline:	On-going
Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships; Natural Resources Utilization

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LT-WF #4: Maintain and further develop interagency and private industry relationships for continuing strong fire response in Polk County.

Ideas for Implementation

- Maintain and enhance protocol for fire jurisdictions, private industry cooperators and landowners to avoid problems during wildfire disruptions;

- Promote and advocate streamlining to enable faster assistance (use of vehicles, manpower, etc.) in a wildfire situation; and

- Lock gates to private timber land during high fire season to minimize human-caused wildfires.

Coordinating Organization:	Emergency Management – Hazard Mitigation Team
Internal Partner:	Public Works
External Partner:	Polk 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:	Public Education/Awareness; Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships

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LT-WF #5: 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;

- Establish neighborhood "drive-through" activities that pinpoint site-specific mitigation activities. Fire crews can give property owners personal suggestions and assistance; and

- Perform public outreach and information activities at county 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 must 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 – Hazard Mitigation Team
Internal Partner:	Community Development
External Partner:	Polk Fire Defense Board, School Districts, OEM, ODF, Interface Communities (i.e., Falls City, Buell, Fort Hill, Grand Ronde)

Timeline:	On-going
Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships; Emergency Operations

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LT-WF #6: 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 the county;

- 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 coordination between fire jurisdictions and utility districts to make sure that the most accurate elevation maps are being used.

Coordinating Organization:	Emergency Management – Hazard Mitigation Team
Internal Partners:	GIS, Planning, Building
External Partners:	State Fire Marshal, Polk Fire Defense Board, ODF, DLCD, utilities
Timeline:	1 to 3 years
Plan Goals Addressed:	Public Education/Awareness; Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships;

LT-WF #7: 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 and broadcast burning following logging to abate the risk of catastrophic fire and restore the more natural regime of high frequency, low-intensity burns.

Prescribed and broadcast burning can provide benefit 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 – Hazard Mitigation Team
Internal Partner:	Public Works
External Partners:	Polk Fire Defense Board, ODF, Confederated Tribes of Grand Ronde, Watershed Councils, utilities, land managers
Timeline:	1 to 5 years, on-going
Plan Goals Addressed:	Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships; Natural Resources Utilization

Wildfire Resource Directory

County Resources

Polk County Fire Districts – Polk Fire Defense Board

The fire service in Polk County is an integrated force trained to respond to emergencies that can range from the small house fire to an earthquake. The fire services of Polk County coordinates its efforts through mutual aid agreements, Fire Defense Board, State Fire Marshals Office and the State Conflagration Act.

Contact: Darrell Patterson, Polk Fire Defense Board Chief
Address: Polk County Fire Department District #1, 1800 Monmouth St., Independence, OR 97351
Phone: 503-838-1510
Fax: 503-838-1235

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, Areas Subject to Natural Disasters and 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. 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 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/

Oregon Forest Resources Institute (OFRI)

The Oregon Forest Resources Institute (OFRI) was created by the Oregon Legislature 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/

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

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 the 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 Willamette Chapter was chartered as a Red Cross unit in 1917. The chapter serves the residents of Polk and Marion Counties. The Willamette Chapter provides a variety of community services which 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, Willamette Chapter
Address: 675 Orchard Heights Rd NW, Suite 200 Salem, OR 97304
Phone: 503-585-5414
Fax: 503-362-3904
Email: rc@redcross-salem.org
Website: http://www.redcross-salem.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
E-mail: dcrfpd2@dcrfpd2.com
Website: http://www.firefree.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 Battlemarch Park, Quincy, MA 02269-9101
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. Founded in 1900 by Gifford Pinchot, it is the largest professional society for foresters in the world. 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.

With 1200 members in 13 chapters throughout the state, the Oregon Society of American Foresters is the largest state affiliate of the national Society. Foresters play a major role in managing Oregon's 30 million acres of forest land. These forests provide a variety of benefits for Oregonians and the nation in the form of wildlife, water, recreation, timber and other forest products. 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 Wildland/Urban Interface Fire Protection Program. 1991. *National Fire Protection Association Standard 299: Protection of Life and Property from Wildfire.* Washington, D.C.: National Fire Protection Association.

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.nfpa.org or http://www.firewise.org

Hirsch, K., M. Pinedo, and J. Greenlee. 1996. *An International Collection of Wildland-Urban Interface Resource Materials* (Information Report NOR-X-344). 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, I-Zone Series
Phone: 780-435-7210
Website: http://bookstore.pfc.cfs.nrcan.gc.ca

National Wildland/Urban Interface Fire Protection Program. 1998. *Wildland/Urban Interface Fire Hazard Assessment Methodology.* Washington, D.C.: NFPA. To obtain this resource:

Contact: Firewise (NFPA Public Fire Protection Division)

Phone: 617-984-7486
Website: http://www.firewise.org

National Wildland/Urban Interface Fire Protection Program. 1998. *Fire Protection in the Wildland/Urban Interface: Everyone's Responsibility.* Washington, D.C.: National Wildland/Urban Interface Fire Protection Program. To obtain this resource:

Contact: Firewise (NFPA Public Fire Protection Division)
Phone: 617-984-7486
Website: http://www.firewise.org

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

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 wildland 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 wildland fire issues.

Contact: Sheila Williams, National Interagency Fire Center
Phone: 208-387-5203
E-mail: 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
E-mail: Sheila_Williams@nps.gov
Website: http://www.forestresourceinstitute.com/

The Western Forester (periodical). Society of American Foresters' 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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[1] Federal Register, V. 66, no. 160. August 17, 2001. list 43383-43435 [01-20592]

[2] Id.

[3] Zybach, Bob. 1993. *The Great Fires: Indian Burning and Catastrophic Forest Fire Patterns of the Oregon Coast Range, 1491-1951*. Corvallis, OR: Oregon State University Press.

[4] Yamhill Basin Council. June 2001. *Chehalem Watershed Assessment*.

[5] Zybach, Bob. 1993. *The Great Fires: Indian Burning and Catastrophic Forest Fire Patterns of the Oregon Coast Range, 1491-1951*.

[6] Id.

[7] Yamhill Basin Council. June 2001. *Chehalem Watershed Assessment*.

[8] Wilkinson, Todd. "Prometheus Unbound." *Nature Conservancy*. May/June 2001.

[9] National Interagency Fire Center, National Register of Urban Wildland Interface Communities Within the Vicinity of Federal Lands that are at High Risk from Wildfire. May 2001. http://www.nifc.gov/fireplan/fedreg.html.

[10] http://www.biscuitfire.com/

[11] "Governor Declares State of Emergency", Ley Garnet, Oregon Public Broadcasting webpage, Portland Oregon: August 22, 2003. http://www.publicbroadcasting.net/opb/news.newsmain?action=article&ARTICLE_ID=537432

[12] Oregon Department of Forestry, Webpage (September 2003): http://www.odf.state.or.us/DIVISIONS/resource_policy/public_affairs/News_Releases/daily/Default.asp

[13] *The Olympian* webpage, http://www.theolympian.com/home/news/20030903/northwest/91088.shtml September 03, 2003.

[14] Rod Nichols, Oregon Department of Forestry. Personal Communication. 2003.

[15] DeBano, Leonard, Daniel Neary, and Peter Folliott. 1998. *Fire's Effects on Ecosystems*, page 21.

[16] Id. at 22.

[17] Id.

[18] Id at 49.

[19] Id. at 304.

[20] Id.

[21] Department of Land Conservation and Development (DLCD). July 2000. *Planning for Natural Hazards: The Oregon Technical Resource Guide*, Ch. 7.

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

[23] Introductory language in Senate Bill 360, July 2001, ODF website, http://www.odf.state.or.us/fireprot/sb360.html

[24] DLCD. July 2000. *Planning for Natural Hazards: The Oregon Technical Resource Guide*, Ch. 7.

[25] DeBano, Leonard, Daniel Neary, and Peter Folliott. 1998. *Fire's Effects on Ecosystems*, page 59.

[26] Id.

[27] DLCD. July 2000. *Planning for Natural Hazards: The Oregon Technical Resource Guide*, Ch. 7.

[28] Id.

[29] Id.

[30] Tomlinson, Stuart. "Dry, With a Dismal Outlook." *The Oregonian*. March 11, 2005. http://www.oregonlive.com/news/oregonian/indes/ssf?/base/front_page/111053925353810.xml

[31] *The Oregonian*, Feb. 25, 2001.

[32] Tomlinson, Stuart. "Dry, With a Dismal Outlook." *The Oregonian*. March 11, 2005. http://www.oregonlive.com/news/oregonian/index.ssf?/base/front_page/111053925353810.xml

[33] Id.

[34] Oregon Governor Ted Kulongoski's "2005 Oregon Drought and Fire Conditions" Website http://governor.oregon.gov/Gov/fd/main_drought_fire.shtml. Accessed 23 March 2005.

[35] DLCD. July 2000. *Planning for Natural Hazards: The Oregon Technical Resource Guide*, Ch. 7.

[36] Burby, R., ed. 1998. *Cooperating with Nature: Confronting Natural Hazards with Land Use Planning for Sustainable Communities*. Washington D.C.: Joseph Henry Press.

[37] Id.

[38] Colorado State Forest Service. July 2001. http://205.169.13.227.

[39] http://www.firewise.org/ffreenew/index2a.htm

[40] Oregon Department of Forestry. 1999. *Oregon Forests Report*.

[41] Wolf, J. Oregon Department of Forestry. Personal communication, February 28, 2001.

[42] Id.

[43] Federal Wildland Fire Policy. July 2001. http://www.fs.fed.us/land/wdfire7c.htm.

[44] Id.

[45] Id.

[46] Harvey, M.J. United States Forest Service (USFS). Personal communication, March 1, 2001.

[47] Fleeger, B. Regional Ecosystem Applied Learning (REAL) Corps. Personal communication, June 30, 2003.

[48] Id.

[49] Harvey, M.J. USFS. Personal communication, March 1, 2001.

[50] Id.

Section 9:
Severe Winter Storm

Why are Severe Winter Storms a Threat to Polk County?

Severe winter storms pose a significant threat to life, property, and the local economy in Polk 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 blowing out of the Columbia River Gorge. Severe freezes, where high temperatures remain below freezing for five or more days, occur seasonally in Polk County. Severe or prolonged snow events occur less frequently, but have widespread impacts on people and property in the 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. Over the course of the month Salem accumulated 39 inches of snow. The snow and ice storms closed highways, stranded motorists, created power outages and resulted in hundreds of thousands of dollars in damage across the state.[3]

Snowstorms

December-February 1862

A heavy snow in December of 1862 blanketed the Willamette Valley and was still present on February 17th when articles ran about the heavy die out of livestock as a result of cold and lack of food with losses estimated at one-half to two-thirds of the livestock in the Willamette Valley.[4]

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.[5]

January 1909

A six-day storm in January brought many locations more snow than is usually accumulated in one year.[6]

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.[7]

January-February 1937

February 1, 1937, in Dallas, brought a record 24 inches of snow in a 24-hour period as the result of a strong winter storm. Most roads and businesses were closed with snow drifts more than 30 inches deep.[8] In Salem, there was a record 27 inches of snow. As a result of the abrupt snowfall, four marquees fell in downtown Salem, many buildings were damaged and three buildings collapsed entirely including a greenhouse and the Ferry Street Tabernacle.[9]

January 1950

Two storm fronts joined up in the Willamette Valley beginning January 12, 1950, bringing snow, heavy wind gusts and freezing temperatures. Schools were closed and falling trees damaged power lines. The worst period of storms was from January 9th to 18th, when the snow depth around Dallas averaged sixteen inches. Several buildings collapsed and much of Dallas was shut down due to snow.[10] By January 26th, 50 inches of snow had already fallen for the year. Due to a silver thaw following the storm, several businesses had problems with flooding from snowmelt, another building collapsed, trees were damaged and some trees fell, damaging power lines.[11] Following this set of storms on January 31st, the temperature in Dallas was recorded as minus eleven degrees Farenheit (-11° F). Frozen pipes and automobiles were prevalent. By the end of the month, a record 68 inches of snow had fallen in Polk County.[12]

January 1956

The snowstorm from January 26 to 27, 1956, began with 3.5 inches of snow fall. This was followed by sub-freezing temperatures that coated roads with a layer of ice in addition to a heavy nighttime fog that created dangerous conditions for motorists and caused some school closures the following day. Icy weather conditions disrupted bus services, and motorists had difficulty on the slick streets, resulting in numerous traffic jams.[13]

March 1960

On March 1 and 2, 1960, there was a large snowstorm that resulted in numerous accidents, several with serious injuries, throughout Polk County, where up to eleven inches of snow fell.[14,15]

January 1969

From January 25 to 30, 1969, there were high, constant levels of snowfall, with ten inches reported in Dallas, and nine inches in Salem, causing school cancellations, business closures, stranded motorists and residents, transit disruptions. This winter storm also closed the ferry at Buena Vista used by motorists to cross the Willamette River. Road crews in Polk County struggled to keep roads clear ahead of the snow. There was only one serious accident but many stranded motorists as a result of the storm.[16] The snow was accompanied by constant sub-freezing temperatures that caused some sporadic power failures, and burst pipes.[17]

February 1989

From February 1 to 8, 1989, there was a combination of below-freezing temperatures, high winds, and snowfall in Polk County. The windchill factor reportedly reached minus 40 degrees Farenheit (-40° F) on the worst day of the storm, February 1st. Icy roads resulted in three injury accidents and numerous non-injury accidents. Burst pipes caused water damage and flooding problems throughout the county including the Polk County Courthouse. There were several fires during the storm where firefighters fought both blazes and the cold.[18] Hospitals in Salem reported 25 cases of storm-related injuries and two cases of hypothermia. Together with below-freezing temperatures and stiff winds, more than one foot of snow fell on some areas of Salem.[19] Customers of Portland General Electric used record amounts of electricity during the storm, forcing the company to start up its Bethel plant in East Salem to meet customer needs.[20]

February 1993

From February 18 to 19, 1993, there was record snowfall of almost twelve inches of snow in a 24-hour period in the Salem area. Wet snow caused tree limbs to break and snapped some powerlines, leaving residents without power for several hours.[21]

December 26, 2003 through January 14, 2004

According to state climatologist George Taylor, snowstorms that swept through the region beginning December 26, 2003, were the snowiest, coldest winter since 1992-3. The winter snowstorm that blew through northwest Oregon at the end of December turned into an ice storm in January.[22] Climatologits called this the worst storm to pelt the west side of Oregon's Cascade Range since 1992 – even worse than the 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.[23] More than 330 flights were cancelled on January 6, 2004, as airplanes sat on the runway encased in ice.[24]

Another 140 flights were cancelled the morning of January 7th alone.[25]

58,000 Portland General Electric (PGE) customers were without power on January 6, 2004.[26] The hardest hit areas were the eastern and southern sections of the service territory, including east Multnomah County, Oregon City, Estacada, Molalla and Mulino, and the Salem area.[27]

Ice Storms

February 1916

A strong ice storm on February 1, 1916, coated wires with ice and caused problems with telephones and telegraph wires. Sparks could be seen as trolley cars moved down ice-covered trolley lines. A north wind sent temperatures plummeting and blanketed Salem in ice and freezing temperatures. Three buildings collapsed as a result of snow accompanying the ice storm, including a cathedral dome and a greenhouse. There was one fatality when a man slipped and fell off a six-story roof while shoveling snow.[28]

January 1942

On January 6, 1942, a significant ice storm rolled across Polk County. Fallen trees and branches that brought down power and telephone lines resulted in thousands of dollars in damage. Telephone and electricity services were completely disrupted in Polk County. Monmouth and Independence were without electricity for several days, and Independence had no water service as a result of the storm.[29]

January 30-31, 1963

Cold temperatures and snow showers created hazardous driving conditions in Polk County during the last days of January 1963, with four inches of snow in Salem together with severe icing conditions.[30,31]

November 1970

Freezing rain caused numerous problems on November 22 and 23, 1970, including power failures that left many residents without light or heat. A heavy coating of ice caused significant damage to power and telephone lines. Several small fires were also the result of icy weather conditions and downed power lines. Icy roads resulted in several accidents, and dangerous road conditions kept schools closed.[32,33]

January 1978

In 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 Polk County and the Willamette Valley, causing eight traffic fatalities and dozens of traffic accidents.[34]

February 2-4, 1996

Similar to the ice storm in 1978, 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. One fatality occurred in a different traffic accident.[35]

Extreme Cold Weather Storms

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.[36]

In addition to the cold weather, four inches on snow fell over much of the Willamette Valley. The weight of the snow downed 400 telephone lines in Salem and caused 21 traffic accidents.[37] The freezing temperatures formed ice in the Willamette River that crushed a steamboat and cause several thousand dollars of damage to the Dennison Bath House.[38]

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 snow and icy roads throughout Polk County. Temperatures in Polk County during this seven-day period were in the mid-teens, not taking into account the wind-chill created by 21 miles per hour wind gusts. The cold snap cut electricity for 100 Salem residents and caused many frozen water pipes.[39] Dozens of fires were reported in Salem from overheated chimneys and stoves, or from blowtorches used to thaw pipes. 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.[40]

Characteristics of Severe Winter Storms in Polk County

Weather Patterns

Severe winter storms affecting Polk County typically originate in the Gulf of Alaska and in the central Pacific Ocean. These storms are most common from October through March.[41] Most of Polk County receives average annual precipitation between 30 and 70 inches, with parts of the Coast Range in the west receiving over 70 inches.[42] The National Climatic Data Center established climate zones in the United States for areas that have similar temperature and precipitation characteristics. Oregon's latitude, topography, and

nearness to the Pacific Ocean give the state diversified climates. Polk County is in Zone 2 (Figure 9-1). The county's climate generally consists of wet winters and dry summers.

Figure 9-1. Oregon Climate Zones

Zone 1: Coastal Area

Zone 2: Willamette Valley

Zone 3: Southwestern Interior

Zone: 4 Northern Cascades

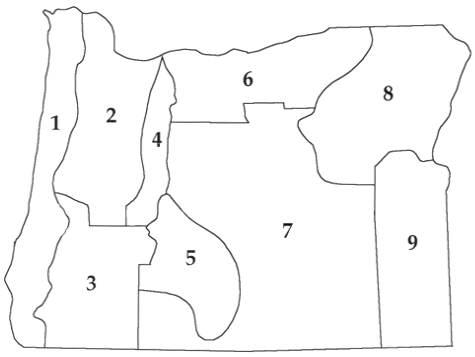
Zone 5: High Plateau

Zone 6: North Central Area

Zone 7: South Central Area

Zone 8: Northeast Area

Zone 9: Southeast Area



Taylor, George H. and Chris Hannan. 1999. *The Oregon Climate Book*.

Normal distribution of precipitation is about 50 percent of the annual total from December through February, lesser amounts in the spring and fall, and very little during summer months.[43] There is an average of only five days per year of measurable snow with snowfall accumulations rarely measuring more than two inches.[44]

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. If a wet Pacific storm happens to reach the area at the same time, larger-than-average snow events may result.[45]

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, and 125 boats, worth a combined value of over three million dollars, sank in the Columbia Gorge.

Ice

Ice storms occasionally occur in northern areas of Oregon, resulting from cold air flowing westward through the Columbia Gorge.[46] 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.[47]

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. 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.[48]

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 the amount and extent of snow or ice, air temperature, wind speed, and event duration. Severe storms can affect the county from the northwest and southeast, and from the Columbia River Gorge. If a severe ice storm occurs within Polk County, there may be prolonged power outages over widespread areas. The probability of such an ice storm is uncertain due to limited historical records, but is considered less likely than a severe ice storm in the Columbia River Gorge, given the usual meteorological patterns for the area. The National Weather Service, Portland Bureau, monitors the stations and provides public warnings on storm, snow, and ice events as appropriate.

Vulnerability and Risk

A vulnerability assessment that describes the number of lives or amount of property exposed to elements of severe winter storms has not yet been conducted for Polk County. Severe winter storms can cause power outages, transportation and economic disruptions, and pose a high risk for injuries and loss of life. The events can also require needed shelter and care for adversely impacted individuals. The county has suffered severe winter storms in the past that brought economic hardship and affected the life and safety of county residents.

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.

Community Winter Storm Issues

Life and Property

Winter storms are deceptive killers. Many of the deaths that occur are indirectly related to the actual storm, including deaths resulting from 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 section 6-1) and landslides (see section 7-1) resulting from heavy snow melt. Trees, power lines, telephone lines, and television and radio antennas can be impacted by ice, wind, snow, and falling trees and limbs. Saturated soil can cause trees to lose their ability to stand and then subsequently fall on houses, cars, utilities, and other property. Similarly, if streets are icy, it is difficult for emergency personnel to travel and may pose a secondary threat to life if police, fire, and medical personnel cannot respond to calls.[49]

Roads and Bridges

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.

During winter storm events, Polk County typically receives numerous calls to clear and maintain roads that are not part of the county road system. The county's first priority is to remove debris from county roads, starting with roadways designated arterials, then removing debris from collectors, and if time and personnel are available, clearing county local roads. It is important that county residents are aware that public access roads and private drives are not part of the Polk County road system.

Power Lines

Historically, falling trees have been the major cause of power outages resulting in interruption of services and damaged property. Polk County has an on-going process to identify potentially hazardous trees within county rights-of-way. In addition, falling trees can bring electric power lines down, creating the possibility of lethal electric shock. Snow and ice may damage utility lines and cause prolonged power outages, but falling trees cause the majority of damage to power lines.[50] Communities in the area are engaged in on-going discussions regarding burying utilities, but costs for doing so are extremely high. Also, damaged underground lines are more difficult and time-consuming to repair than aboveground power lines. Rising population growth and new infrastructure in Polk 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.

Existing Mitigation Activities

County

Polk County Public Works

In preparation of winter storms, Polk County Public Works sands several county roads to make them less icy during the brunt of an ice storm or snowstorm. Since December 1998, there are sixteen different county roads that have been sanded at some time during the months of December through February. The following is a list of the roads sanded by Polk County Public Works Road Crew.

ROAD NAME	ROAD NAME
Bethel Road	Mill Creek Road
Black Rock Road	Oakdale Road
Ellendale Road	Orchard Heights Road NW
Falls City Road	Orchard Knob Road
Gooseneck Road	Perrydale Road
Harmony Road	Red Prairie Road
Hopewell Road	Rickreall Road
James Howe Road	Zena Road

West Valley Housing Authority

West Valley Housing Authority has been serving Polk County affordable housing and community development needs since 1966. The Housing Authority's mission as stewards of public funds and trust is to serve the residents of Polk County who experience barriers to housing, to create a quality environment that enables residents to live responsibly and with dignity and to support them in their efforts to achieve self-sufficiency. The Housing Authority could identify special-needs populations that may need to be evacuated or brought to see health care providers in the event of a severe winter storm event.

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.

Regional

American Red Cross – Willamette Chapter

The American Red Cross provides shelter during natural hazard events for those whose homes are destroyed or inaccessible during these events. During the most recent natural hazards events that impacted Polk County, the county shelters were underutilized.[51] The Polk County Fairgrounds could be used as a possible shelter site because it is easily accessible and centrally located.[52]

Federal

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 re-transmission using the Emergency Alert System.

Mitigation 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 identified to reduce Polk County's risk from flood, landslide, wildfire, severe winter storm and windstorm, drought, expansive soils and seismic and volcanic events.

Goal #1: PUBLIC EDUCATION AND AWARENESS

Provide public information and education/awareness to all residents of the county concerning natural hazard areas and mitigation efforts.

Goal #2: PREVENTIVE AND IMPLEMENTATION

Develop and implement activities to protect human life, commerce, property and natural systems.

Goal #3: COLLABORATION AND COORDINATION

Strengthen hazard mitigation by increasing collaboration and coordination among citizens, public agencies, non-profit organizations, businesses, and industry.

Goal #4: FUNDING AND PARTNERSHIPS

Seek partnerships in funding and resources for future mitigation efforts.

Goal #5: EMERGENCY OPERATIONS

Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

Goal #6: NATURAL RESOURCES UTILIZATION

Link land use planning, development criteria, codes, and natural resources and watershed planning with natural hazard mitigation.

Severe Winter Storm Mitigation Action Items

The severe winter storms mitigation action items were formulated through researching regional mitigation plans and natural hazards planning literature, and interviews with local stakeholders. Plan action items were refined through discussions with the mitigation plan steering committee and 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 the county, and organizations and residents in Polk 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 storms in Polk 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: Enhance strategies for debris management from severe winter storms.

Ideas for Implementation

- Develop coordinated management strategies for de-icing roads, plowing snow, clearing roads of fallen trees and debris from public property;

- Increase coordination between Public Works and local utilities; and

- Publicize which roads are part of the county system so that residents are aware that the county prioritizes county roads for clearing, and the county relies on its residents to clear private drives.

Coordinating Organization:	Public Works' Road Maintenance Division
Internal Partner:	GIS, Planning, CAO
External Partners:	Utilities, county residents, solid waste franchises, landfills
Timeline:	2 years
Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships; Emergency Operations; Natural Resources Utilization

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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 human life, commerce, property, natural systems and utility systems; and

- Develop partnerships between utility providers and county and local public works agencies to document known hazard areas.

Coordinating Organization:	Emergency Management – Hazard Mitigation Team
Internal Partners:	Community Development, Public Works
External Partners:	Cities, utilities
Timeline:	2 years
Plan Goals Addressed:	Funding & Partnerships, Emergency Operations; Natural Resources Utilization

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ST-SWS #3: Update the county's debris management plan.

Idea for Implementation

- Update the Polk County Debris Management Plan, which is an element of the county's Emergency Response Plan; and

- Provide information to the public on debris management and disposal sites.

Coordinating Organization:	Emergency Management – Hazard Mitigation Team
Internal Partner:	Community Development/Planning
External Partner:	Utilities, cities, solid waste franchises, and landfills
Timeline:	2 years
Plan Goals Addressed:	Funding & Partnerships, Emergency Operations; Natural Resources Utilization

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, commerce, property, and natural systems from severe winter storm events. This information may include, but not be limited to:

  1. How to cook safely when power is out.

  2. How to safely install a generator and connect appliances to service.

- Distribute educational materials to Polk County residents and public and private sector organizations regarding evacuation routes i.e., detours during road closures;

- Update Polk County's Web site information to include information about how to prepare for severe winter storms;

- Use the community access Cable Channel 17, and other media outlets including Spanish-language stations to post storm-related information;

- Distribute audience-specific educational materials to schools, churches, and other public and private sector organizations;

- Develop methods of improving the county's emergency warning system;

- Educate citizens about the different National Weather Service announcements;

- Identify and contact at-risk populations such as the elderly or disabled not living in group homes/assisted care facilities;

- Make available a map indicating locations of emergency shelters in the county; and

- Create inventory of supplies available for at-risk populations in severe winter storm situations.

Coordinating Organization:	Emergency Management – Hazard Mitigation Team
Internal Partner:	Community Development
External Partners:	Utilities, Cities, West Valley Housing Authority, American Red Cross, Churches, Oregon voluntary organizations active in disaster, Polk Fire Defense Board
Timeline:	1 to 2 years, Ongoing
Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Funding & Partnerships; Emergency Operations

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LT-SWS #2: Develop and implement programs to keep trees from threatening lives, property, and public infrastructure as a result of severe weather events.

Ideas for Implementation

- Develop partnerships between utility providers, county and city agencies to document known hazard areas and minimize risks;

- Coordinate with overhead utilities in developing GIS layers for power lines and at-risk trees;

- Provide residents with a list of acceptable trees for under power lines; and

- Provide information about overhead utilities' on "Right Tree – Right Place" Program.

Coordinating Organization:	Emergency Management – Hazard Mitigation Team
Internal Partners:	GIS, Public Works, Community Development
External Partners:	Overhead Utilities, Cities
Timeline:	On-going
Plan Goals Addressed:	Preventive & Implementation; Funding & Partnerships; Natural Resources Utilization

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LT-SWS #3 Promote the benefits of tree-trimming and tree replacement programs and help to coordinate local efforts by public and private agencies.

Ideas for Implementation

- Coordinate with private overhead utilities and adjacent property owners in harvest plans that are adjacent to roads and/or power line easements near the county's public rights-of-way.

Coordinating Organization:	Public Works – Road Maintenance
Internal Partners:	GIS, Emergency Management - Hazard Mitigation Team
External Partners:	Utility and telecommunications companies, ODOT, city public works, owners of property adjacent to public rights-of-way
Timeline:	3 to 5 years
Plan Goals Addressed:	Public Education & Awareness, Funding & Partnerships; Natural Resources Utilization

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LT-SWS #4: Encourage harvesting of trees along utility and road corridors, preventing potential winter storm damage.

Ideas for Implementation

- Encourage the clearing of trees along utility corridors and roads, which will prevent winter storm damage; and

- Encourage owners of property adjacent to road corridors and utility operators to harvest trees in the corridors that will prevent winter

storm damage, mitigate fire hazards, and could be used in fish enhancement projects.

Coordinating Organization:	Public Works - Roadmaster
Internal Partner:	Emergency Management - Hazard Mitigation Team
External Partner:	Cities, Utilities, FEMA, ODFW, DSL, ODOT, ODF, forest products industry, watershed councils, property owners of land adjacent to public rights-of-way
Timeline:	On-going
Plan Goals Addressed:	Preventive & Implementation; Collaboration & Coordination; Natural Resources Utilization

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LT-SWS #5: 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 - Roadmaster
Internal Partners:	GIS, Building, Planning, CAO
External Partners:	USFS, BLM, ODF, ODOT, utility operators, county residents
Timeline:	On-going
Plan Goals Addressed:	Prevention and Implementation; Collaboration & Coordination; Funding & Partnerships; Natural Resources Utilization

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Severe Winter Storm Resource Directory

County Resources

West Valley Housing Authority

The West Valley Housing Authority has been serving Polk County affordable housing and community development needs since 1966. Their goal is to provide opportunity for all low-income individuals and families in the Polk County area to have access to safe and decent affordable housing. The Housing Authority believes that disabled, elderly and family members who receive timely help with housing are encouraged in their efforts toward stability, self-sufficiency, and self-respect. Their mission is to serve the residents

of Polk County who experience barriers to housing, to create a quality environment that enables residents to live responsibly and with dignity and to support them in their efforts to achieve self-sufficiency.

Contact: West Valley Housing Authority
Director: Adolph "Val" Valfre, Jr.
Address: 204 SW Walnut Avenue
P.O. Box 467, Dallas, OR 97338
Phone: 503-623-8387
Fax: 503-623-6907
Website: www.wvpha.org
Email: avalfre@wvpha.org

State Resources

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: Oregon State University
Strand Ag Hall Room 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.

Contact: National Oceanic and Atmospheric Administration
Address: 14th Street & Constitution Avenue, NW, Room 6013, 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

Publications

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

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

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[1] National Weather Service, Portland Office/

[2] *The Oregon Statesman*, February 2, 1937: no. 268, page 1.

[3] National Weather Service, Portland Office.

[4] *The Oregon Statesman*, February 18, 1862.

[5] Taylor, George H. and Chris Hannan. 1999. *The Oregon Weather Book*. Corvallis, OR: Oregon State University Press.

[6] Id.

[7] Id.

[8] *Itemizer-Observer*. February 4, 1937: vol. 68, no. 5, page 1.

[9] *The Oregon Statesman*. February 2, 1937: no. 268, pages 1–2.

[10] *Itemizer-Observer*. January 19, 1950: vol. 75, no.3, page 1.

[11] *Itemizer-Observer*. January 26, 1950: vol.75, no. 4, page 1.

[12] *Itemizer-Observer*. February 2, 1950: vol. 75, no. 5, page 1.

[13] *The Oregon Statesman*. January 28, 1956: no. 307, page 1.

[14] *The Oregon Statesman*. March 3, 1960: no. 342, page 1.

[15] *Oregon Statesman*. March 4, 1960: no. 343, page 1.

[16] *Itemizer-Observer*. January 30, 1969: vol. 94, no. 5, page 1.

[17] *The Oregon Statesman*. January 29, 1969: no. 308, page 1.

[18] *Itemizer-Observer*. February 8, 1989: vol. 144, no. 6, pages 1 and 3A.

[19] *The Oregon Statesman*. February 3, 1989: vol. 138, no. 313, page 1.

[20] *The Oregon Statesman*. February 4, 1989: vol. 138, no. 314, page 2A

[21] *The Oregon Statesman*. February 20, 1993: vol. 141, no. 333, page 1.

[22] "Storm Leaves Northwest in a Standstill." January 7, 2004. *KATU News*. Available on the World Wide Web http://www.katu.com/news/story.asp?ID=63527. Accessed August 23, 2004.

[23] "Some Areas Thawing, While Others Remain Icy." January 8, 2004. *KATU News*. Available on the World Wide Web http://www.katu.com/news/story.asp?ID=63532. Accessed August 23, 2004.

[24] "Storm Leaves Northwest in a Standstill." January 7, 2004. *KATU News*. Available on the World Wide Web http://www.katu.com/news/story.asp?ID=63527. Accessed August 23, 2004.

[25] "Ice Turns Roadways into Rinks." January 8, 2004. *News-Register*. Available on the World Wide Web http://www.newsregister.com/news/results.cfm?story_no=175070. Accessed August 23, 2004.

[26] "Power Knocked Out to Thousands Across Northwest." January 7, 2004. *KATU News*. Available on the World Wide Web http://www.katu.com/news/story.asp?ID=63529. Accessed August 23, 2004.

[27] "Storm Buries County in Snow." January 6, 2004. *News-Register*. Available on the World Wide Web http://www.newsregister.com/news/results.cfm?story_no=175036. Accessed August 23, 2004.

[28] *The Oregon Statesman*. February 3, 1916: no. 268, page 1.

[29] *Itemizer-Observer*. January 8, 1942: vol. 67, no. 2, page 1.

[30] *The Oregon Statesman*. January 29, 1963: no.308, page1.

[31] Taylor, George H. and Chris Hannan. 1999. *The Oregon Weather Book*. Corvallis, OR: Oregon State University Press.

[32] *The Oregon Statesman*. November 23, 1970: no. 241, page 1.

[33] *Itemizer-Observer*. November 26, 1970: vol. 95, no. 48, page 1.

[34] *The Oregon Statesman*. January 3, 1978: vol. 127, no. 195, page 1.

[35] Taylor, George H. and Chris Hannan. 1999. *The Oregon Weather Book*.

[36] Id.

[37] *The Oregon Statesman*. December 16, 1924: page 1.

[38] *The Oregon Statesman*. December 17, 1924: page 3.

[39] *The Oregon Statesman*. January 25, 1957: page 1.

[40] *The Oregon Statesman*. January 27, 1957: page 1

[41] Interagency Hazard Mitigation Team. 2000. *State Hazard Mitigation Plan.* Oregon State Police – Office of Emergency Management. Salem, OR.

[42] Id.

[43] Taylor, George H. and Chris Hannan. 1999. *The Oregon Weather Book*.

[44] National Weather Service, Portland Bureau. March 2001. http://www.wrh.noaa.gov/Portland/snowstorm.html.

[45] Taylor, George H. and Chris Hannan. *The Oregon Weather Book*.

[46] Id.

[47] Id.

[48] Id.

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

[50] Ford, Dave. Public Information Officer, Portland General Electric. Personal interview. November 24, 2004.

[51] Williamson, Roger. American Red Cross, Willamette Chapter. Personal Interview. February 10, 2005.

[52] Id.

Section 10:
Windstorms (Including Tornadoes)

Why are Windstorms a threat to Polk 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 caused local governments to spend 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. While Polk County did not receive a Presidential Disaster Declaration for this storm, many other counties in the state did, illustrating the severity of these storms.

The hazard mitigation grant mitigated future losses to utility infrastructure. The grant assisted utilities in developing tree-trimming practices, right-of-way clearing policies, and in sharing techniques that reduce power line breakage by improved and alternate attachments to poles. A consumer-oriented program was also initiated to assist property owners in selecting trees that are power line friendly.

Similarly, a storm on February 7 and 8, 2002, resulted in a Presidential Disaster Declaration for five Oregon Counties.[1] Nine other counties were declared contiguous counties affected by the storm. Such a declaration allowed family farmers to apply for loans to assist with storm-related damage.

Why are Tornadoes a Threat to Polk County?

Tornadoes are the most concentrated and violent storms produced by the earth's atmosphere.[2] A tornado is a vortex of rotating winds and strong vertical motion that possesses remarkable strength and can cause almost unbelievable damage. Wind speeds in excess of 300 miles per hour have been observed within tornadoes, and it is suspected that some tornado winds exceed 400 mph.[3] While most common in the Midwest, Oregon and other western states have experienced tornadoes on occasion, many of them producing significant damage and occasionally causing injury and death. Tornadoes can pose a significant threat to life and property, and can topple trees over buildings and power lines causing power outages, and disruption of essential services. In addition to strong

winds, the low-pressure system associated with tornadoes can literally explode buildings that it passes over.[4]

Historical Windstorm Events

Regional

The Mid/Southern Willamette Valley, including Polk County has experienced 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 below outlines the most severe windstorms recorded in the region.

Table 10-1: Significant Wind Storms Affecting The Southern and Mid-Willamette Valley: 1931-2002

DATE	AFFECTED AREA	CHARACTERISTICS
April 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
December 1951	Statewide	Wind speed 60 mph in Willamette Valley. 75 mph gusts. Damage to buildings and utility lines.
December 1955	Statewide	Wind speeds 55-65 mph with 69 mph gusts. Considerable damage to buildings and utility lines
November 1958	Statewide	Wind speeds at 51 mph with 71 mph gusts. Every major highway blocked by fallen trees
October 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
March 1971	Most of Oregon	Greatest damage in Willamette Valley. Homes and power lines destroyed by falling trees. Destruction to timber in Lane Co.
November 1981	Most of Oregon	Highest winds since 10/62. Wind speed 71 mph in Salem. Marinas, airports and bridges severely damaged
January 1990	Statewide	Heavy rain with winds exceeding 75 mph. Significant damage. One fatality
December 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)
November 1997	Western Oregon	Wind speed 52 mph in Willamette Valley. Trees uprooted. Considerable damage to small airports.
February 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. 1999. *The Oregon Weather Book*, pp.151-157; Hazard Mitigation Team Survey Report, Severe Windstorm in Western Oregon, February 7, 2002 (FEMA-1405-DR-OR)

Polk County

Windstorms have historically been a threat to Western Oregon, and most of the storms described in Table 10-1 impacted Polk County. The following storms, though not isolated to Polk County, caused especially severe damage to the county.

April 1931 Windstorm

This windstorm downed trees along the Falls City-Valsetz Road and caused intermittent power outages. It also brought a pale gray dust that covered the land and filtered into homes and buildings. In Dallas, the dust limited visibility to only a few blocks[5].

October 12, 1962 (The Columbus Day Storm)

The infamous Columbus Day windstorm brought wind gusts of up to 90 miles per hour and was related to two deaths in Polk County. The high winds damaged approximately 75 percent of homes in Dallas and collapsed a barn, killing fifty head of cattle. In Independence, the winds fanned a fire that destroyed a ranch. In Monmouth, the Oregon College of Education (Western Oregon University) received damages estimated at $275,000 (in 1962 dollars). Throughout the county, 50 percent of the older prune orchards and 85 percent of other prune orchards were destroyed by the storm. In addition to property damage, 932 telephone outages occurred in Dallas, 6,400 in Salem, and across the state there were 53,100 phone outages[6].

November 13-15, 1981

Sometimes referred to as the "Friday the 13th Storm", this windstorm was the most powerful since the Columbus Day Storm of 1962. This windstorm produced gusts up to 70 miles per hour; the *Itemizer Observer* reported that it "knocked out electric power to large parts of the county, brought down dozens of trees, felled power lines and poles, removed roofs and scattered debris across the county.[7]" Although the storm did not cause major damage, its effects were widespread: several buildings were damaged and toppled trees blocked the Falls City-Valsetz Road.[8] Numerous injuries resulted from wind-blown debris in western Washington and Oregon.[9]

December 12, 1995 Windstorm

This windstorm caused such widespread damage from downed trees and power and communication outages that Governor Kitzhaber declared a state of emergency in all of western Oregon[10]. One hundred and fifty National Guard troops were called on to assist residents and public utility crews.[11] In Salem, the National Weather Service reported average winds of 40 miles per hour with gusts up to 59 miles per hour. In the region between Salem and Corvallis, 7500 people lost phone service. Fortunately, damage was comparatively light in Polk County. As one headline in the *Itemizer*

Observer read, "Ice and Winds Ravage Adjacent Areas, but Leave Polk County Unscathed."[12]

February 7, 2002

The most recent of large windstorm events arrived in the Willamette Valley with wind gusts up to 70 miles per hour causing 27,000 power outages statewide.[13] The severity of this storm prompted President Bush to issue Major Disaster Declarations for five Oregon Counties. Nine other Oregon counties were named contiguous counties, allowing family farmers to receive loans to address storm-related damage.[14]

Historical Tornado Events

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.[15] No injuries or deaths were reported during this period. Although infrequent, several significant tornado events have occurred within Northwestern Oregon and Polk County.

Northwestern Oregon Region

January 19, 1887

In the first reported tornado in Oregon, a local resident described a small tornado in the vicinity of Cottage Grove. The tornado twisted a four-foot diameter fir tree from its roots, picked up a couple of sheep and carried them for 200 yards, and tore down fences.[16]

February 26, 1904

A tornado struck the vicinity of Mount Tabor in east Portland. Four houses were destoyed and others were moved off their foundations. Damage totalled $5,000.[17]

February 19, 1926

A small tornado near McMinnville felled many tress and destroyed a huge "dry house". Several accounts indicate that there may have been four or five whirlwinds in a group.[18]

September 8, 1938

A tornado was first spotted south and east of Halsey. The *Oregonian* on September 8, 1938, featured a photograph of the tail of the tornado dropping earthward from black thunder clouds in Brownsville.[19]

January 20, 1953

On this date, a tornado struck Corvallis. The twister, which suddenly appeared out of dark clouds at 8 a.m., struck the downtown area. During its brief presence, it "exploded" one building, passed close to the Roosevelt School, and then crossed the Willamette River before disappearing. Accompanying the tornado were rain and hail, which fell in sheets, causing more damage to businesses than did the twister.[20]

April 12, 1957

A very strong storm system reached northern Oregon between April 12th and 14th, bringing heavy rains and wind gusts up to 70 miles per hour. On the 12th, a dark storm cloud appeared near Sandy, southeast of Portland. Heavy rain and hail began to fall. As the storm moved east from Sandy, a funnel cloud appeared and touched ground as a 50-foot wide tornado. Large fir trees, 18 to 36 inches in diameter, were twisted off or snapped 30 to 40 feet off the ground. A large barn under construction was lifted off its foundation and carried several hundred feet in the air, before falling to the ground and shattering in pieces. Roofs of homes and barns were damaged and several outbuildings were carried a considerable distance before being destroyed.[21]

April 5, 1972

On this date, possibly the most destructive tornado in Oregon occurred. The tornado touched down near Portland at the south shore of the Columbia River damaging four pleasure boat moorages on Marine Drive, 50 cabin cruisers, boathouses and dock shelters. It then crossed the Columbia drawing water up with it. The tornado continued on its nine-mile long path through Vancouver, Washington, where it caused six deaths, 300 injuries and at least $5 million dollars in damage.[22]

March 22, 1994

On this date, a small tornado touched down near a shopping area in Albany. It blew out a store window and damaged some merchandise inside, but overall damage was very limited.[23]

January 1996

In January 1996, and apparent tornado struck the Oregon coast near Lincoln City. Police reported a number of windows broken, windows exploded outward, and a number of fish deposited on land, apparently after being lifted out of the water by the tornado.[24]

Polk County

One significant tornado occurred in Polk County.

November 11, 1925

At approximately 11 a.m., a tornado began a few miles southwest of Salem in Polk County and traveled east-northeast for about five miles. Most of the tornado's path was in Marion County. Damage occurred to a few buildings and trees, while the total damage was merely a few thousand dollars. It is quite evident that the storm was a rather poorly defined tornado, which reached the ground at a few places in a five-mile path extending from just north of Independence to a point in the Liberty district, just to the southwest of Salem. At no place was the path well outlined, as for the most part damage was confined to old weak structures. No serious injuries were reported. Some damaged buildings showed

the effects of the sudden expansion of the air in the buildings against the reduced pressure outside.[25]

Characteristics of Windstorms in Polk 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 generated from the Pacific Ocean are strong along the coast, but slow down inland due to the obstruction of the Coastal and Cascade mountain ranges.[26] 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.[27]

Tornadoes

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.[28]

Windstorm and Tornado Hazard Assessment

Hazard Identification

A windstorm is generally a short duration event involving straight-line winds and/or gusts in excess of 50 miles per hour. 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. Foothill sections of the county experience 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.[29] The largest tornado path widths can exceed one mile, and the smallest widths can be less than ten yards.[30] Widths can vary considerably during a single tornado, because the size of the tornado can change considerably during its lifetime.[31] Path lengths can vary from a single point to more than 100 miles.[32] More highly populated areas within the county are those at greatest risk during a tornado.

The probability of a major tornado occurring in Polk 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 wind hazards or to elements of tornadoes has not yet been conducted for Polk County. There are many issues related to what is in danger within communities experiencing windstorms and tornadoes. Windstorms and tornadoes can cause power outages, transportation, and economic disruptions, and significant property damage and pose a high risk for injuries and loss of life. Major utilities cite windstorms as one of the two biggest natural hazards that affect their infrastructure – ice storms is the second.[33] 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 and tornado risk analysis include: population and property distribution in the hazard area; the frequency of tornadoes and windstorm events; infrastructure that may be impacted by tornadoes or windstorms; 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.

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.

Community Windstorm 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 present 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.

Polk 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.[34] 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 Polk County. Windstorms can cause flying debris and

downed utility lines. For example, tree limbs breaking in winds of only 45 miles per hour can be thrown over 75 feet. As a result, 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.[35] 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.[36] 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/sup-pressed 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; Portland General Electric Co.©

Table 10-4. Tree Failure Profile - Species: Bigleaf Maple *(Acer macrophyllum)*

Failed Part	Description of failure/ Tree characteristics	Associated defects/	Environment	Management History

		Indicators		
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; Portland General Electric Co.©

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).[37] Table 10-1 shows the various damage levels used to categorize tornadoes.

Table 12.1 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.[38] 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 and Existing Activities

Mitigation 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 identified to reduce Polk County's risk from flood, landslide,

wildfire, severe winter storm and windstorm, drought, expansive soils and seismic and volcanic events.

Goal #1: PUBLIC EDUCATION AND AWARENESS

Provide public information and education/awareness to all residents of the county concerning natural hazard areas and mitigation efforts.

Goal #2: PREVENTIVE AND IMPLEMENTATION

Develop and implement activities to protect human life, commerce, property and natural systems.

Goal #3: COLLABORATION AND COORDINATION

Strengthen hazard mitigation by increasing collaboration and coordination among citizens, public agencies, non-profit organizations, businesses, and industry.

Goal #4: FUNDING AND PARTNERSHIPS

Seek partnerships in funding and resources for future mitigation efforts.

Goal #5: EMERGENCY OPERATIONS

Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

Goal #6: NATURAL RESOURCES UTILIZATION

Link land use planning, development criteria, codes, and natural resources and watershed planning with natural hazard mitigation.

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 windstorm and tornado mitigation action items were formulated through researching regional mitigation plans and 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 windstorm and tornado mitigation action items provide direction on specific activities that organizations and residents in Polk County can undertake to reduce risk and prevent loss from windstorm events and tornadoes. 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 and tornadoes in Polk County. These action items are designed to meet the mitigation plan goals.

Short-term (ST) Windstorm and Tornado Action Items

Short-term windstorm and tornado action items include general mitigation activities that agencies are capable of implementing within 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, 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 above-ground utility lines and roads.

Coordinating Organization:	Emergency Management – Hazard Mitigation Team
Internal Partners:	Public Works, Community Development, GIS
External Partners:	Cities, ODF, BLM, ODOT, Utility providers
Timeline:	2 years
Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Funding & Partnerships; Natural Resources Utilization

ST-WS #2: 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 local agencies responsible for debris removal and provide residents locations for debris disposal; and

- Notify area residents, business owners, and employees of alternative routes i.e., detours in case of road blockage

Coordinating Organization:	Emergency Management – Hazard Mitigation Team
Internal Partner:	Public Works/Roads
External Partners:	ODOT, cities, regional recycling facilities
Timeline:	2 years
Plan Goals Addressed:	Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships; Emergency Operations; Natural Resources Utilization

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ST-WS #3: Maintain tree trimming near aboveground power lines.

Ideas for Implementation

- Coordinate with overhead utilities to evaluate tree trimming.

Coordinating Organization:	Public Works
Internal Partners:	Emergency Management – Hazard Mitigation Team, Community Development
External Partners:	Overhead Utilities, Cities
Timeline:	On-going
Plan Goals Addressed:	Preventive & Implementation; Collaboration & Coordination; Emergency Operations; Natural Resources Utilization

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Long-term (LT) Windstorm and Tornado Action Items

Long-term windstorm and tornado 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 Polk 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 Polk County.

  2. Maps of the locations within Polk 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 – Hazard Mitigation Team
Internal Partners:	Planning, GIS
External Partners:	FEMA, NCDC, OCS, NWS
Timeline:	5 years
Plan Goals Addressed:	Preventive & Implementation

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 Partners:	Emergency Management – Hazard Mitigation Team, GIS
External Partner:	Utility companies
Timeline:	On-going
Plan Goals Addressed:	Preventive & Implementation

LT-WS #3: Increase public awareness of windstorm and tornado mitigation activities.

Ideas for Implementation

- Collect existing information on public education materials for protecting life, property, and the environment from windstorm and tornado 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 – Hazard Mitigation Team
Internal Partners:	Planning
External Partners:	Utilities, cities, FEMA
Timeline:	On-going
Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Emergency Operations; Natural Resources Utilization

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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:	Community Development/Building
Internal Partner:	Planning
External Partner:	Cities
Timeline:	5 years
Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation

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LT-WS #5: Develop and implement programs to keep trees from threatening lives, property, and public infrastructure during windstorm events and tornadoes.

Ideas for Implementation

- Partner with responsible agencies and organizations to design and implement tree programs that reduce risk to life, property, and utility systems; and

- Develop partnerships between utility providers and county and local public works agencies to document known hazard areas.

Coordinating Organization:	Public Works
Internal Partners:	Community Development/Planning
External Partners:	Utilities, cities
Timeline:	On-going
Plan Goals Addressed:	Preventive & Implementation; Natural Resources Utilization

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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 educational materials on tree species that are susceptible to wind throw; and

- Locate hazardous trees and add to map.

Coordinating Organization:	Community Development
Internal Partner:	GIS
External Partners:	Cities, Overhead Utilities
Timeline:	On-going
Plan Goals Addressed:	Preventive & Implementation; Natural Resources Utilization

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LT-WS #7: Encourage critical facilities to secure emergency power.

Ideas for Implementation

- Seek funding and capital improvements for emergency power sources for critical facilities.

Coordinating Organization:	Emergency Management – Hazard Mitigation Team
Internal Partner:	Community Development/Planning
External Partners:	Cities, other counties, Polk Fire Defense Board, police stations, water systems
Timeline:	On-going
Plan Goals Addressed:	Preventive & Implementation; Collaboration &Coordination; Funding & Partnerships

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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 – Hazard Mitigation Team
Internal Partners:	Planning, County Administrator's Office
External Partners:	Cities, Utilities, FEMA, USFS, ODFW, DSL, BLM, ODOT, forest products industries
Timeline:	On-going
Plan Goals Addressed:	Preventive & Implementation; Natural Resources Utilization

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LT-WS #9: Encourage harvesting of trees blown down during a windstorm or tornado.

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 – Hazard Mitigation Team
Internal Partners:	Planning, County Administrator's Office

External Partners:	Cities, Utilities, FEMA, USFS, ODFW, DSL, BLM, ODOT, forest products industries
Timeline:	On-going
Plan Goals Addressed:	Preventive & Implementation; Natural Resources Utilization

LT-WS #10: Increase and maintain public awareness of severe windstorms and tornadoes 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, commerce, property, and the environment from windstorm events;

- Distribute educational materials to County residents and public and private sector organizations regarding evacuation routes i.e., detours 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 – Hazard Mitigation Team
Internal Partner:	Community Development
External Partners:	Utilities, Cities, American Red Cross, Churches, Oregon Voluntary Organizations Active in Disaster, ARES, Fire Defense Board
Timeline:	On-going
Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Funding & Partnerships

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Windstorm and Tornado 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: Oregon State University
Strand Ag Hall Room 326, Corvallis, OR 97331-2209
Phone: 541-737-5705
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
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: 130-228 St. SW, Bothell, WA 98021-9796
Phone: 425-487-4678
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
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 Willamette Chapter serves the residents of Marion and Polk counties. The Willamette Chapter provides a variety of community services which 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, Willamette Chapter
Address: 675 Orchard Heights Rd NW, Suite 200, Salem OR
Phone: 503-585-5414
Fax: 503-362-3904
Website: http://www.redcross-salem.org
Email: rc@redcross-salem.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/

International Society of Arboriculture

The International Society of Arboriculture is a worldwide professional organization dedicated to fostering a greater appreciation for trees and to promoting research, technology, and the professional practice of arboriculture.

Contact: International Society of Arboriculture
Address: P.O. Box 3129, Champaign, IL 61826-3129
Phone: 217.355.9411
Fax: 217.355.9516
E-mail: isa@isa-arbor.com
Website: www.isa-arbor.com

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: 806-742-3136

E-Mail: Architecture.Programs@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/htp/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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[1] United States. Office of the President. *Presidential Declaration of a Major Disaster for the State of Oregon* (FEMA-1405-DR), dated March 12, 2002, and related determinations. The counties declared: Coos, Curry, Douglas, Lane, and Linn.

[2] Taylor, George H. and Chris Hannan. 1999. *The Oregon Weather Book*. Corvallis, OR: Oregon State University Press.

[3] Id.

[4] Taylor, George. "Weather Matters." *Mid-Valley Sunday*: March 28, 1999.

[5] *Itemizer Observer*. April 1931: Vol. 56 No. 17.

[6] *Itemizer Observer*. October 18, 1962: Vol. 87, No. 42, pages 1, 2, 4.

[7] *Itemizer Observer*. November 18, 1981: Vol. 106, No. 47, page 1.

[8] *Itemizer Observer*. November 18, 1981: Vol. 106 No. 47, pages 1, 8.

[9] Taylor, George H. and Raymond R. Hatton. 1996. *The Oregon Weather Book*. Corvallis, OR: Oregon State University Press. Page 153.

[10] *The Statesman Journal*. December 12, 1995.

[11] *Statesman Journal*. December 14, 1995.

[12] *Itemizer Observer*. December 13, 1995.

[13] *Statesman Journal*. February 9, 2002.

[14] US Department of Agriculture. Available on the World Wide Web http://www.fsa.usda.gov/or/Notice/Flp104.pdf

[15] National Severe Storms Forecast Center.

[16] Taylor, George H. Chris Hannan. 1999. *The Oregon Weather Book*.

[17] Id.

[18] Id.

[19] Id.

[20] Taylor, George. "Weather Matters." *Mid-Valley Sunday*: March 28, 1999.

[21] Taylor, George H. and Chris Hannan. *The Oregon Weather Book*.

[22] Taylor, George. "Weather Matters." *Mid-Valley Sunday*: March 28, 1999.

[23] Id.

[24] Id.

[25] American Meteorological Society Monthly Weather Review, November 1925.

[26] National Weather Service, Portland Bureau. Available on the World Wide Web http://www.wrh.noaa.gov/Portland. Accessed February 2002.

[27] Taylor, George H. and Chris Hannan. 1999. *The Climate of Oregon.* Corvallis, OR: Oregon State University Press.

[28] Taylor, George H., Holly Bohman, and Luke Foster. August 1996. *A History of Tornadoes in Oregon.* Oregon Climate Service. Corvallis, OR: Oregon State University. Available on the World Wide Web http://www.ocs.orst.edu/pub_ftp/reports/book/tornado.html

[29] National Severe Storms Laboratory.

[30] Id.

[31] Id.

[32] Id.

[33] Ford, Dave. Public Information Office, Portland General Electric. Personal Interview. February 3, 2005.

[34] Interagency Hazard Mitigation Team. 2000. *State Hazard Mitigation Plan*. Oregon State Police – Office of Emergency Management. Salem, OR.

[35] Winfrey, Greg. Chief of the Rogue River Rural Fire Protection District. Personal interview. March 2001.

[36] Portland General Electric Web page, http://www.portlandgeneral.com/safety_and_outage/tree_maint/trees_and_outages.asp. Accessed May 2003.

[37] The Tornado Project.

[38] Interagency Hazard Mitigation Team. 2000. *State Hazard Mitigation Plan*. Oregon State Police – Office of Emergency Management. Salem, OR.

Section 11:
Drought

Why is Drought a Threat to Polk 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]

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.

Historical Drought Events

Oregon

1928-1941

A significant drought affected all of Oregon from 1928 to 1941. This prolonged statewide drought created significant problems for the agriculture industry. The first of the three Tillamook Forest burns occurred during this drought in 1933.[4]

1985-1994

Although not as severe as the 1976-77 drought in any one year (see below), the cumulative effect of ten dry years caused problems statewide. The peak year was 1992, when the state declared a drought emergency. 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.[5]

Polk County was part of a drought declaration in 1992, and the county adopted a water curtailment plan at that time.[6] Although there was documented crop damage, and water systems were affected, Polk County residents in conjunction with that event submitted no claims for crop losses.[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.

The period from October 2000 - 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 - February 1977 was drier in the Northwest.[11]

Northwestern Oregon Region

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.[12]

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.[13] 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 is the driest February on record since 1977, surpassing 2001's conditions.[14] 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 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 in March 2005. 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 records 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.[15] Drought occurs in virtually all climatic zones, but its characteristics vary significantly from one region to another.[16] Drought is a temporary condition; it differs from aridity, which is restricted to low rainfall regions and is a permanent feature of climate.[17]

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.[18] The area of strong convection, which produces large rain clouds, usually shifts eastward as waters in those areas warm.[19] In the western Pacific, easterly trade winds often reverse and blow from the west, reducing ocean temperatures.[20]

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.[21] Both the polar and subtropical jet streams are changed as well.[22] The former often dips southward over the North Pacific, then veers northward into Alaska.[23] Although some storms still reach the Northwest, they tend to be less frequent than during average years.[24] This causes the Northwest to be generally drier than average during such an event.

Drought Hazard Assessment

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.[25] 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.[26] 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.[27]

- 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).[28] 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.[29] Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts.[30] 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.[31] 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.[32] Socioeconomic drought refers to the situation that occurs when physical water shortage begins to affect people.[33] Socioeconomic drought occurs when the demand for an economic good exceeds supply as a result of a weather-related shortfall in water supply.[34]

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.[35] 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 Polk County. Depending on the severity of the drought, however, it poses a risk for agricultural and timber losses, property damage, and 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.[36]

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.[37]

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 **Polk Soil and Water Conservation District** (Polk 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. The mission of the Polk SWCD is to provide for the conservation of the renewable natural resources of Polk County through control and prevention of soil erosion, degradation of water quality, and flooding; conservation and development of natural resources, water resources, natural beauty, and recreation; and the promotion of the health, safety, and general welfare of the people of Polk County, Oregon.

Federal

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.

Mitigation Plan Goals

Mitigation 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 identified to reduce Polk County's risk from flood, landslide, wildfire, severe winter storm and windstorm, drought, expansive soils and seismic and volcanic events.

Goal #1: PUBLIC EDUCATION AND AWARENESS

Provide public information and education/awareness to all residents of the county concerning natural hazard areas and mitigation efforts.

Goal #2: PREVENTIVE AND IMPLEMENTATION

Develop and implement activities to protect human life, commerce, property and natural systems.

Goal #3: COLLABORATION AND COORDINATION

Strengthen hazard mitigation by increasing collaboration and coordination among citizens, public agencies, non-profit organizations, businesses, and industry.

Goal #4: FUNDING AND PARTNERSHIPS

Seek partnerships in funding and resources for future mitigation efforts.

Goal #5: EMERGENCY OPERATIONS

Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

Goal #6: NATURAL RESOURCES UTILIZATION

Link land use planning, development criteria, codes, and natural resources and watershed planning with natural hazard mitigation.

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 drought 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 comments from the public.

The drought action items provide direction on specific activities that organizations and residents in Polk 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 the steering committee and local decision makers in pursuing strategies for implementation.

This section lists action items identified to reduce the risk from drought impacts in Polk 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: Encourage the dissemination of ideas by county-based agencies on effective methods of water use curtailment.

Ideas for Implementation

- Encourage Polk SWCD, NRCS, local watershed councils and water providers when they provide technical services for local land owners on ways to reduce water use during drought emergencies, including voluntary and enforced methods, no outside use of water (residential), mandatory reductions of certain uses, etc.

Coordinating Organization: Polk County

Internal Partners:	Community Development, CAO
External Partners:	Polk SWCD, Watershed Councils, OSU Extension Service, NRCS, Water Systems, Oregon Water Resources Department (WRD)
Timeline:	2 years and on-going
Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Collaboration & Coordination; Funding &Partnerships; Natural Resources Utilization

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ST-D #2: Encourage water providers to inter-tie water systems.

Ideas for Implementation

- With the assistance of MWVCOG, encourage water providers located proximate to one another, yet with separate water systems, to develop the physical capability to send water from one system to the other.

Coordinating Organization:	Community Development
Internal Partner:	Public Works
External Partners:	MWVCOG, cities and rural communities; community water associations, OAWU, OECDD, Rural Development (funding sources); WRD, ODFW, PUC
Timeline:	2 years and on-going
Plan Goals Addressed:	Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships

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ST-D #3: Provide information about emergency water rights for domestic uses.

Ideas for Implementation

- Provide information to water uses fire-fighting purposes' exemption.

Coordinating Organization:	Community Development
Internal Partner:	Public Works
External Partners:	NRCS, Polk SWCD
Timeline:	2 years; on-going
Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation

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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; and

- Encourage drought-resistant landscaping for urban areas.

Coordinating Organization:	Polk SWCD
Internal Partner:	Community Development
External Partners:	OSU Extension Service, NRCS, Watershed Councils, Farm Bureau, ODA, WRD, ODFW, Cities
Timeline:	1 to 2 years, and On-going
Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships

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 watering 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:	Polk SWCD
Internal Partner:	Community Development
External Partners:	ODA, WRD, OECDD, DEQ, ODFW,DSL, OWEB, NRCS, OSU Extension Service
Timeline:	On-going
Plan Goals Addressed:	Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships

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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 depressions, diversion dikes, or terraces.

Coordinating Organization:	Community Development
Internal Partners:	GIS, Public Works
External Partners:	OSU Extension Service, Watershed Councils, NRCS, Polk SWCD, ODA, WRD, DSL, ODFW, DEQ
Timeline:	On-going
Plan Goals Addressed:	Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships; Natural Resources Coordination

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LT-D #4: Support agencies' plan for long-range water resources development that will lead to additional water supplies and help determine funding sources for the studies.

NOTE: Studying alternative sources may reveal under-utilized water resources and other information useful to water managers.

Ideas for Implementation

- Assist in the determination of which alternative water sources in or near Polk County would benefit by detailed studies and also assist in the determination of how these studies can be funded.

Coordinating Organization:	Community Development
Internal Partners:	Public Works, GIS
External Partners:	Polk SWCD, OSU Extension, WRD, ODA, DEQ, ODFW, OECDD, DOGAMI, DLCD
Timeline:	3 to 5 years
Plan Goals Addressed:	Preventive & Implementation; Collaboration & Coordination; Partnerships

Drought Resource Directory

County Resources

Polk Soil and Water Conservation District (Polk SWCD)

The staff employed by the Polk 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. The mission of the Polk SWCD is to provide for the conservation of the renewable natural resources of Polk County through control and prevention of soil erosion, degradation of water quality, and flooding; conservation and development of natural resources, water resources, natural beauty, and recreation; and the promotion of the health, safety, and general welfare of the people of Polk County, Oregon.

Contact: Polk Soil and Water Conservation District
Address: 580 Main Street, Suite A, Dallas, OR 97338-1911
Phone: 503-623-9680
Fax: 503-623-6335

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 (ODA)

ODA has a three-fold mission: food safety and consumer protection; protecting the natural resource base; and marketing agricultural products. The Natural Resources Division's mission is to conserve, protect, and develop natural resources on public and private lands so agriculture will continue to be productive and economically viable in Oregon. Primary program areas include: water quality, confined animal feeding operations, smoke management, land use, soil & water conservation districts, and plant conservation biology.

Contact: Oregon Department of Agriculture
Address: 635 Capitol Street NE, Salem, OR 97301-2532
Phone: 503-986-4550
Fax: 503-986-4747
E-Mail: info@oda.state.or.us
Website: http://www.oregon.gov/oda

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 WRD for a permit to use water that they otherwise would not have a 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 to the middle 1800´s and some dates are as recent as the current 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: Oregon State University
Strand Ag Hall Room 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.

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
Phone: 503-326-2340
Website: http://nimbo.wrh.noaa.gov/Portland

Natural Resources Conservation Service

The Natural Resources Conservation Service (NRCS) provides assistance to owners of America's private land with conserving their soil, water, and other natural resources. Local, state and federal agencies and policymakers also rely on their expertise. The NRCS delivers technical assistance based on sound science suited to a customer's specific needs. Cost shares and financial incentives are available in some cases. Most work is done with local partners. The NRCS creates a monthly Surface Water Supply Index map that represents an index of factors like snow pack, reservoir levels, and precipitation and stream flow rates. The information is reflected as an indexed number to represent the availability of surface water in areas defined by NRCS. This map is called the Surface Water

Supply Index (SWSI) and provides a quick overview of the surface water availability across Oregon.

Contact: Salem Service Center – NRCS
Address: 3867 Wolverine Street NE, Suite 16, Salem, Oregon 97305-4267
Phone: 503-399-5741
Fax: 503-399-5799
Website: http://www.or.nrcs.usda.gov/contact/marion.html

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/

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[1] Interagency Hazard Mitigation Team. 2000. *State Hazard Mitigation Plan*. Oregon State Police – Office of Emergency Management.. Salem, OR.

[2] National Drought Mitigation Center

[3] Id.

[4] Taylor, George H. and Chris Hannan. 1999. *The Oregon Weather Book*. Corvallis, OR: Oregon State University Press.

[5] Id.

[6] Clemens, Gene. Polk County Community Development Director. Personal Interview. December 21, 2004.

[7] US Natural Resources Conservation Service, Dallas office.

[8] National Drought Mitigation Center.

[9] Id.

[10] Id.

[11] Id.

[12] Id.

[13] Taylor, George. "Weather Matters." *Mid-Valley Sunday*: January 9, 2000.

[14] "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

[15] Moreland, A. 1993. Open-File Report 93-642. USGS.

[16] National Drought Mitigation Center.

[17] Id.

[18] Taylor, George H. March 1998. *Impacts of the El Southern/Southern Oscillation on the Pacific Northwest.*

[19] Id.

[20] Id.

[21] Id.

[22] Id.

[23] Id.

[24] Id.

[25] National Drought Mitigation Center, available on the World Wide Web http://www.drought.unl.edu/index.htm. Accessed August 24, 2004.

[26] Id.

[27] Interagency Hazard Mitigation Team. 2000. *State Hazard Mitigation Plan.*

[28] National Drought Mitigation Center, available on the World Wide Web http://www.drought.unl.edu/index.htm. Accessed August 24, 2004.

[29] Id.

[30] Id.

[31] Id.

[32] Id.

[33] Interagency Hazard Mitigation Team. 2000. *State Hazard Mitigation Plan.*

[34] National Drought Mitigation Center, available on the World Wide Web http://www.drought.unl.edu/index.htm. Accessed August 24, 2004.

[35] 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.

[36] National Drought Mitigation Center

[37] Id.

Section 12:
Expansive Soils

Why are Expansive Soils a Threat to Polk County?

Soil is an essential component in the construction and stability of houses, commercial buildings, and other structures. Since structures are built on soil, structural damage to a structure can occur if the soil expands, contracts or slides. There are three basic types of naturally occurring soil: sand, silt and clay. Clay soils are generally classified "expansive." Expansive soil is a soil that under some condition is capable of increasing its volume when wetted; normally, a soil containing expansive clay minerals.

Expansive soils and bedrock underlie more than one-third of Earth's land surface. In the United States, these materials are prevalent in the Southern, Western and Rocky Mountain States.[1] Expansive soils expand to a significant degree upon wetting and shrinks upon drying. Types of structures most often damaged from swelling soil include building foundations and walls of residential and light (one-or two-story) buildings, highways, canal and reservoir linings, and retaining walls.[2] Lightly loaded one- or two-story buildings, warehouses, residences, and pavements are especially vulnerable to damage because these structures are less able to suppress the differential heave of the swelling foundation soil than heavy, multistory structures.[3]

Predictions of heave with time are rarely reliable because the location and time when water is available to the soil cannot be easily foreseen. Most heave and the associated structural distress occurs within five to eight years following construction, but the effects of heave may also not be observed for many years until some change occurs in the foundation conditions to disrupt the moisture regime.[4] It is important in the engineering context to determine the magnitude of heave and the procedures of ways to minimize distress of structures.

The effects of expansive soils can be dramatic if the soils' supporting structures are allowed to become too wet or too dry. In 1982, a FEMA report found that expansive soils are the most costly natural hazard in the US, causing more damage than all other natural hazards combined, including earthquakes, floods, tornadoes and hurricanes.[5]

Expansive soils are one of the nation's most prevalent causes of damage to buildings and construction. Annual loses are estimated between $2 billion and $9 billion.[6] Losses include severe structural damage, cracked driveways, sidewalks and basement floors, heaving of roads and highway structures, condemnation of buildings, and disruption of pipelines and sewer lines.[7]

In Polk County, more than 162,000 acres contain soils with moderate to severe shrink-swell potential. Soils identified as

possessing moderate to severe shrink-swell potential are shown in Map 10.

Expansive Soil Hazard Assessment

Hazard Identification

All soils will change in volume with a change in moisture content. This is soils' shrink-swell characteristic. Shrinking and swelling soils can lead to damaging foundations and structures. The change in volume is influenced by the kind and amount of clay in the soil. Expansive soils contain a high percentage of certain kinds of clay particles that are capable of absorbing large quantities of water. Soil volume may expand ten percent or more as the clay becomes wet. The powerful force of expansion is capable of exerting pressures of 20,000 pounds per square foot or greater on foundations, slabs or other confining structures.[8]

The items in Table 12.1 are signs to look for to determine possible expansive soil-related movement. The probability that a foundation has experienced some movement increases with the number of indicators observed, their frequency, and location in the structure.

Table 12.1. Indicators of Expansive Soil Movements.

Exterior Indicators	Interior Indicators
• Diagonal (stair-stepping) cracks in brick walls. Cracks may go through brick or mortar and vary in width	• Cracks in sheetrock walls or ceilings.
• Sagging brick lines when sighting along a wall.	• Bowed or non-vertical walls.
• Bowed or non-vertical walls.	• Bottom of wall separating from floor.
• Separation of wood trim joints at corners.	• Cracks at wall corners.
• Separation of concrete driveway, patio, or sidewalk from foundation.	• Cracks above doors.
• Titling of landscaping/retaining walls.	• Sticking doors (warped door frames).
	• Sticking windows.
	• Sloping floor surface.
	• Cracks in ceramic or vinyl tile.
	• Cracks in concrete floor $^{1}/_{16}$th inch across or wider

Source: M.B. Addison. 1986. *A Guide to Foundation Maintenance.*

Vulnerability and Risk

Although the *Soil Survey of Polk County* identifies areas of Polk County that have moderate to severe shrink-swell potential, a vulnerability assessment that describes the value of property improvements exposed to expansive soils has not yet been conducted for Polk County. Depending on the severity of the expansive soils, it poses a risk for property damage and damage to infrastructure including roads, sidewalks, and pipelines.

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 Expansive Soils Issues

Public Roads

Characteristic expansive or swelling materials are highly plastic clays and clay shales that often contain colloidal i.e., expanding lattice clay minerals such as the montmorillonites. One cause of soil expansion is intake of water into the montmorillonite. In order for potentially expansive soils to actually swell in an engineered structure, they must initially be in a water deficient condition as a result of stress or climate or both, and then water must become available as a result of a change in the soil's environment. In semiarid climates with deep water tables, decreased evapo-transpiration produces increases in water content of soils beneath covered areas.[9] Pavement heaving resulting from either of the water sources mentioned may take several years to become noticeable.[10]

In Polk County, there are several roads that show signs of pavement heaving due to underlying expansive soils: James Howe Road, Crowley Road, Perrydale Road and Grand Ronde Road seem to be underlain with expansive soils. At the north end of Perrydale road, there are obvious horizontal cracks indicative of pavement heaving.

Standard stabilization methods include chemical treatments to reduce the expanding lattice materials' affinity for water and the construction of physical barriers to prevent ingress of water. Hydraulic barriers in the form of horizontal and vertical membranes coupled with shoulder and ditch paving are recommended for both new construction and existing pavements in areas currently exhibiting distress.[11] While such measures cannot prevent all future swelling of the potentially expansive pavement subgrades, they will reduce the amount of swelling and delay its occurrence.[12]

Property

Shrinking and swelling i.e., damaging movements of soils can damage a number of property improvements. The differential movement caused by swell or shrinkage of expansive soils can increase the probability of damage to a structure's foundation. Differential rather than total movements of the foundation soils are generally responsible for the major structural damage.[13] These movements originate from changes in soil moisture.[14]

Damages sustained by structures include: distortion and cracking of pavements and on-grade floor slabs; cracks in grade beams, walls, and drilled shafts; jammed or misaligned doors and windows; and failure of steel or concrete blocks supporting grade beams. Lateral forces may lead to buckling of basement and retaining walls.[15] The magnitude of damages to structures can be extensive,

impair the usefulness of the structure, and detract aesthetically from the environment. Maintenance and repair requirements can be extensive, and the expenses can grossly exceed the original cost of the foundation.[16]

Design and construction of structures, when unaware of the existence and behavior of swelling soils, can worsen a readily manageable situation. Where swelling soils are not recognized, improper building or structure design, faulty construction, inappropriate landscaping and long-term maintenance practices unsuited to the specific soil conditions can become a continuing, costly problem.[17]

Footings in expansive soils react differently than patios, driveways and roads i.e., concrete and asphalt where the cracking and heaving appear temporary as the soils dry and shrink back to their original position. The concentrated weight of a structure will inhibit the soil's upward expansion. Outward expansion, on the other hand, may continue. The footings will not be returned to their original position as the soils dry and shrink. Instead, they can "ooze" down to a slightly lower level.[18] This process can accumulate if the wetting and drying is allowed to continue season after season, year after year.

Damage is most noticeable if the footings "ooze" at varying rates under different areas of the structure.[19] Cracks may appear, windows and doors may stick and floors may slope as the footings become progressively more out of level. Improper drainage, plumbing leaks, and even thirsty trees can cause this differential.

Damage occurs within a few months following construction, may develop slowly over a period of about five years, or may not appear for many years until some activity occurs to disturb the soil moisture.

Some possible actions to mitigate the potential damage to structures caused by expansive soils are set forth in Table 10.2. Some of these actions may require the assistance of an expert.

Table 10.2. Living With Expansive Soils – Possible Actions

TYPICAL SOURCES	POSSIBLE PROBLEMS	POSSIBLE ACTIONS
• Rainfall	Non-uniform runoff from roof may result in localized heave.	Maintain soil sloping away from all sides of the foundation for a distance of at least 5 feet, use gutters with downspouts that discharge at least 3 feet from the foundation.
• Gutter Downspout / Roof Gutters	Concentrated sources of water may lead to non-uniform foundation movements.	Extend discharge a minimum of 3 feet from the foundation and use splash blocks to avoid erosion or use flexible discharge tubes.
• Poor Drainage	Localized source of water from rainwater flowing or ponding next to the foundation may lead to localized heave of the foundation.	Slope ground away from all sides of foundation, keep dirt line several inches below the brick line, use clay soil fill to create positive slope away from the foundation. Do not use sandy soils for fill next to foundation - use clays. Compact fill to shed water, not absorb it.
• Flower Beds	Localized source of water may result in non-uniform foundation movements.	Do not flood or pond irrigation water, slope ground surface away from foundation with edging, use mulch to slow evaporation.
• Sprinkler	Valves and joints may leak with time, resulting in localized water sources that may cause non-uniform foundation movements	Check for and correct any leaks at joints and valves.
• Trees	Tree roots grow under foundation and dry out soils causing non-uniform foundation settlements.	Plant trees a distance greater than their mature height from the foundation. If existing trees are closer, install an approximately 4-foot deep tree root/vertical moisture barrier system near the foundation and possibly prune trees if barrier system is under the drip line of the tree.
• Shallow Subsurface Seepage / Moving Down Slope	Concentrated source of water to foundation soils may result in non-uniform heave of the foundation.	Install interceptor trench drain up slope to collect and divert seepage water around foundation soils and discharge down slope or to a sump.
• Plumbing Line Leaks	Leaks in sewer or water lines provide localized source of water than may lead to localized foundation movements.	Monitor water bills, get leak detection plumber to isolate and repair leaks, verify repairs with pressure tests.
Moisture Vapor Rising from Wetter Soil Beneath Foundation	Gradual and uniform rise in soil moisture under foundation may lead to gradual heave of structure.	Normal occurrence, foundation stiffness should be designed and constructed for this long-term condition.

Source: Addison, Marshall. "Living With Expansive Soils." Ramjack Systems. 10 Mar. 2005 <http://www.ramjacksystems.com/soilgde.txt>.

Mitigation 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 identified to reduce Polk County's risk from flood, landslide, wildfire, severe winter storm and windstorm, drought, expansive soils and seismic and volcanic events.

Goal #1: PUBLIC EDUCATION AND AWARENESS

Provide public information and education/awareness to all residents of the county concerning natural hazard areas and mitigation efforts.

Goal #2: PREVENTIVE AND IMPLEMENTATION

Develop and implement activities to protect human life, commerce, property and natural systems.

Goal #3: COLLABORATION AND COORDINATION

Strengthen hazard mitigation by increasing collaboration and coordination among citizens, public agencies, non-profit organizations, businesses, and industry.

Goal #4: FUNDING AND PARTNERSHIPS

Seek partnerships in funding and resources for future mitigation efforts.

Goal #5: EMERGENCY OPERATIONS

Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

Goal #6: NATURAL RESOURCES UTILIZATION

Link land use planning, development criteria, codes, and natural resources and watershed planning with natural hazard mitigation.

Expansive Soils 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. 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 expansive soils action items provide direction on specific activities that organizations and residents in Polk County can undertake to reduce risk and prevent loss as a result of development on or near expansive soils. 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 expansive soils' impacts in Polk County. The expansive soils action

items apply to structures and to pavement subgrade soils. Under short-term and long-term actions items, there is further separation between action items for structures and action items for pavement subgrades. These action items are designed to meet the mitigation plan goals.

Expansive Soils Action Items

Expansive soils action items include general mitigation activities capable of implementation, given existing resources and authorities.

STRUCTURES

ES #1: Educate the public about expansive soils.

Ideas for Implementation

- Ensure proper drainage away from the structure;
- Plant trees at least fifteen (15) feet away from foundations on expansive soils;
- Preconstruction: Prior to building the structure, perform a soils test of the site to ensure the soils are stable or to determine the approximate effect the soils will have on the structure;
- Post-construction: Maintain a uniform and constant moisture level in the soil and provide additional strength and support to the foundation;
- Replace existing soil with an impermeable soil or compact the soil (i.e., engineered fill) for a building location;
- Grade sites for landscaping away from the structure, and maintain the grade established by the builder of the structure;
- Repair plumbing leaks;
- Discourage the removal of downspout extensions and splash blocks to harvest water that runs off of roofs. Release downspout water at least five (5) feet away from foundation walls via non-erosive surfaces;
- Maintain sprinkler heads and lines to avoid breaks that could allow water to pool next to the foundation, and
- Regarding subsurface drainage, encourage the installation of drains if necessary to eliminate ponding; and

- Apply chemical soil treatments to stabilize the soil.

Coordinating Organization:	Community Development
Internal Partners:	Building, GIS
External Partners:	Building contractors, property owners with expansive soils, soils and geotechnical engineers, engineering geologists, realtors, arborists, landscapers, NRCS, OSU Extension, Polk SWCD
Timeline:	On-going
Plan Goals Addressed:	Preventive & Implementation; Natural Resources Utilization

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PAVEMENT SUBGRADE

ES #2: Develop revisions for and revise the Polk County Road Standards for areas of the county with expansive soils.

Ideas for Implementation

- Revise the Polk County Road Standards, particularly for county roads in areas with expansive soils.

Coordinating Organization:	Public Works Roadmaster
Internal Partner:	Community Development
External Partners:	ODOT, cities
Timeline:	On-going
Plan Goals Addressed:	Preventive & Implementation

ES #3: Determine the feasibility of installing hydraulic barriers or physical restraints to prevent the entry of water into expansive soils.

Ideas for Implementation

- Determine the feasibility of encapsulating the expansive soil for complete isolation from all water sources (only for new pavement construction); or

- Determine the feasibility of utilizing mechanical methods that provide physical restraint for the soil to keep it from swelling.

Coordinating Organization:	Public Works
Internal Partner:	Community Development
External Partners:	ODOT, cities
Timeline:	On-going

Plan Goals Addressed: Preventive & Implementation; Natural Resources Utilization.

ES #4: Compact soil in a manner that reduces its suction i.e., affinity for water.

Ideas for Implementation

- Compact subgrade soils to low dry unit weights using kneading methods to reduce swelling for moderately plastic soils.

Coordinating Organization: Public Works
Internal Partner: Community Development
External Partners: Property owners, building managers, cities
Timeline: On-going
Plan Goals Addressed: Preventive & Implementation; Natural Resources Utilization.

ES #5: Remove and replace expansive subgrade soil with a non-expansive material.

Ideas for Implementation

- Use non-expansive soils or expansive soils treated with lime or other swell-prevention chemicals as the replacement fill.

Coordinating Organization: Public Works
Internal Partner: Community Development
External Partners: Soils engineers, ODOT, cities
Timeline: 3 to 5 years
Plan Goals Addressed: Preventive & Implementation; Natural Resources Utilization.

ES #6: Use sub-surface drain tile or perforated pipe wrapped in fabrics or graded granular filters below the edges of pavements.

NOTE: Sub-drains will not have any effect on water moving into expansive soils in the vapor phase or water moving in unsaturated oil in response to gradients in soil suction.

Coordinating Organization: Public Works
Internal Partner: Community Development
External Partners: Soils engineers, ODOT, cities
Timeline: 3 to 5 years
Plan Goals Addressed: Preventive & Implementation.

Expansive Soils Resource Directory

Federal Resources

National Soil Survey Center (USDA-NRCS)

At the National Soil Survey Center (NSSC), the Director, National Leaders, and Head of the Soil Survey Laboratory are responsible for: policy, technical guidance, procedures, and standards; soil investigation assistance; soil survey laboratory functions; developing handbooks and manuals to guide soil survey operations; training on a group and individual basis; developing and maintaining soil survey data and information systems; assistance in planning regional work planning conferences; liaison to NCSS Regional Agriculture Experiment Station Soil Survey Committees; and technical coordination at the national level.

Contact: National Soil Survey Center
Address: 100 Centennial Mall North, Room 152, Lincoln, NE 68508-3866
Phone: 402-437-5499
Fax: 402-437-5336
Website: http://soils.usda.gov/contact/nssc/

Additional Resources

Publications

So Your Home Is Built On Expansive Soils (A Discussion On How Expansive Soils Affect Buildings). 1995. New York: The American Society of Civil Engineers.

This 65-page booklet edited by Warren Wray, Ph.D., PE., was prepared by the Shallow Foundation Committee of the Geotechnical Division of the American Society of Civil Engineers. The purpose of this book is to assist homeowners in understanding why expansive soils shrink and heave and how excessive shrinking and heaving can be moderated. It also attempts to define the difference between cosmetic damage and structural damage resulting from expansive soil movement. The information is presented in two parts. Part one discusses the characteristics of expansive soils and how they affect buildings while the second part includes the questions most frequently asked by persons who have, or are building, homes on expansive soils and the answers they seek.

Contact: American Society of Civil Engineers (ASCE)
Phone: 800-548-2723
Website: http://www.pubs.asce.org/cedbsrch.html

ASTM International. 1999. "Standard Test Method for Using pH to Estimate the Soil-Lime Requirement for Soil Stabilization." *Annual Book of ASTM Standards, Section 4, Construction.* Volume 04.09, Soil and Rock (II)-Geosynthetics, ASTM, West Conshohocken, PA.

Contact: ASTM International
Address: 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959
Phone: 610-832-9585
Website: http://www.astm.org/cgi-bin/SoftCart.exe/index.shtml?L+mystore+vxdl3135+1111025805

Knezevich, Clarence A. October 1982. *Soil Survey of Polk County, Oregon.* : USDA Natural Resources Conservation Service (NRCS).

Soil survey maps by NRCS provide the most detailed surficial soil maps available. *Soil Survey of Polk County, Oregon* contains engineering test data, estimates of soil engineering properties, and interpretations of properties for each of the major soil series within the county. The maps usually treat only the upper 30 to 60 inches of soil and may not fully define the foundation soil problem.

Contact: Soil Survey Division,
USDA-Natural Resources Conservation Service
Room 4250 South Building
14th & Independence Ave, SW
Washington, DC 20250
Phone: 202-720-1820
Website: http://soils.usda.gov/

Steinberg, Malcom. 1998. *Geomembranes and the Control of Expansive Soils.* McGraw-Hill Professional. ISBN: 0070611785

This book explains when and where geomembranes can be used effectively, and discusses expansive soil conditions and problems as well as control solutions. It includes descriptions of geotechnical membrane placement methods, plus information on costs and durability; and worldwide case studies of buildings, highways, roads, airports, canals, pipelines, railroads, and landfills – all with solutions to expansive soil problems.

Nelson, J.D. and Miller B.J. 1992. *Expansive Soils: Problems and Practice in Foundations and Pavement Engineering.* John Wiley & Sons, Inc., New York, 259 pages.

Expansive Soils examines factors that influence the design of foundations and pavements built on expansive soils, and explores key design procedures and remedial measures that address these factors effectively. Backed by the authors' extensive research and experience, including interviews with practicing engineers working with expansive soils, this authoritative volume is an important reference text for geotechnical and foundation engineers, geologists, construction professionals, and students.

ISBN: 0-471-18114-5

[1] Expansive Soils Research Laboratory. Center for Geotechnical Engineering Science, University of Colorado-Denver.

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Section 13:
Earthquake

Why are Earthquakes a threat to Polk 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. Local governments, planners, and engineers must consider the threat of earthquakes 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 Polk County.[1]

The most recent significant earthquake event affecting Polk 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 Polk County felt the tremor. While the impacts of this quake were not severe in Oregon, the economic losses in Washington were 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.[2]

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.[3]

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 Polk 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, however, 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 cities provide a good source of historical documentation of earthquakes of a magnitude five or greater since about 1850.[4] The seismic risk is more severe today than in the past because population is increasing.

It is imperative that residents of Polk 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. Polk County is no exception to seismic activity. The county has experienced a long history of earthquakes, with varying magnitudes. Major earthquakes were felt in 1941 (magnitude 7.1), 1962 (magnitude 5.2), and 2001 (magnitude 6.8).

Although seismograph stations were established as early as 1906 in Seattle and 1944 in Corvallis, improved seismograph coverage of the Polk County region did not begin until 1980, when the University of Washington expanded its regional network into northwestern Oregon. Figure 13-1 shows the location of selected Pacific Northwest earthquakes that have occurred since 1972.

February 28, 2001, Nisqually Earthquake- Magnitude 6.8

The most recent significant earthquake to be felt in Polk County was the Nisqually earthquake, on February 28, 2001. The earthquake occurred at 10:54 a.m. and was centered 35 miles southwest of Seattle.[5] 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.[6]

While the quake caused little damage in Polk County, it did slow businesses and schools as potential damage was assessed. Schools in neighboring Marion County felt the Nisqually Earthquake, though little damage was found. The local schools that reported the strongest tremors were mostly in northern Marion County.[7] Saint

Paul and North Marion high schools, both north of Woodburn, also briefly evacuated students.[8]

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.[9]

March 25, 1993, Scotts Mills Earthquake- Magnitude 5.7

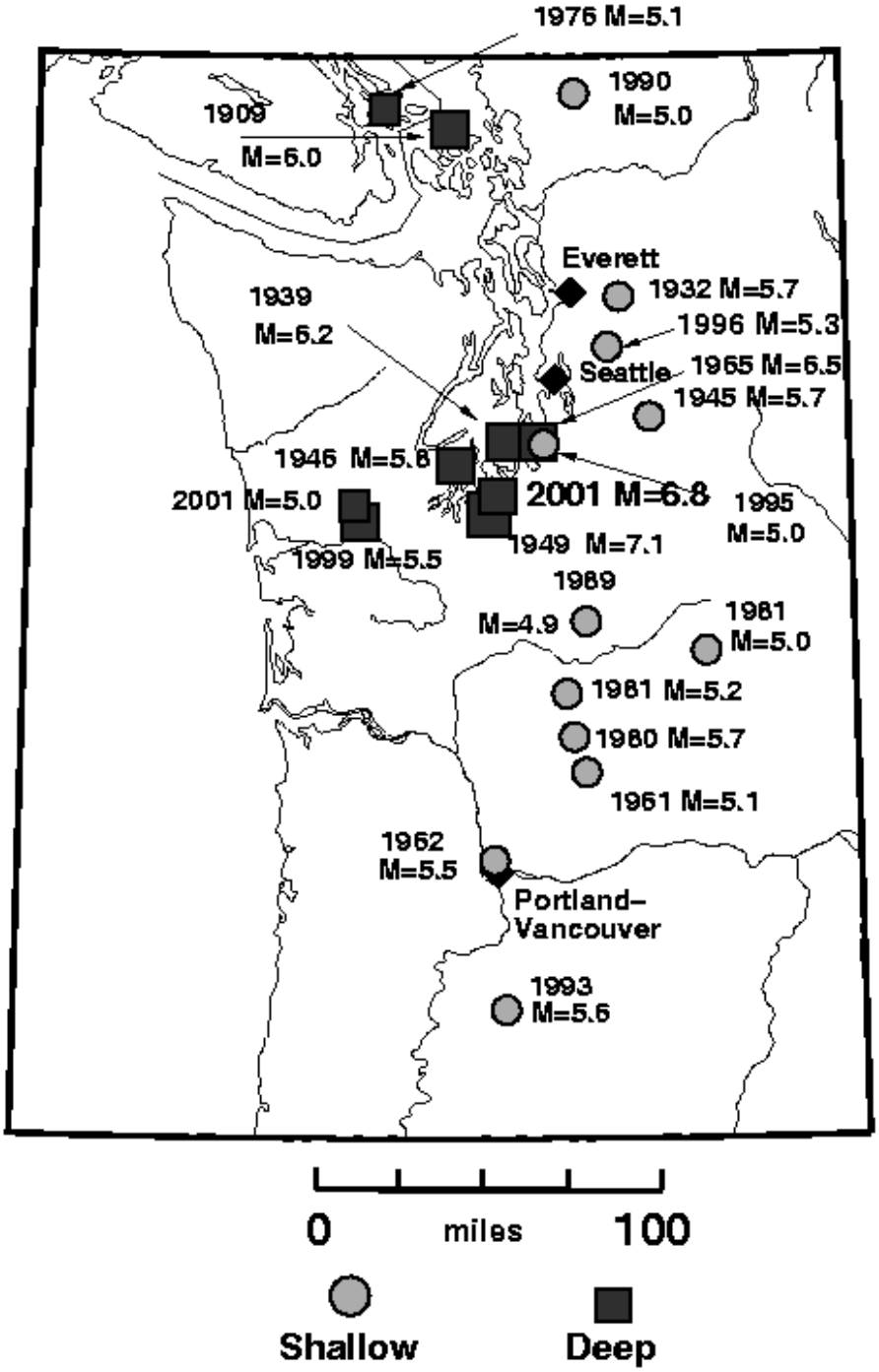
The Scotts Mills Earthquake (also known as the "Spring Break Quake") was centered in neighboring Marion County, near the town of Woodburn and Scotts Mills. The quake originated about two miles south of Scotts Mills and twelve to thirteen miles underground. Damage was negligible in most of Polk County. There were no reports of damage on the police logs of the Polk County Sheriff's office, or the Dallas, Monmouth or Independence police departments.[10] However, Salem did suffer some damage. Ralph Lettenmaier of West Salem, Dallas Police animal control officer, said the vibration knocked a lamp over breaking a light bulb in his house and cracked a neighbor's ceiling.[11] The rotunda of the State Capitol cracked, and the Golden Pioneer statue nearly was rocked off its base.[12] Neighboring Marion County suffer the most damage. In the town of Mount Angel, authorities closed the historic St. Mary Catholic Church for fear its 200-foot bell tower could collapse.[13] Chunks of plaster fell from the walls at the Queen of Angels Monastery.[14]

Woodburn felt the strongest effects of the quake. Officials shut down four, century-old brick and mortar buildings that began to crumble.[15] At the Wal-Mart store, fumes overcame several employees when pesticides, paints and car batteries mixed.[16]

March 7, 1963, Salem, Oregon – Magnitude 4.6

On March 7, 1963, a quake measuring 4.6 on the Richter scale shook Polk County. Despite the low magnitude of the quake, damage still occurred – especially to older masonry buildings. A porch was loosened from its house south of Salem, and three instances of cracked plaster were reported, two south of Salem, and the other in Polk County.[17] One Polk County resident noted, "a big noise was heard."[18] The impact felt by the Polk County courthouse was resulting plaster damage. The *Itemizer Observer* reported on the courthouse damage by saying, "a considerable quantity of plaster was cracked and in some cases knocked down."[19]

Figure 13-1. Selected Pacific Northwest Earthquakes since 1872



Source: Pacific Northwest Seismograph Network.
www.geophys.washington.edu/SEIS/PNSN/INFO_GENERAL/hist.html

November 5, 1962, Vancouver, Washington- Magnitude 5.2

Three and a half weeks after the devastating Columbus Day Storm, an earthquake that measured approximately 5.2 on the Richter scale shook the Portland area. It was the largest quake to be generated by a fault under Portland and Vancouver.[20] The *Oregon*

Statesman reported little damage, although much of the county was shaken up. A resident in North Salem said it felt as if somebody was "shaking the house vigorously."[21] Another resident said, "our table began shaking just like I was in a boat."[22]

The quake was felt over a wide area of Oregon and Washington. Reports of the earthquake came from Eugene, Oregon, 110 miles south of Portland, and from Seattle, Washington, 135 miles to the north.[23] 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.[24]

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.[25] Damage was very limited – typical of an earthquake of lower magnitude. Albany reported some cracked plaster.[26]

April 13, 1949, Olympia, Washington- Magnitude 7.1

On April 13, 1949, Polk county residents felt an earthquake that was centered near Olympia, Washington. In Washington, this quake caused eight deaths. While Polk 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 as far east as Prineville and La Grande.[27] In downtown Salem and 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.[28]

Causes and Characteristics of Earthquake in Polk 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, Polk county is susceptible to both intraplate and subduction zone earthquakes. The county may also be susceptible to crustal fault earthquakes as well.

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.[29] 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. A crustal fault was the cause of the "Spring Break Quake," which was centered in neighboring Marion County.

Deep Interplate 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.[30] 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.[31]

Subduction Zone Earthquakes

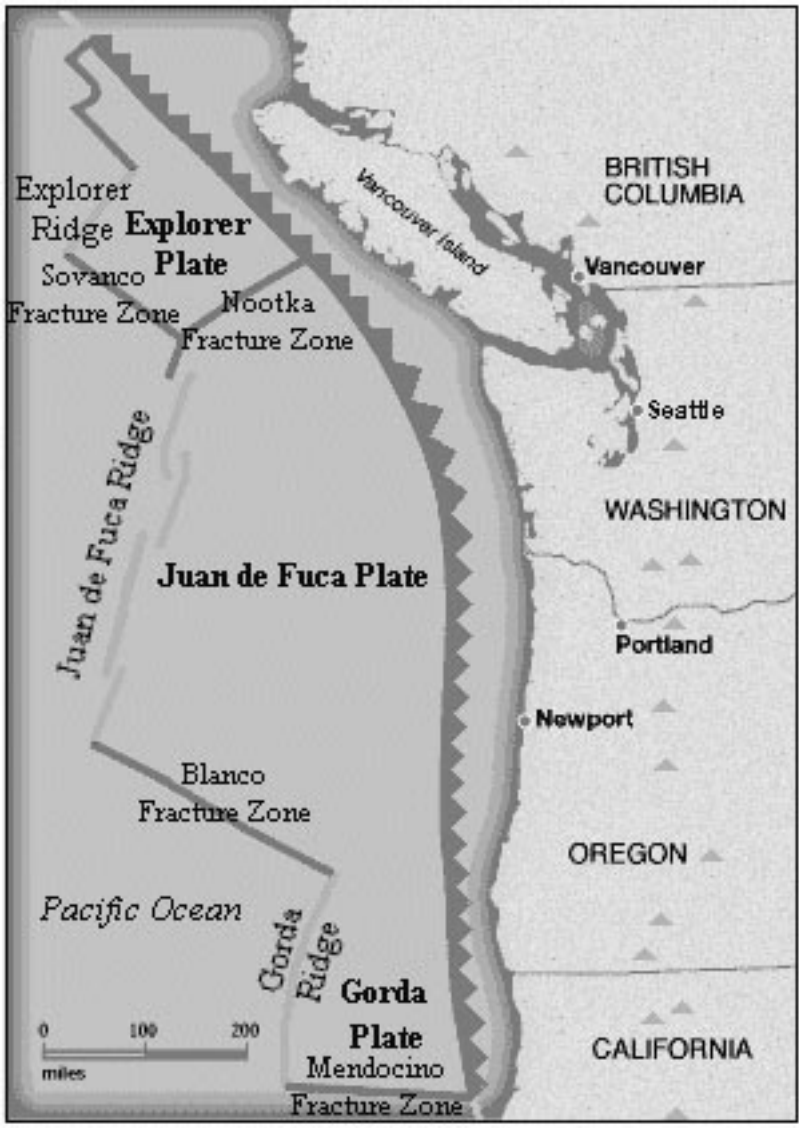
The Pacific Northwest is located at a convergent plate boundary, where the Juan de Fuca and North American tectonic plates meet. The two plates are converging at a rate of about one to two inches per year. This boundary is called the Cascadia Subduction Zone (see Figure 13-2). It extends from British 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 Polk County. It is estimated that shaking from a large subduction zone earthquake could last up to five minutes.[32]

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.

Figure 13-2. Cascadia Subduction Zone



Source: Department of Land Conservation and Development.
www.lcd.state.or.us/coast/hazards/juandefucaplates.htm

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 Polk 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.[33] Areas of susceptibility to liquefaction include areas with groundwater tables and sandy soils.[34]

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.[35] Amplification can also occur in areas with deep sediment filled basins.

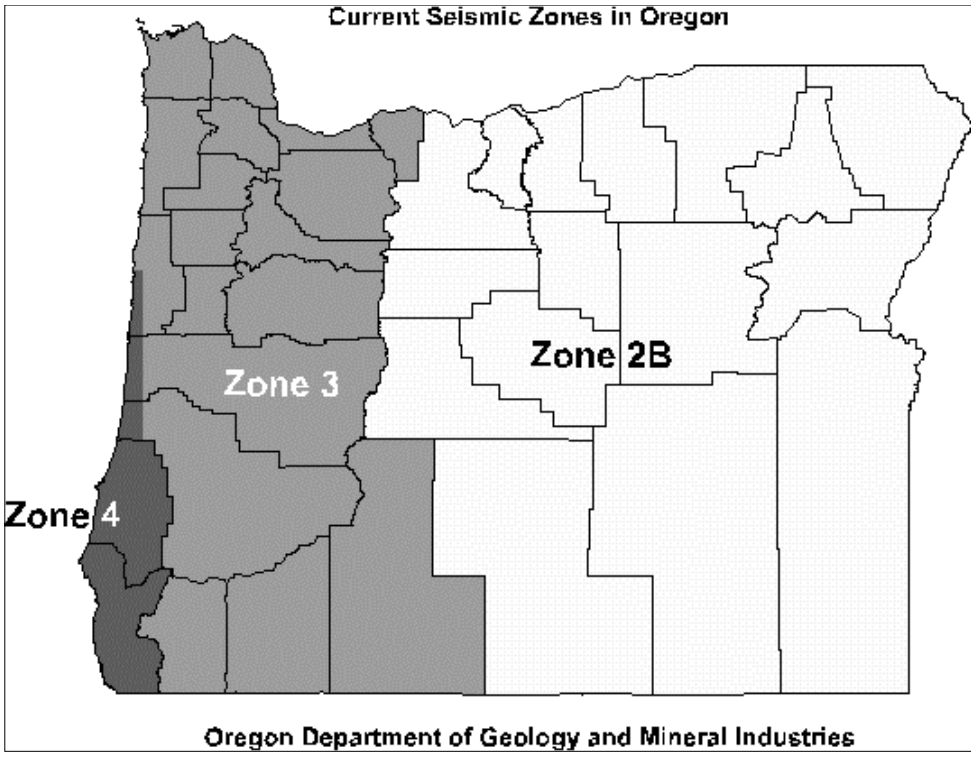
Earthquake Hazard Assessment

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.[36]

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. An increase in zone number reflects increased risk of seismic activity. Many buildings in Polk County were built prior to the imposition of the new seismic zone code requirements, established in 1993.

Figure 13-3. Seismic Zones in Oregon



Vulnerability Assessment

The effects of earthquakes span a large area. The degree to which the earthquakes are felt, however, and the damages associated with them may vary. At risk from earthquake damage are large stocks of old buildings and bridges, many high tech and hazardous material facilities, extensive sewer, water, and natural gas pipelines, a petroleum pipeline, and other critical facilities and private property located in 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 experience 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 city 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 relative earthquake maps and conducting risk analyses of various regions in the state. Map 9 shows the relative earthquake hazard areas within Polk County.

Table 13-1 presents preliminary damage figures for Polk County for both an 8.5 Cascadia subduction zone event and a 500-year event. This data is not currently available on the city-level. It should be noted that the figures have a high degree of uncertainty and should be used only for general planning purposes.[37]

Table 10-1. Estimated Earthquake Damage Summary for Polk County

Polk County	8.5 Cascadia Subduction Zone event (HAZUS99 software)	8.5 Cascadia Subduction Zone event (HAZUS97 software)	500-year model (HAZUS99 software)	500-Year model (HAZUS97 software)
Injuries	N/A	124	1,217 (at 2pm)	266
Deaths	N/A	2	86	6
Displaced households	N/A	538	1,003	1,064
Short term shelter needs	N/A	419	801	825
Economic losses for buildings	N/A	249,000,000	496,513,000	529,000,000
Operational the day after the quake:				
Fire Stations	N/A	55%	19%	NA
Police stations	N/A	46%	21%	NA
Schools	N/A	45%	19%	NA
Bridges	N/A	72%	82%	NA
Economic losses to:				
Highways	N/A	28,000,000	2,681,000	72,000,000
Airports	N/A	6,000,000	11,572,000	13,000,000
Communication systems:				
Economic losses	N/A	688,000	496,513,000	2,000,000
Operating the day of the quake	N/A	55%	26%	NA
Debris generated (Thousands of tons)	N/A	219	367,000	378

HAZUS97 Source: Wang, Y., and J.L. Clark. 1999. "Earthquake Damage in Oregon: Preliminary Estimates of Future Earthquake Losses." Special Paper 29, page 57. DOGAMI.
HAZUS99 Source: Reesor, David, and Mark Darienzo. OEM Office. September 3, 2003.

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 Polk 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 led to increases in the construction standards for buildings in Polk 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 Polk 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. State code requires seismic upgrades only when there is significant structural alternation 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 conducting inventories and seismic retrofits is a major issue. Some of the buildings in Polk County are more susceptible to earthquake damage because they are made of unreinforced brick and concrete. 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 Polk County commute frequently by automobile and public transportation such as buses. 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

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. Bridges built before the mid-1970's have a significantly higher risk of suffering structural damage during a moderate to large earthquake compared with those 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.[38] About 30 percent of homeowners now have earthquake coverage, according to Insurance Information Services of Oregon and Idaho.[39] The DOGAMI survey also indicated that only 24 percent correctly identified what to do during an earthquake.[40]

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.

Existing Mitigation Activities

County Programs

All but one of the incorporated cities in Polk County have a city building code official, while other areas of the county work directly with the county building code official. Together, city and county building code officials enforce building codes and coordinate inspections following a seismic event. The Polk County GIS Division has mapped critical facilities and major public buildings so that the responsible jurisdiction can assign inspection of these structures in a timely manner.

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. 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.

Mitigation 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 identified to reduce Polk County's risk from flood, landslide, wildfire, severe winter storm and windstorm, drought, expansive soils and seismic and volcanic events.

Goal #1: PUBLIC EDUCATION AND AWARENESS

Provide public information and education/awareness to all residents of the county concerning natural hazard areas and mitigation efforts.

Goal #2: PREVENTIVE AND IMPLEMENTATION

Develop and implement activities to protect human life, commerce, property and natural systems.

Goal #3: COLLABORATION AND COORDINATION

Strengthen hazard mitigation by increasing collaboration and coordination among citizens, public agencies, non-profit organizations, businesses, and industry.

Goal #4: FUNDING AND PARTNERSHIPS

Seek partnerships in funding and resources for future mitigation efforts.

Goal #5: EMERGENCY OPERATIONS

Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

Goal #6: NATURAL RESOURCES UTILIZATION

Link land use planning, development criteria, codes, and natural resources and watershed planning with natural hazard mitigation.

Earthquake Mitigation Action Items

The earthquake mitigation action items were formulated through researching regional mitigation plans and 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 earthquake mitigation action items provide direction on specific activities that organizations and residents in Polk 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 Polk 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 Polk County and improve technical analysis of earthquake hazards.

Ideas for Implementation

- Update Polk 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 Partners:	Emergency Management – Hazard Mitigation Team, Planning
External Partners:	OSU, USGS, BLM, DOGAMI, OEM, FEMA
Timeline:	2 years
Plan Goals Addressed:	Preventive & Implementation; Collaboration & Coordination

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 read *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 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 – Hazard Mitigation Team
Internal Partners:	Building, Community Development
External Partners:	City Building Officials, school districts, builders' associations, Institute for Business and Home Safety (IBHS), West Valley Housing Authority, Red Cross, DOGAMI, IISOI, Oregon Seismic Safety Policy Advisory Commission (OSSPAC), FEMA, OEM
Timeline:	1 to 2 years, On-going
Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Emergency Operations

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ST-EQ #3: Inform residents of value of earthquake hazard insurance.

Ideas for Implementation

- Provide earthquake insurance information to Polk 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;

- Work with real estate industry representatives to educate them about what types of structures are resistant to earthquakes; and

- Include information on county Web site.

Coordinating Organization:	Emergency Management – Hazard Mitigation Team
Internal Partner:	Community Development
External Partners:	IISOI through local insurance agencies; mortgage companies, insurance and real estate industries, DOGAMI

Timeline:	On-going
Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Collaboration & Coordination

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ST-EQ #4: Identify funding sources for and implement high priority structural and nonstructural retrofits of structures that are identified as critical and/or essential facilities, and are seismically vulnerable.

Ideas for Implementation

- Evaluate grant and foundations that support earthquake mitigation activities; and

- Explore options for including seismic retrofitting in existing programs such as low-income housing, insurance reimbursements, and pre- and post-disaster repairs.

Coordinating Organization:	Emergency Management – Hazard Mitigation Team
Internal Partner:	Community Development
External Partners:	IISOI, OSSPAC, local banks, credit unions, SBA, Rural Development, OECDD; FEMA, OEM, West Valley Housing Authority, Red Cross
Timeline:	1 to 2 years
Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Funding & Partnerships

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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; and

- Consider county adoption of the International Building Code® (IBC).

Coordinating Organization:	Building
Internal Partner:	Planning

External Partners:	City planning departments, builders, developers, property owners
Timeline:	On-going
Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Collaboration & Coordination

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LT-EQ #2: Encourage seismic strength evaluations of critical facilities in the county to identify vulnerabilities for mitigation of schools and universities, public infrastructure, and critical facilities 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 all buildings designated critical facilities to meet current seismic 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 – Hazard Mitigation Team
Internal Partners:	Planning, Building; Public Works
External Partners:	City planning departments; water systems; Oregon Association of Water Utilities (OAWU); school districts, hospitals, ODOT, colleges and universities; dam/reservoir owners/managers; Willamette ESD; Oregon Building Codes Division; OECDD; Rural Development; WRD
Timeline:	On-going
Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships; Emergency Operations;

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 Polk County.

Coordinating Organization:	Emergency Management – Hazard Mitigation Team
Internal Partners:	Planning, Building, Public Works, GIS
External Partner:	City Planning Departments, Utilities
Timeline:	On-going
Plan Goals Addressed:	Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships

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LT-EQ #4: Encourage earthquake safety promotion and drills to 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 including: Spanish; and

- Encourage County schools to promote earthquake safety education.

Coordinating Organization:	Emergency Management – Hazard Mitigation Team
Internal Partner:	Planning Department
External Partners:	City Planning Departments, School Districts, West Valley Housing Authority, Community Organizations
Timeline:	On-going
Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Collaboration & Coordination; Emergency Operations

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LT-EQ #5: Improve local capabilities to perform earthquake building safety evaluations.

Ideas for Implementation

- Offer training in procedures for earthquake building safety evaluations to CERT volunteers through acknowledged CERT teams in the County; and

- Provide information about training in Applied Technology Council (ATC) 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 – Hazard Mitigation Team
Internal Partners:	Building, Public Works
External Partners:	FEMA, OEM, Polk Fire Defense Board
Timeline:	On-going
Plan Goals Addressed:	Preventive & Implementation; Collaboration & Coordination

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Earthquake Resource Directory

State Resources

Department of Land Conservation and Development (DLCD)

DLCD administers the state's Land Use Planning Program. he program is based on 19 Statewide Planning Goals, including Goal 7, Areas Subject to Natural Hazards and Disasters. 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
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.

Contacts: 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, PO Box 14370, Salem, Oregon 97309
Phone: 503-378-2911
Fax: 503-373-7833
Website: http://www.osp.state.or.us/oem/

The Nature of the Northwest Information Center

The Nature of the Northwest Information Center is operated jointly by the Oregon Department of Geology and Mineral Industries and the USDA Forest Service. 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

US Geological Survey (USGS)

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).

Contact: USGS, National Earthquake Information Center
Address: Box 25046; DFC, MS 967; Denver, Colorado 80225
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
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 representative s 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 Partage Bay Place E, Slip G, Seattle WA 98102
Phone: 206-328-2533
Fax: 206-328-2533 (call first)
Website: http://www.crew.org/

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 Willamette chapter serves the residents of Marion and Polk counties. The Willamette Chapter provides a variety of community services which 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, Willamette Chapter
Address: 675 Orchard Heights Rd NW, Suite 200 Salem, OR
Phone: 503-585-5414
Fax: 503-362-3904
Website: http://www.redcross-salem.org/
Email: rc@redcross-salem.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. 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

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

Wolfe, Myer R. et al. 1986. *Land Use Planning for Earthquake Hazard Mitigation: A Handbook for Planners.* 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
E-mail: hazctr@colorado.edu
Website: http://www.colorado.edu/UCB/Research/IBS/hazards

Spangle Associates. 1998/1999). Urban Planning and Research. (1) *Using Earthquake Hazard Maps: A Guide for Local Governments in the Portland Metropolitan Region.* (2) *Evaluation of Earthquake Hazard Maps for the Portland Metropolitan Region.* Portola Valley, California.

These two publications are useful for local governments concerned with land use in earthquake hazard areas. The proximity of Polk 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

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[1] Interagency Hazard Mitigation Team. 2000. *State Hazard Mitigation Plan*. Oregon State Police – Office of Emergency Management. Salem, OR.

[2] Wang, Yumei and J.L. Clark. 1999. *Earthquake Damage in Oregon: Preliminary Estimates of Future Earthquake Losses.* DOGAMI: Special Paper 29.

[3] "Preparing for Earthquakes in Oregon." *Oregon Geology*. March/April 1997: Vol. 59, No. 2.

[4] Bott, Jacqueline and Ivan G. Wong. Historical Earthquakes In and Around Portland, Oregon." *Oregon Geology*. September 1993: Vol. 55, No. 5, page 116.

[5] *Statesman Journal*. March 1, 2001.

[6] Hill, Richard. "Geo Watch Warning Quake Shook Portland 40 Years Ago." *The Oregonian.* October 30, 2002.

[7] Id

[8] Id.

[9] Id.

[10] *Itemizer Observer*. March 31, 1993.

[11] Id.

[12] *Statesman Journal*. March 26, 1993.

[13] Id.

[14] Id.

[15] Id.

[16] Id.

[17] *Oregon Statesman*. March 8, 1963.

[18] Id.

[19] *Itemizer Observer*. March 14, 1963.

[20] Hill, Richard. "Geo Watch Warning Quake Shook Portland 40 Years Ago." *The Oregonian.* October 30, 2002.

[21] *Oregon Statesman*. November 6, 1962.

[22] Id.

[23] Id.

[24] Id.

[25] *Statesman Journal*. August 19, 1961.

[26] Id.

[27] *Statesman Journal*. April 13, 1949.

[28] Id.

[29] Wong, Ivan G and Jacqueline D.J. Bott. November 1995. "A Look Back at Oregon's Earthquake History, 1841- 1994." *Oregon Geology*. Vol. 57, No. 6, page 125.

[30] Id.

[31] Hill, Richard. "Geo Watch Warning Quake Shook Portland 40 Years Ago." *The Oregonian.* October 30, 2002.

[32] Community Planning Workshop, 2002.

[33] Department of Land Conservation and Development (DLCD). July 2000. *Planning for Natural Hazards: The Oregon Technical Resource Guide*, Ch. 8, page 7.

[34] Burns, Scott. Portland State University, Department of Geology. Personal Interview. June 2003.

[35] Id.

[36] DLCD. July 2000. *Planning for Natural Hazards: The Oregon Technical Resource Guide*, Ch. 8, page 7.

[37] Wang, Y. and J.L. Clark. 1999. "Earthquake Damage in Oregon: Preliminary Estimates of Future Earthquake Losses." Special Paper 29, page 57. Portland, OR: DOGAMI.

[38] Beggs, Charles E. March 21, 2000. "One in Three Homes Insured for Quakes Since Spring Break Shaker." *News-Register*. Available on the World Wide Web http://www.newsregister.com/…/story_print.dfm?story_no=11361. Accessed August 26, 2004.

[39] Id.

[40] Id.

Section 14:
Volcanic Eruption

Why are Volcanic Eruptions a Threat to Polk County?

Polk County and the Pacific Northwest lie on the "Ring of Fire," an area of very active volcanic activity surrounding the Pacific Basin. Volcanic eruptions occur regularly along the Ring of Fire, in part, because of the movement of the Earth's tectonic plates. The Earth's outermost shell, the lithosphere, is broken into a series of slabs know as tectonic plates. These plates are rigid, but they float on a hotter, softer layer in the Earth's mantle. As the plates move about on the layer beneath them, they spread apart, collide, or slide past each other. Volcanoes occur most frequently at the boundaries of these plates and volcanic eruptions occur when the hotter, molten materials, or magma, rise to the surface.

The primary threat to lives and property from active volcanoes is from violent eruptions that unleash tremendous blast forces, generate mud and debris flows, and produces flying debris and ash clouds. The immediate danger area in a volcanic eruption generally lies within a 20-mile radius of the blast site. Mount Jefferson is located in the southeastern corner of neighboring Marion County, contributing to the risk of Polk County residents. There are also a number of active volcanoes within the 100-mile danger areas that pose a threat to Polk County residents and property. The threat they pose is associated primarily with ash fall. Between 1843 and 1860, a series of 21 eruptions took place in the Cascades, and there is speculation that the Northwest may be entering another period of volcanic activity.[1] The Eastern portion of Polk County has an annual probability of one in five thousand for the deposition of 1 centimeter (0.4 inches) or more of tephra from any of the major Cascade volcanoes.[2]

History of Volcanic Eruption Events in the Pacific Northwest

There are seven major volcanoes in the Cascade region that are in relative proximity and pose a potential threat to Polk County (see figure 11-2). They include Mount Jefferson, Mount St. Helens, Mount Hood, Mount Rainier, the Middle and South Sisters, and Broken Top. Of the seven, all are known or suspected to be active and most have geological records that indicate past histories of explosive eruptions with large ash releases. Mount Hood is the only volcano that has no geological evidence of large explosive events, though it still poses a threat of ash releases.

Three Sisters and Broken Top

The Three Sisters are located about 100 miles southeast of Polk County. Recently, volcanic activity has been found on the South Sister. Satellite images indicate upward movement of land near the volcano – the surface moved toward the satellite (mostly upward) by

as much as ten centimeters cm (about four inches) sometime between August 1996 and October 2000.[3] The most likely cause is magma accumulation in the Earth's crust, a process that has been observed with radar interferometry at several other volcanoes worldwide.[4] There is no immediate danger of a volcanic eruption or other hazardous activity.[5] The potential exists, however, that further activity could increase danger.

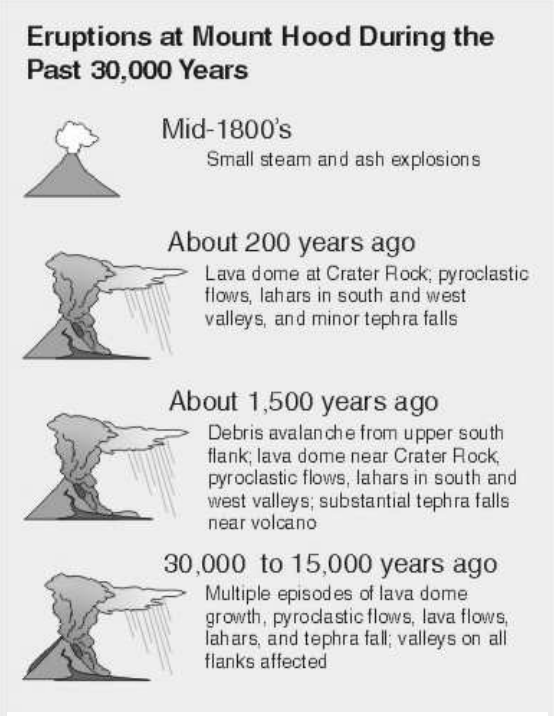
South Sister, Middle Sister, and Broken Top – major composite volcanoes clustered near the center of the region – have erupted repeatedly over tens of thousands of years and may erupt explosively in the future. In contrast, mafic volcanoes, which range from small cinder cones to large shield volcanoes like North Sister, are typically short-lived (weeks to centuries) and erupt less explosively than do composite volcanoes.[6]

Mount Hood

Mount Hood is located about 100 miles northeast of Polk County. It has been recurrently active over the past 50,000 years. It has had two significant eruptive periods in geologically recent times, one about 1,500 years ago and another about 200 years ago. Figure 14.1 shows the major geologic events in the Mount Hood Region during the past 30,000 years.

While Mount Hood has shown no recent signs of volcanic activity, scientists predict the next eruption will consist of small explosions generating pyroclastic flows, ash clouds, and lahars (mud and debris flows).

Figure 14-1. Major Eruptions at Mt. Hood



Source: USGS Cascades Volcano Observatory

Mount Jefferson

Mount Jefferson is one of the closest of all the volcanoes to Polk County. Located on the eastern edge of neighboring Marion County, Mount Jefferson presents a threat of ash fallout to Polk County.

Mount Jefferson has erupted repeatedly for hundreds of thousands of years, with its last eruptive episode during the last major glaciation, which culminated about 15,000 years ago. Geologic evidence shows that Mount Jefferson is capable of large explosive eruptions. The largest such eruption occurred between 35,000 and 100,000 years ago, and caused ash to fall as far away as the

present-day town of Arco in southeast Idaho. Although there has not been an eruption at Mount Jefferson for some time, experience at explosive volcanoes elsewhere suggests that Mount Jefferson cannot be regarded as extinct. If Mount Jefferson erupts again, areas close to the eruptive vent will be severely affected, and even areas tens of kilometers (tens of miles) downstream along river valleys or hundreds of kilometers (hundreds of miles) downwind may be at risk.[7]

Mount Rainier

Mount Rainier is located approximately 130 miles north of Polk County. Mount Rainier stands at 14,410 feet, and dominates the surrounding landscape as the tallest land feature. The primary hazard posed to Polk County is ash fallout from Mount Rainier.

Mount Rainier is an active volcano that first erupted about half a million years ago. Because of Rainier's great height and northerly location, glaciers have cut deeply into its lavas, making it appear deceptively older than it actually is. Mount Rainier is known to have erupted as recently as in the 1840s, and large eruptions took place as recently as about 1,000 and 2,300 years ago.[8]

Mount St. Helens

Mount St. Helens, located in southwestern Washington about 100 miles northeast of Polk County, is fifty thousand years old. Over the past 500 years, it has produced four major explosive eruptions and dozens of smaller eruptions. On May 18, 1980, Mount St. Helens "Exploded violently after two months of intense earthquake activity and intermittent, relatively weak eruptions, causing the worst volcanic disaster in the recorded history the United States."[9]

Damage to the built environment within the immediate hazard vicinity in Washington State included twenty-seven bridges, about two hundred homes, more than 185 miles of highways and roads, and fifteen miles of railways. Ash from the eruption column and cloud spread across the United States in three days and circled around the Earth in fifteen days. Detectable amounts of ash were noted in an area covering 22,000 square miles. Debris flows quickly filled the Toutle and Cowlitz Rivers and ultimately flowed into the Columbia River at Longview, Washington. The debris blocked the main shipping channel in the Columbia, stranded ships in port, and closed the ports of Portland, Vancouver, and Kalama for over a month. Several water and sewage treatment facilities were also damaged or destroyed. The estimated damage attributed to the eruption was $1.1 billion.

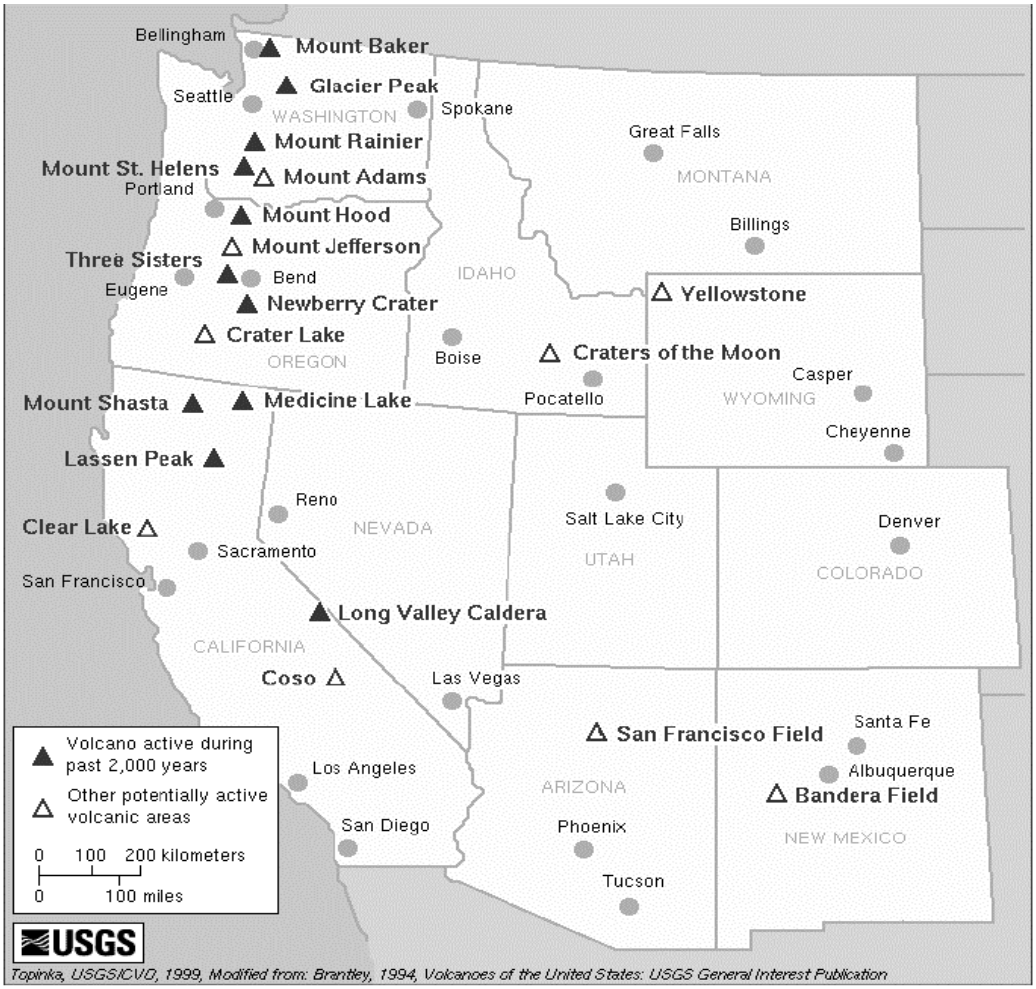
The May 18, 1980, eruption was preceded by about two months of precursor activity, including dome building, minor earthquakes, and venting of gasses. The lateral blast, debris valance, and mudflow associated with the eruptions caused extensive loss of life and widespread destruction of property. The eruption triggered a magnitude 5.1 earthquake about one mile beneath the volcano. In

the six-year period after the initial eruption, hundreds of small ash emissions at Mount St. Helens occurred.

The eruption of Mount St. Helens took the lives of 57 people and nearly 7,000 big game animals. All birds and most small mammals in the area were killed, as were twelve million Chinook and Coho salmon fingerlings that perished when their hatcheries were destroyed.

The May 18, 1980 eruption was followed by five smaller explosive eruptions over a period of five months.[10] A series of sixteen, dome-building eruptions constructed the new, 880 foot high, lava dome in the crater formed by the May 18, 1980 eruption. An eruption occurring in 1480 A.D. was approximately five times larger than the May 18, 1980 event.[11]

Figure 11-2. Potentially Active Volcanoes in the West



Source: United States Geological Survey.
http://www.volcano.si.edu/reports/usgs/maps.cfm#usa

On the night of March 8, 2005, a plume of ash and steam spewed nearly seven miles high into the air. Glowing tendrils of lava were spotted inside the mountain's crater following the explosion.[12] The plume rose nearly twice as high as one produced by the last eruption in October 2004. Ten small earthquakes were measured in the area on Tuesday leading up to the eruption. The largest appeared to be a magnitude 2.5, according to the USGS.[13]

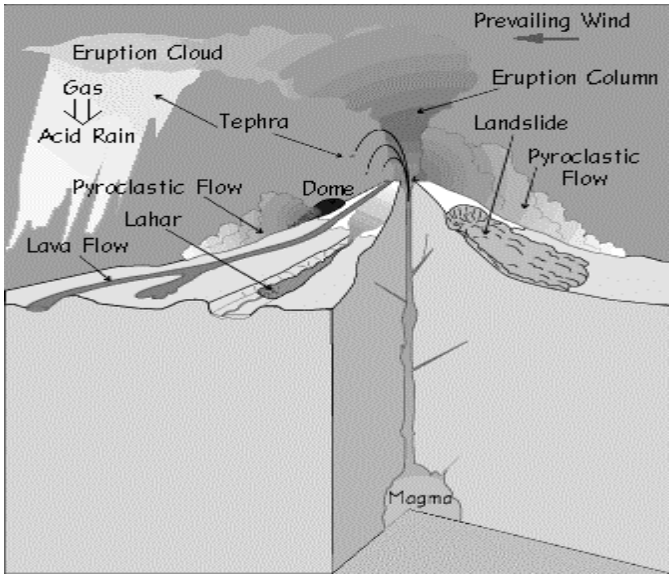
History of Volcanic Eruption Events Affecting Polk County

The only historical incidence of a volcano directly affecting Polk County was the eruption of Mount St. Helens on May 18, 1980. Spewing ash blotted out the sun for hundreds of miles across Washington, Idaho and western Montana, closing highways because of poor visibility.[14] The Willamette Valley was covered with a thin, gray sheet of volcanic ash.[15] While the area escaped with only a light dusting of the airborne pumice, Portland was choked with the powdery stuff and speed limits on metropolitan streets and highways were cut to 15 miles per hour due to the lack of visibility.[16]

Hazards Related to Volcanic Eruptions

Volcanic hazards may be manifest in several ways – from lava flows and landslides to tephra (volcanic ash deposition). Figure 14-3 shows a cross-section of a volcano and the types of hazards the may be associated with volcanic events.

Figure 14-3. Cross section of a volcano



Source: United States Geological Survey.
http://volcanoes.usgs.gov/Hazards/What/hazards.html

Tephra

Tephra consists of sand-sized or finer particles of volcanic rock and larger fragments. During explosive eruptions, tephra, together with a mixture of hot volcanic gases, is ejected rapidly into the air from volcanic vents. The suspended materials are carried high into the atmosphere and begin to move downwind. As the ash particles cool or become moisture laden they start to fall under the influence of gravity. The larger fragments fall near the volcanic vent, while finer particles drift downwind as a large cloud and then fall to the ground to form a blanket-like deposit of ash.[17]

Tephra introduces a number of hazards including the impact of falling fragments, the suspension of abrasive particles in the air and water, and the burial of structures, transportation routes, and vegetation. Tephra can also threaten public health, clog drainage systems, and create major debris management problems. The 1980 eruption of Mount St. Helens, for example, injected tephra to altitudes of twelve to twenty miles and deposited it over an area of 40,000 square miles or more. The direction and velocity of the wind, along with the magnitude and duration of the eruption, determine the location, size, and shape of the tephra fall. Wind forecasts from National Weather Service and models of ash dispersal developed by volcanologists can provide short-term forecasts for areas that might be subject to ash fall.[18]

Lahars

Melting snow and ice caused by pyroclastic flows and surges can generate lahars, also called volcanic mudflows or debris flows. Lahars are rapidly flowing, water-saturated mixtures of mud and rock fragments. Lahars range in consistency from mixtures resembling freshly mixed concrete to very muddy water, and can carry materials as large as truck size boulders. Past lahars at Mount Hood completely buried valley floors in the Sandy, Hood, and White River drainages. Polk County is not directly at risk from lahars. Neighboring counties are, however, which could ultimately affect the economy and other resources of Polk County.

Lava Flows

Magma under the Earth that reaches the surface is called lava. Lava flows downhill and is channeled into river valleys. A lava flow only affects terrain that is down-slope from its vent. While lava flows are destructive, they are not normally life threatening. Polk County is not at a direct risk to lava flows. The indirect effects, however**,** could be felt from neighboring counties.

Earthquakes

Earthquakes can trigger volcanic eruptions or they can cause them. An earthquake produced by stress changes in solid rock from injection or withdrawal of magma (molten rock) is called a volcano-tectonic earthquake. The other categories of volcanic earthquakes, called long period earthquakes, are produced by the injection of

magma into surrounding rock. Volcanic earthquakes tend to be mostly small and not a problem for areas tens of miles from the volcano. For specific hazards related to earthquakes, see Chapter 13 of this document.

Directed Blasts, Pyroclastic Flows and Volcanic Landslides

Directed blasts, also known as lateral blasts, are sideways-directed volcanic explosions that can shoot large pieces of rock at high speeds for several miles.[19] Pyroclastic flows are fluid mixtures of hot rock fragments, ash, and gases that sweep down the flanks of volcanoes. Landslides, or debris avalanches, are a rapid downhill movement of rocky material, snow, or ice.[20] Though these hazards could cause great impact to communities near an erupting volcano; they do not pose a threat to Polk County residents.

Volcanic Eruption Hazard Assessment

Hazard Identification

The USGS/Cascades Volcano Observatory (CVO) produced a volcanic hazard zonation report for Mount Hood in 1997 and 2000. The report includes a description of potential hazards that may occur to immediate communities.

Hazard zones were determined based on the distance from the volcano, vent location, and type of hazardous events. Proximal Hazard Zones 1 and 2 are areas subject to rapidly moving debris avalanches, pyroclastic flows, and lahars that can reach the hazard boundary in less than 30 minutes, as well as slow-moving lava flows. Areas within proximal hazard zones should be evacuated before an eruption begins because there is little time to get people out of harm's way once an eruption starts. Most pyroclastic flows, lava flows, and debris avalanches will stop within the proximal hazard zone, but lahars can travel much farther.

Distal Hazards Zone 3 includes areas adjacent to rivers that are pathways for lahars. Estimated travel time for lahars to reach these zones is more than 30 minutes, which may allow individuals time to move to higher ground and greater safety if given notice. Lahars could affect transportation corridors by damaging or destroying roads, and can damage Bull Run pipelines that cross the Sandy River.

Map 12 shows potential volcanic hazard areas.

Vulnerability Assessment

Vulnerability assessment is the second phase of a hazard assessment. It combines information generated through hazard identification with an inventory of the existing development exposed to volcanic eruptions. Vulnerability assessments assist in predicting how different types of property and population groups

will be affected by a hazard.[21] Data that includes areas susceptible to ash fall in the city can be used to assess the population and total value of property at risk from volcanic eruptions events.

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 Polk County volcanic eruption events, there are many qualitative factors (issues relating to what is in danger within a community) that point to potential vulnerability. Polk County faces no direct threat from a volcanic eruption. Its proximity to a number of Cascade Range volcanoes, however, places the county at risk from ash fallout originating from such an event.

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 risk from volcanic eruptions and ash fall include population and property distribution in the hazard area, the frequency of events, and potential wind direction. 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.

Community Volcanic Eruption Issues

Volcanic eruption is not an immediate threat to the residents of Polk County, as there are no active volcanoes within the county. Nevertheless, the presence of a few geologically young volcanic structures near Polk County and the secondary threats caused by volcanoes in the Cascade region must be considered. Volcanic ash can contaminate water supplies, cause electrical storms, create health problems, and collapse roofs.[22]

Building and Infrastructure Damage

Ash fall of about 0.4 inch is capable of creating temporary disruptions of transportation operations and sewage disposal and water treatment systems. Highways and roads could be closed for hours, days, or weeks afterwards. The series of eruptions at Mount St. Helens in 1980 caused Interstate 90 from Seattle to Spokane to close for a week. US Highway 26 in Oregon faced similar problems. The impact of the ash fall caused the Portland International Airport to close for a few days. The airport faced a series of challenges in cleaning up the ash that accumulated on its runways.

The fine-grained, gritty ash can also cause substantial problems for internal-combustion engines and other mechanical and electrical equipment. The ash can contaminate oil systems, clog air filters, and scratch moving surfaces. Fine ash can also cause short circuits in electrical transformers, which in turn cause power blackouts.

During an eruption at Mount Hood, Bonneville Power Administration transmission lines may be severed. A number of high voltage lines are located in the immediate vicinity of Mount Hood. These lines provide a portion of the electrical power to Polk County, the Portland Metropolitan Area, and the rest of the Willamette Valley.

Pollution and Visibility

Ash fallout from an eruption column can blanket areas within a few miles of the vent with a thick layer of pumice. High-altitude winds may carry finer ash from tens to hundreds of miles from the volcano, posing a hazard to flying aircraft, particularly those with jet engines.[23] Fine ash in water supplies will cause brief muddiness and chemical contamination. Ash suspended in the atmosphere is especially a concern for airports, where aircraft machinery could be damaged or clogged.

Ash fall also decreases visibility and disrupts daily activities. For example, some individuals may experience eye irritation. When the ash fall produced by the Mount St. Helens' eruption started to blow towards Oregon in June 1980, some of the airlines at the Portland International Airport responded immediately by stopping their service.

Economy

Volcanic eruptions can disrupt the normal flow of commerce and daily human activity without causing severe physical harm or damage. Ash that is a few inches thick can halt traffic, cause rapid wear of machinery, clog air filters, block drains, creeks, and water intakes, and impact agriculture.[24] Removal and disposal of large volumes of deposited ash can also have significant impacts on government and business.

The interconnectedness of the region's economy can be disturbed after a volcanic eruption. Roads, railroads, and bridges can be damaged from lahars and mudflows. The May 1980 eruption of Mount St. Helens demonstrated the negative affect on the tourism industry. Conventions, meetings, and social gatherings were canceled or postponed in cities and resorts throughout Washington and Oregon in areas not initially affected by the eruption. The eruption did lead, however, to the creation of a thriving tourist industry for decades following event.

Transportation of goods may also be halted. Subsequent airport closures can disrupt airline schedules for travelers. In addition, the movement of goods via the Columbia River and other major waterways can also be halted due to debris in the river, and tephra in the air. The Mount St. Helens event in May 1980 cost the trade and commerce industry an estimated $50 million in only two days, as ships were unable to navigate the Columbia.[25] Clouds of ash often cause electrical storms that start fires and damp ash can short-circuit electrical systems and disrupt radio communication.

Volcanic activity can also lead to the closure of nearby recreation areas as a safety precaution long before the activity ever culminates into an eruption.[26]

Existing Mitigation Activities

Federal Programs

Monitoring Volcanic Activity at Mount Hood and Mount St. Helens

The USGS collaborated with scientists from the Geophysics Program at the University of Washington to monitor seismic activity at both Mount St. Helens and Mount Hood after the May 1980 eruption at Mount St. Helens. When unusual activity is observed, scientists immediately notify government officials and the public. The U.S. Forest Service serves as the primary dissemination agency for emergency information. As the activity changes, USGS scientists provide updated advisories and meet with local, state, and federal officials to discuss the hazards and appropriate levels of emergency response. The experience since 1980 at Mount St. Helens and elsewhere indicates that monitoring is sufficient for scientists to detect the ascent of fresh magma that must take place before another large eruption. This information will enhance warnings and facilitate updated assessments of the hazard.

In addition, the USGS and the National Weather Service monitor lahar and flood hazards at Mount St. Helens. The latter agency has responsibility for providing warnings of floods, including lahars. These monitoring activities not only help nearby communities, but can also provide significant benefit to the Pacific Northwest, including Polk County.

Volcanic Event Notification Emergency Coordination

An emergency coordination center (ECC) was established at the US Forest Service (USFS) facility in Vancouver, Washington after the 1980 eruption of Mount St. Helens. A communications network and telephone call-down procedure was developed to facilitate rapid dissemination of information about the activity of the volcano. Information was also disseminated through public meetings, press conferences, and briefings with governmental agencies and private businesses. Currently, the system has the capability of issuing written predictions weeks in advance of most eruptions. This eliminates the need for 24-hour duty for both USFS/ECC and CVO staff except when eruptions are imminent. It can enter all predictions and updates into a computer "news" system for easy review by those on the call-down list; update volcanic activity reports when the volcano is quiet; and develop a seismic alarm to alert scientists to small events that occur without precursors.

USGS Video Programs

One good example of education and outreach is the USGS series of videos related to volcanic eruption. The USGS has produced a

video program “At Risk: Volcano Hazards from Mount Hood, Oregon.” The video describes and illustrates the types of volcanic hazards posed by Mount Hood, and shows areas near the volcano that could be affected by future activity. The video was produced to provide nearby residents, businesses, and public agencies basic information about future potential hazards from the volcano.

Decade Volcanoes Project

The Decade Volcanoes project began as part of the International Decade for Natural Disaster Reduction (IDNDR). The aim of the Decade Volcanoes project is to direct attention to a small number of selected, active volcanoes world-wide and to encourage the establishment of a range of research and public-awareness activities aimed at enhancing an understanding of the volcanoes and the hazards posed by them. Mount Rainier, in the Cascade Range, has been designated one of the Decade Volcanoes.[27]

Mitigation 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 identified to reduce Polk County’s risk from flood, landslide, wildfire, severe winter storm and windstorm, drought, expansive soils and seismic and volcanic events.

Goal #1: PUBLIC EDUCATION AND AWARENESS

Provide public information and education/awareness to all residents of the county concerning natural hazard areas and mitigation efforts.

Goal #2: PREVENTIVE AND IMPLEMENTATION

Develop and implement activities to protect human life, commerce, property and natural systems.

Goal #3: COLLABORATION AND COORDINATION

Strengthen hazard mitigation by increasing collaboration and coordination among citizens, public agencies, non-profit organizations, businesses, and industry.

Goal #4: FUNDING AND PARTNERSHIPS

Seek partnerships in funding and resources for future mitigation efforts.

Goal #5: EMERGENCY OPERATIONS

Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

Goal #6: NATURAL RESOURCES UTILIZATION

Link land use planning, development criteria, codes, and natural resources and watershed planning with natural hazard mitigation.

Volcanic Eruption Mitigation Action Items

The volcano mitigation action items were formulated through researching regional mitigation plans and 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 volcano action items provide direction on specific activities that organizations and residents in Polk County can undertake to reduce risk and prevent loss as a result of a volcano eruption. 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 volcanic eruption impacts in Polk County. These action items are designed to meet the mitigation plan goals.

Short-term (ST) Volcano Action Items

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

ST-V #1: Increase awareness of volcanic eruptions and their potential impact to the county.
Education is an effective way to relate how an infrequent hazard event could affect the daily life of a county resident.

Ideas for Implementation

- Inform and educate the public about volcanic hazards in the Polk County region. The public awareness campaign may take many forms;

- Collaborate with United States Geological Service – Cascades Volcano Observatory (USGS-CVO) and related agencies to create ash fall warning messages that are more appropriate for Polk County. (Research has shown that warnings that are not specific in terms of areas affected or precautionary actions that should be prescribed, or that lack a sense of urgency, will result in low responses.)

- Collaborate with USGS-CVO, FAA, National Weather Service, law enforcement offices, and the media to develop a warning message framework that is more appropriate for Polk County so that communities and individuals have a clear sense of how to respond;

- Collaborate with county public health for immediate warning to communities about air quality following volcanic eruptions (Note: Ash fall distribution is not predictable due to its dependence on wind speed and direction. Therefore, Polk County Public Health can alert communities when Mt. St. Helen, Mt. Hood, or other volcanoes produce ash, and distribute information quickly about air quality and visibility, and whether it is safe for residents to go outdoors or travel); and

- Play the USGS volcanic eruption videotape at schools, community centers, critical facilities, and major businesses.

Coordinating Organization:	Emergency Management – Hazard Mitigation Team
Internal Partners:	Community Development, Public Health, GIS
External Partners:	USGS-CVO, FAA, National Weather Service, Law Enforcement Offices, Cities, OSU, DOGAMI, DEQ, Media
Timeline:	On-going
Plan Goals Addressed:	Public Education & Awareness; Preventive & Implementation; Collaboration & Coordination; Funding & Partnerships; Emergency Operations.

ST-V #3: Identify critical facilities and major industries that may be affected by ash falls and collaborate with them on ash fall emergency response.

The Intel Corporation has taken the initiative to consult scientists on the probability of problems associated with volcanic eruptions in the Cascade region.[28]

Ideas for Implementation

- Collaborate and exchange experiences and knowledge among facility managers of potentially impacted industries in Polk County to reduce the impact of ash fall on their sites.

Coordinating Organization:	Emergency Management – Hazard Mitigation Team
External Partners:	SEDCOR, Major Industries, Cities, DOGAMI, USGS-CVO, water and wastewater systems operators

Timeline:	1 to 2 years
Plan Goals Addressed:	Public Education & Awareness; Collaboration & Coordination

Long-term (LT) Volcano Action Items

Long-term volcano 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-V #1: Strengthen response and recovery programs, and develop and implement public education programs for volcanic eruption hazards.

Ideas for Implementation

- Determine critical activities that must be implemented for varying degrees of ash fall;

- Create a hazard-specific supplement in the Polk County Emergency Operations Plan that defines the special concerns created by ash fall (e.g., health, cleanup; impacts to high tech and other industries);

- Provide county residents basic public education materials that describe volcanic eruption hazards (pyroclastic surges, pyroclastic flows, lahars, mudflows, landslides, ash fall), potential impacts, and appropriate response and mitigation activities;

- Create volcanic eruption hazard scenarios for Polk County to determine potential problems the county may face with varying amounts of ash fall; and

- Coordinate with the media for volcanic hazard education programs to reduce conveyance of misinformation.

Coordinating Organization:	Emergency Management – Hazard Mitigation Team
Internal Partner:	Community Development
External Partners:	OEM, USGS-CVO, DOGAMI, Cities, Media
Timeline:	On-going
Plan Goals Addressed:	Prevention & Implementation; Collaboration & Coordination; Funding & Partnerships; Emergency Operations

LT-V #2: Create and map hypothetical eruption scenarios to display potential eruption hazards.

Note: Hypothetical eruption scenarios for area volcanoes, showing the different possible eruption hazards can help the public understand the impacts of a volcanic eruption. Pierce County, Washington uses hypothetical scenarios for Mount Rainier to show possible impacts.

Ideas for Implementation

- Potential scenarios can show such occurrences of lava flows, tephra, ash plumes, lahars (debris flows), and possible geographic extent of impact.

- The scenarios can also cover likely grain size, thickness, physical properties, and hazards associated with ash fall;

- Cascades Volcano Observatory could partner with OSU/PSU/OIT geologists to create potential eruption scenarios.

Coordinating Organization:	Emergency Management – Hazard Mitigation Team
Internal Partner:	GIS
External Partners:	OSU/PSU/OIT; USGS-CVO, DOGAMI
Timeline:	3 to 5 years
Plan Goals Addressed:	Public Education & Awareness; Collaboration & Coordination; Funding & Partnerships

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Volcanic Eruption 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, Areas Subject to Natural Disasters and Hazards. DLCD 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 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: Earthquake and Tsunami Program Coordinator
Address: 3225 State Street, PO Box 14370, Salem, Oregon 97309
Phone: 503-378-2911
Fax: 503-373-7833
Website: http://www.osp.state.or.us/oem/

Federal Resources

USGS-David A. Johnston Cascades Volcano Observatory (CVO)

CVO provides accurate and timely information pertinent to assessment, warning, and mitigation of natural hazards. It provides warnings during volcanic crises by monitoring volcanoes and interpreting results in the context of current hazard assessments. It also provides information for use in land-use management emergency response plans, and public education.

Contact: CVO
Address: 5400 MacArthur Blvd, Vancouver, WA 98661
Phone: 360-993-8900
Fax: 360-993-8980
Website: http://vulcan.wr.usgs.gov/CVO_Info/framework.html

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
Phone: 503-326-2340
Website: http://nimbo.wrh.noaa.gov/Portland

Federal Emergency Management Agency (FEMA)

The Federal Emergency Management Agency (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 provides disaster relief funds following a natural hazard and works closely with the Oregon State Police - Office of Emergency Management.

Contact: Public Affairs Officer
Address: 130 228th Street, St., Bothell, WA 98021-9796
Phone: 425-487-4610
Fax: 425-487-4690
Website: http://www.fema.gov/library/volcano.htm
Email: opa@fema.gov

Additional Resources

Smithsonian Institution's Global Volcanism Program (GVP)

The Smithsonian Institution's Global Volcanism Program (GVP) is housed in the Department of Mineral Sciences, part of the National Museum of Natural History, on the National Mall in Washington D.C. The GVP are devoted to a better understanding of Earth's active volcanoes and their eruptions during the last 10,000 years. GVP activities can be divided into two main efforts that are closely linked: reporting of current eruptions around the world, and building databases and archival resources for Earth's active volcanoes and their eruptions. In doing so we provide a global context for our planet's active volcanism.

Contact: Global Volcanism Program, Department of Mineral Sciences
Address: Smithsonian National Museum of History, Washington, D.C. 20560-0119
Phone: 202-633-1860
Fax: 202-357-2476
Website: http://www.volcano.si.edu/
Email: gvp@si.edu

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

Institute of Geological & Nuclear Sciences Limited (GNS)

GNS has an excellent website that describes volcanic hazards in New Zealand. It provides simple and informative descriptions of volcanic hazards that are useful for communities around the world. It discusses the types of volcanic hazards and emergency response and mitigation actions that could be implemented.

Contact: Institute of Geological & Nuclear Sciences
Address: 69 Gracefield Rd, PO Box 30-368, Lower Hutt, New Zealand
Phone: 04-570-1444
E-mail: webmaster@gns.cri.nz
Website: http://www.gns.cri.nz/earthact/volcanoes/hazards/index.htm

Publications

Volcanic-Hazard Zonation for Mount St. Helens. Washington Open-File Report 95-497 (1995). Produced by the USGS-CVO, this report explains the various hazardous geologic processes of Mount St. Helens and the types of hazards and damages that have occurred at Mount St. Helens. It also includes valuable references and suggested reading.

Contact: USGS-CVO
Address: 5400 MacArthur Blvd, Vancouver, WA 98661
Phone: 360-993-8900
Fax: 360-993-8980
Website: http://vulcan.wr.usgs.gov/Volcanoes/MSH/Hazards

Volcano Hazards in the Mount Hood Region, Oregon Open-File Report 97-89 (1997) USGS-CVO

Produced by the USGS-CVO, this report documents past hazardous events that have occurred at Mount Hood and includes several volcano hazard maps. It also discusses hazard forecasts and warnings as well as ways to protect oneself from volcano hazards.

Contact: USGS-CVO
Address: 5400 MacArthur Blvd, Vancouver, WA 98661
Phone: 360-993-8900
Website: http://vulcan.wr.usgs.gov/Volcanoes/MSH/Hazards

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

Debris management is generally associated with post-disaster recovery. Developing management strategies to ensure strong debris management during and after a natural hazard event is a way to integrate debris management with mitigation. 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

1 DOGAMI website, http://sarvis.dogami.state.or.us/earthquakes/volcanoeshist.htm, Accessed August 12, 2003.

2 USGS website, http://geopubs.wr.usgs.gov/open-file/of99-437/of99-437map.pdf. Accessed August 14, 2003.

3 USGS website, http://vulcan.wr.usgs.gov/Volcanoes/Sisters/WestUplift/ground_uplift_may2001.html. Accessed August 12, 2003.

4 Id.

5 Id.

6 http://geopubs.wr.usgs.gov/open-file/of99-437/of99-437.pdf. Accessed August 12, 2003.

7 http://vulcan.wr.usgs.gov/Volcanoes/Cascades. Accessed August 12, 2003.

8 http://vulcan.wr.usgs.gov/Volcanoes/Rainier/summary_mount_rainier.html. Accessed August 20, 2003.

9 Tilling, et al. 1990. http://www.Vulcan.wr.usgs.gov/Volcanoes/MSH/Hazards

10 *Volcanic Hazard Zonation for Mount St. Helens, Washington*. 1995. USGS, Open-File-Report 95-497.

11 Community Planning Workshop. 2002.

12 "Scientists Seek Source of Mount St. Helens Blast." CNN.com Web site < http://www.cnn.com/2005/TECH/science/03/09/saint.helens/>. Posted March 9, 2005. Accessed March 28, 2005.

13 Id.

14 *Oregon Statesman*. May 19, 1980.

15 *Itemizer Observer*. May 28, 1980.

16 Id.

17 Community Planning Workshop. 2002.

18 Id.

19 "Volcanoes." March 2001. FEMA Website, www.fema.gov/library/volcano.htm

20 Wright and Pierson. 1973, 1992. *Living with Volcanoes*. USGS Volcano Hazards Program Circular.

21 Burby, R., ed. 1998. *Cooperating with Nature*. Washington D.C.: Joseph Henry Press.

22 Id.

23 USGS. March 2001. *Volcano Hazards of the Lassen Volcanic National Park Area*.

24 Id.

25 *Clackamas County Courier*. October 1986.

26 Cashman, Kathy. University of Oregon Department of Volcanology. Personal Interview. March 14, 2001.

27 United States Geologic Survey – Cascades Volcano Observatory. http://volcano.und.nodak.edu/vwdocs/volc_images/decade/

[28] Community Planning Workshop. September 2001. Washington County Mitigation Action Plan: Volcanic Eruption.

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 10th 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, Willamette Chapter	Executive Director, 675 Orchard Heights Rd NW, Salem, OR 97304, 503-585-5414, karens@redcross-salem.org http://www.redcross-salem.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

		(DOGAMI)		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	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

		(FPMS)		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 – 228th 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 – 228th 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
Environ-mental 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 – 228th 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 – 228th 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 – 228th 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.
Emergency Watershed Protection	Multi-Hazard	USDA-NRCS	Marion County NRCS 3867 Wolverine St NE, Salem, OR 97305-4266, 503-399-5741,	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

			www.or.nrcs.usda.gov/contact/marion.html	hazards.

Federal Resources and Programs (continued)

Program	Hazard	Agency	Contact Information	Type of Assistance
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	American Red Cross, Willamette Chapter, 675 Orchard Heights Rd. NW, Suite 200, Salem, OR 97304, 503-585-5414, rc@redcross-salem.org, http://www.redcross-salem.org/	The Willamette Chapter serves Polk and Marion Counties.
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 Polk County agencies, businesses, and residents, Polk County engaged the public in three primary ways. A steering committee comprised of individuals representing different divisions and departments in Polk County and the American Red Cross 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 Polk 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 Polk 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 23, 2004
- October 21, 2004
- December 8, 2004
- January 20, 2005
- February 10, 2005
- February 24, 2005
- March 1, 2005
- March 24, 2005

The steering committee formed under the guidance of Gene Clemens, Director, Polk County Community Development Department, 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:

Polk County Steering Committee

Name	Organization
Allen, Jim	Planning Director, Polk County Planning Division
Bender, Dean	Emergency Manager, Polk County Sheriff's Department
Carpenter, Dennis	Chief, SW Polk Fire District
Clemens, Gene	Director, Polk County Community Development
Ellis, Greg	Manager, City of Independence
Fancey, Mark	Project Manager, MWVCOG
Geisler, Aaron	Director, Polk County Public Works
Hough, Jim	Manager, City of Monmouth
Ingram Moore, Judith	Project Manager, MWVCOG
Maca, Bob	Yamhill County Emergency Manager
Montanaro, Eve	Luckiamute/Ash Creek Watershed Coordinator
Patterson, Darrell	Chief, Polk County Fire Deistrict #1
Redon, Charles	Rickreall/Glenn-Gibson Watershed Coordinator
Scott, Eric	Tribal Engineer, The Confederated Tribes of Grand Ronde
Slyh, Bob	Polk County Planning Commission Chair
Topp, Deborah	Rickreall/Glenn-Gibson Watershed Coordinator
Unger, Dennis	SW Polk Fire District
Vanderzanden, John	Marion County Emergency Manager
Williamson, Roger	American Red Cross
Wolfe, Bob	Polk County Sheriff
Woodrum, Bill	Windermere Real Estate, Dallas, OR
Wyatt, Jerry	Director, City of Dallas Community Development

Stakeholder Interviews

The second form of public participation was stakeholder interviews. The interviews offered alternative ways for Polk 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 Polk County. These individuals provide insight into the various natural hazard events that occur in Polk 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 less 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 plan's project managers memorialized the information recorded in the stakeholder interviews 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.

Polk County Natural Hazards Mitigation Plan Stakeholders

Last Name	First Name	Agency/Affiliation
Anderson	David	Fish Biologist, Boise Cascade
Bauer	Gary	Government Relations, Northwest Natural
Buchanan	Hugh	Weyerhaeuser Safety Coordinator (Dallas, OR Lumber Mill)
Bunch	Allen	Risk Management, Chemeketa Community College
Carrey	Jay	Director of Campus Safety, WOU
Cooper	Russ	Monmouth Public Works Director (Acting)
Disch	Donna	Office of State Fire Marshall
	Doris	Rickreall Community Water Association
Eddings	Chuck	Chief, West Valley Fire District
Eichorn	Ernie	Chemawa District, BPA
Ford	Dave	Manager, Portland General Electric
Fowler	Louis	Chief, Spring Valley RFPD
Gould	Randy	Manager, Marys Peak Resource Area, BLM
Hastings	Jackie	Polk Soil & Water Conservation District Manager
Holstein	Bill	Chief, Sheridan RFPD
Hubbard	Bruce	Chief Amity RFPD
Johnston	Doris	Regional Community Manager, Pacific Power
Knode	Mike	Chief, Salem Fire Department
Minnick	Nancy	Assistant to the Director of Campus Safety, WOU

Stakeholders (continued)

Last Name	First Name	Agency/Affiliation
Montague	Ellen	Communications, Willamette Education Service District
Nepstad	Jeff	Silviculture & Protection Coordinator, The Confederated Tribes of the Grand Ronde
Putnam	Bret	Chief, Dayton RFPD
Riemer	Curt	Luckiamute Domestic Water Cooperative Manager
Shepard	Rod	Harvesting Unit Manager, Boise Cascade
Timmons	Eric	Park Manager, Willamette Mission State Park District (Polk Co. Units: Helmick State Park, Spring Valley & Luckiamute Greenways, Holman Wayside)
Topp	Deborah	Coordinator, Rickreall/Glen-Gibson Watersheds
Walker	Ann	Coordinator, National Fire Plan, ODF
Whitaker	Todd	Ash Creek Water Control District
Wildman	Dave	Monmouth Power & Light
Wylie	Dennis	Park Manager, Champoeg State Heritage Area
Young	Bob	Falls City Fire Department
Zimmerman	Mary	Consumers Power, Inc.

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 Polk County residents.

Methodology

The community open house was held on April 19, 2005. The open house was advertised through public announcements sent to local newspapers and radio stations. 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 Federal Emergency Management Agency 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. It 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 ripple 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 benefit/cost comparison 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, measures, or projects fall into three general categories: benefit/cost analysis and 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 assess the value of mitigation for public sector and private sector activities.

Benefit/Cost Analysis

Benefit/cost analysis is a key mechanism used by Oregon Emergency Management (OEM), the Federal Emergency Management Agency (FEMA), and other state and federal agencies in evaluating hazard mitigation projects. In addition, the Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 93-288, as amended, also requires benefit/cost analysis.

Benefit/cost analysis is used in natural hazards mitigation to show whether 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 the value and timeliness of undertaking a project in order to avoid disaster-related damages. The basis of a benefit/cost analysis is calculating: (1) the frequency and severity of a hazard, (2) avoided future damages, and (3) risk.

Benefit/cost analyses evaluate all costs and benefits in terms of dollars, and compute a net benefit/cost ratio to determine the feasibility of implementing a project. 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, however, 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. Thus, 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, which 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:

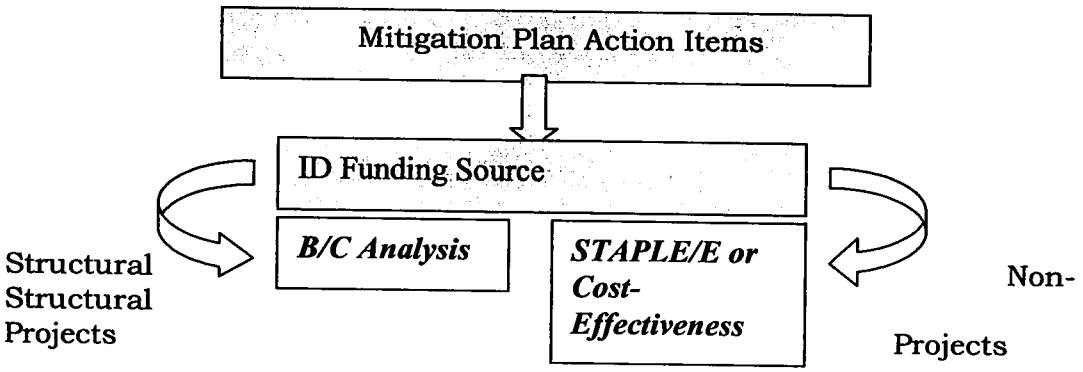
- How would the action impact the environment?
- Would the action need environmental regulatory approvals?

- 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. This framework should be used to further analyze the feasibility of prioritized mitigation activities.

1. **Identify the Alternatives**

   Alternatives for reducing risk from natural hazards can include structural projects to enhance disaster resistance, education and outreach, and acquisition or demolition of exposed properties, among others. Different mitigation projects can assist in minimizing risk from 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

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

appropriate alternative. Potential economic criteria with which to evaluate activities 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 potential economic obsolescence of the investment. This is difficult to project. These considerations would 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 could include the risk-free cost of capital, but it may include the decision maker's time preference as well as a risk premium. Determining the discount rate includes consideration of inflation.

3. Analyze and Rank the Alternatives

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

- ***Net present value.*** Net present value is the value of the expected future returns of an investment 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 parameters can be estimated using observed prices, costs, and engineering data. The difficult part is to correctly determine the effectiveness of the hazard mitigation project and the resulting reduction in damages and losses. Equally as difficult is assessing the probability that an event 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 building or land. Effects 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 structured to estimate total economic impacts. Total economic impacts are the sum total of direct and indirect economic impacts. Total economic impact models are usually not combined with economic feasibility models. Many models exist to estimate total economic impacts of changes in an economy. Decision makers should understand the total economic impacts of natural disasters in order to calculate the benefits of a mitigation activity. This suggests that understanding the local economy is an important first step in being able to understand the potential impacts of a disaster, and the benefits of mitigation activities.

Additional Considerations

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

Benefit/cost analysis is complicated, and the numbers may divert attention from other important issues. It is important to consider the qualitative factors of a project associated with mitigation that cannot be evaluated economically.

There are alternative approaches to implementing mitigation projects. 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. Eidinger, 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.

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

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.

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

Risk Management Solutions, Inc. *Development of a Standardized Earthquake Loss Estimation Methodology, 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

POLK COUNTY BASIC EMERGENCY OPERATIONS PLAN

I. AUTHORITY

This plan applies to and has been approved by the Polk County Board of Commissioners (BOC) who have delegated the Sheriff's Office as the lead agency in the Emergency Management Organization (EMO). The Sheriff has been given the collateral title of Emergency Management Director and has the authority and responsibility for the organization, administration, and operations of the Emergency Management Organization. The title and responsibility is subject to the direction and control of the Polk County BOC relative to ORS 401.305.

The Sheriff can then appoint an Emergency Program Manager or carry out the duties him/herself. The EMO will assist the Emergency Program Manager in carrying out his/her duties.

The State of Oregon Emergency Management Division and the Polk County Administration have shown their formal approval and acceptance of this plan through the Adoption Letters contained herein.

The organizational and operational concepts set forth are promulgated under the following authorities:

A. Federal

1. Federal Civil Defense Act of 1950, PL 81-950 as amended
2. The Disaster Relief Act of 1974, PL 93-288 as amended
3. Robert T. Stafford Disaster Relief and Emergency Assistance Act, PL 100-707
4. Title III, of the Superfund Amendments and Reauthorization Act of 1986, (SARA), PL 99-499 as amended
5. Code of Federal Regulations (CFR), Title 44. Emergency Management Assistance
6. EO 12656, Assignment of Emergency Preparedness Responsibilities, of November 18, 1988

B. State Of Oregon

1. Oregon Revised Statutes **(ORS) 401.305** through **401.335**.
2. Executive Order of the Governor

C. **Polk County**

1. Polk County Ordinance # 91-3.

II. PURPOSE

A. This plan identifies methods which, in cooperation and coordination with other public and private agencies, will preserve life and minimize damage from the effects of a natural or human-caused disaster.

B. To assist in meeting the above, this plan provides:

1. For a county emergency operations organization, while recognizing the need for county government to continue to coordinate and operate through the Board of Commissioners, elected officials, and department heads to maintain and/or restore normal services.

2. Identification of an Emergency Operations Center (EOC), a location from which community resources (both inside and outside county control) is coordinated.

3. A line of succession by which Polk County can maintain continuity of government, and an issuance of local authority by which operational activity may be initiated at the onset of an emergency situation.

4. Functional annexes to identify how county departments or agencies will work within the Emergency Management Organization and how they plan to carry out their operational responsibilities.

5. Establishment of response priorities.

6. Definitions and assessments of natural, technological, and human-caused hazards of which the community should be aware and upon which all entities and response agencies can assess their preparedness.

7. A base on which each incorporated municipality within Polk County can develop their own disaster plan that will be coordinated with this plan and will show how each city intends to fulfill its responsibilities in responding to an emergency. (ORS 401.015(2) and 401.305).

8. A data gathering and damage analysis capability that will enable the county to receive, record, display, assess, report and disseminate data on damage sustained during disasters.

III. MISSION

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. Developing, maintaining and using this plan constitutes a major component of the emergency management program.

IV. SITUATIONS AND ASSUMPTIONS

A. **Situation**

1. Polk County is primarily an agricultural and timber based economy. There are 745 square miles of terrain rising from the Willamette River in the east, with intermittent hills rising immediately from the valley floor in West Salem, to the Coast Range covering most of the West Boundary. The area between the Willamette River and the Coast Range is undulating farmland with diverse crops being grown. Portions of the County may be inaccessible at certain times of year due to flooding of the Willamette, Luckiamute and Yamhill Rivers and Rickreall Creek.

2. The population is approximately 63,000, which is mostly settled in West Salem, Dallas, Falls City, Independence and Monmouth, with a small portion of the City of Willamina and the rest scattered in small rural communities and on acreage throughout the county.

3. Five major arterials serve Polk County. Highway 221 runs north and south along the eastern border of the county and accommodates commercial and recreational traffic. Highway 223 runs north and south between Dallas and the Benton County Line. Highway 99 runs north and south through the center of the county and accommodates a heavy portion of commercial traffic. Highway 22 runs east and west through the county and also accommodates a heavy portion of commercial traffic as well as recreational and commuter traffic to and from the coast. Highway 18 merges with Highway 22 along the northwest corner of the county. Both Highway 18 and 22 have been designated as "Safety Corridors" due to the high number of serious and fatal motor vehicle accidents.

4. Spirit Mountain Casino, the top tourist attraction in the State of Oregon, is located in Polk County and has a daily average of 7,500 visitors.

5. Polk County is required by ORS 401 to develop, maintain and manage an emergency management program that includes an emergency operations plan.

B. Assumptions

1. Polk County is exposed to hazards that could disrupt the community by causing damage and creating casualties. Natural hazards include droughts, floods, wildfires, winter storms, and earthquakes. Although currently diminished, a threat of war remains and could include nuclear, chemical, biological or conventional attack. Other disasters could develop from a hazardous materials accident, conflagration, major transportation accident, radiological incident, deliberate act of terrorism, and civil disorder.

2. Polk County will continue to be exposed to the hazards noted above as well as others that may develop in the future.

3. It is possible for a major disaster to occur at any time, and at any place in the county. In some cases, dissemination of warning and increased readiness measures may be possible. However, many disasters and events can, and will, occur with little or no warning.

4. Local government officials recognize their responsibilities for the safety and well being of the public and will assume their responsibilities in the implementation of this emergency plan.

5. Proper implementation of this plan may reduce or prevent disaster-related losses.

V. CONCEPT OF OPERATIONS

A. General

1. Local government has the primary responsibility for emergency management functions and for protecting life and property from the effects of hazardous events. The County Emergency Operations Plan (EOP) should be used when there is a need or strong potential need for resources that are not normally available to emergency response agencies.

2. This EOP includes management and coordination of large-scale events, identifying and obtaining additional assistance/resources for emergency response agencies from the state and/or federal government through the County's Emergency Management Organization. This will be accomplished by activation and use of the Emergency Operations Center (EOC).

3. This plan is primarily applicable to extraordinary situations, it is not intended for use in response to the normal, day to day, emergency situations.

4. Assistance will be provided by Polk County Emergency Management to municipalities which do not have full-scale emergency management organizations and adequate resources. In addition, these services, as requested, can supplement the emergency functions of those municipalities who have developed emergency operations structures and plans.

5. Local government will coordinate with the private sector to provide relief and human services to disaster victims. Those include volunteer organizations, clubs, churches, and business. Access to emergency services shall not be denied on the grounds of race, color, national origin, sex, age, disability, marital status, or religious or political affiliation.

6. The presiding official of Polk County may declare a local state of disaster. The purpose of the declaration is to activate the recovery and rehabilitation aspects of the plan and to authorize the furnishing of aid and assistance. When the emergency exceeds local government capability to respond, assistance will be requested from neighboring jurisdictions in accordance with existing mutual aid agreements and then through state government. **(1-800-452-0311 or FAX 588-1378)**

B. Phases of Emergency Management

This plan follows an "all-hazard" approach and acknowledges that most responsibilities and functions performed during an emergency are not hazard specific. Likewise, this plan accounts for activities before and after, as well as during emergency operations. Consequently, all phases of emergency management are addressed as shown below.

1. **Mitigation**

Mitigation activities are those which eliminate or reduce the probability of a disaster occurring. Also included are those long-term activities that lessen the undesirable effects of unavoidable hazards.

2. Preparedness

Preparedness activities serve to develop the response capabilities needed in the event an emergency should arise. Planning and training are among the activities conducted under this phase.

3. Response

Response is the actual provision of emergency services during a crisis. These activities help to reduce casualties and damage and speed recovery. Response activities include warning, evacuation, rescue and other similar operations.

4. Recovery

Recovery is both a short-term and long-term process. Short-term operations seek to restore vital services to the community and provide for the basic needs of the public. Long-term recovery focuses on restoring the community to its normal, or improved, state of affairs. The recovery period is also an opportune time to institute mitigation measures, particularly those related to the recent emergency. This is also the phase to reassess applications, processes, and functions of all annexes of this disaster plan for deficiencies. Restoration to upgrade damaged areas is possible if it can be shown extra repairs will mitigate or lessen the chances of, or damages caused by, another such similar disaster.

C. Types of Emergency Situations

In response to the events of September 11, 2001 and the continued terrorist threat to the United States, the Federal Government, Oregon State Police Office of Public Safety and Security and the Polk County Sheriff's Office adopted terrorist threat levels that are equivalent to the types of emergency situations defined in this section.

1. Emergency Incident

This is an occurrence that is generally handled within the normal organizational procedures of a county department or agency, such as a response to an armed robbery call by the Sheriff's Office and would not require implementation of this plan.

a. Level one: Normal Operations (Green)

Level one status indicates normal conditions. No known threats or warnings, routine patrol functions.

2. Special Emergency

This is an incident that has special or unusual characteristics requiring response and/or support by more than one department or agency and may require partial implementation of this plan and/or a local declaration of emergency to access state resources or to enact emergency ordinances. An example here would be a hazardous material spill that occurred on the boundary of two jurisdictions and required an evacuation of a fairly large area.

a. Level Two: Guarded Operations (Blue)

General information about a potential threat, absent indication of potential target type, location or time. May include weather advisories and minor storm warnings.

3. Major Emergency

This is an occurrence that requires multi-agency response, allocation of resources, emergency services and support not normally serving the area, and one which affects a large portion of the population, property and critical services in Polk County. Additional resources and coordination would be provided through the Emergency Operations plan and may require a request for state and federal aid through a state declaration of emergency.

a. Level Three: Elevated Security (Yellow)

Credible source information of specific or potential threat, suggesting target type, time, or geographic location. May include, but not limited to, major weather situations like flood or storm warnings, planned civil disturbances, strikes or labor disputes.

4. Disaster

Disasters are determined by a measurement of total impact of a "state of emergency" in a community and demand a crisis response beyond the capability of local government.

a. Level Four: High Security (Orange)

Credible source information of threat to a specific asset or target. Natural disasters including earthquakes, wildfires, flooding, etcetera. May include large-scale industrial accidents, fires and / or explosions.

5. State of Emergency

This exists whenever any part or all of Polk County is suffering or is in danger of suffering an event that may cause injury, death, damage, or destruction to the extent that extraordinary measures must be taken.

a. Level Five: Severe Security (Red)

A terrorist attack has occurred or based on credible and corroborated intelligence is imminent. A natural disaster or industrial accident has occurred of such scale as to warrant a level five response.

D. Response Priorities In A Major Emergency/Disaster

1. Self Preservation

Protection of County employees and assets from the effects of a disaster

would be the first priority.

2. **Lifesaving/Protection of Property**

This is a focus on efforts to save lives of people other than County employees. It may include prevention or mitigation of major property damage if results of such damages would likely prevent an immediate danger to human life.

3. **Unit Reconstitution**

Unit reconstitution is the recall of critical employees, if the incident occurs during non-working hours, and the collection, inventory, temporary repair and allocation of County assets in order to provide maximum prompt, sustained operations in response to disaster. This would include activation of the County EOC for the purpose of coordinating emergency response activities.

4. **Emergency Food and Shelter**

Provision of immediate food and shelter, primarily through the Red Cross with coordination of the EOC, for disaster victims would become an immediate priority.

5. **Restoration of Infrastructure**

Restoration of County critical infrastructure (utilities, roads, bridges, buildings, etc) would be a prime concern that would require the coordination of local, state, and federal agencies with the private sector.

6. **Statutory Response**

Providing a partial or full range of County services beyond that of lifesaving and security, law enforcement, etc. Included under statutory responses is County support to other units of local government in their assigned missions, coordinating additional resources, declaring a state of emergency, and requesting state and federal assistance.

7. **Recovery**

Restoration of lost or impaired capabilities caused by the effects of the disaster or contingency; a return to normal operating conditions and providing non-emergency services to the public.

E. Inter-jurisdictional Relationships

1. **Municipalities**

a. Under the provisions of ORS 401.305, each City may establish an emergency management agency and appoint an emergency program manager.

b. Each City shall notify the County of the individual responsible for emergency management activities in its jurisdiction. Any city not choosing to establish an emergency management

agency may develop a cooperative intergovernmental agreement with the County, specifying the emergency management activities to be accomplished at each level.

c. If a City takes no action to increase its emergency management capability, such areas will be considered in County planning and County resources will be deployed under the direction of the County to respond should emergency conditions exist that threaten residents of that city.

d. The Chief Executives of the incorporated cities within the County are responsible for the direction and control of their local resources during emergencies.

e. The Chief Executives of the incorporated cities are responsible for requesting additional resources not covered under mutual aid for emergency operations. Such requests shall be directed to Polk County Emergency Management, including any requests for a state declaration of emergency or presidential disaster declaration.

2. **Special Service Districts**

These districts provide services such as fire protection and water delivery systems that are not available from county government. They are governed by an elected Board of Directors and have policies separate from city and county government. They often overlap city and county boundary lines, thus, these districts serve as primary responders to emergencies within their service districts, and they are responsible for coordination of policy, plan development, and operations activity through designated representatives. (See **Polk County Confidential Resource Manual** for emergency contact information).

3. **Private Sector**

Disaster response by local government agencies can be augmented by business, industry and volunteer organizations.

a. **Business And Industry**

The Emergency Management Director will perform coordination efforts with business and industry. This will include providing assistance, as appropriate, in action taken by industry to meet State regulations in emergency preparedness, and businesses that provide essential services such as utility companies. Schools, hospitals, nursing/care homes and other institutional facilities are required by federal, state or local regulations to have disaster plans.

b. **Volunteer Organizations**

These organizations will provide certain services in emergency situations. The County will generally work with these organizations through previously established agreements. In the preparedness time frame, essential training programs will be coordinated by the sponsoring agencies, of such

organizations as American Red Cross, Salvation Army, church groups, amateur radio clubs, etc.

c. **Public**

The public shall be provided available educational/instructional materials and presentations on subjects regarding safety practices and survival tactics for the first 72 hours of a disaster.

4. **Mutual Aid** (ORS 401.480 and 401.490)

State law grants permission for local governments to enter into Cooperative Assistance Agreements with public and private agencies in accordance with their need. Personnel, supplies and services may be utilized by a requesting agency, if the granting agency cooperates and extends such services. However, without a mutual aid pact, both parties must be aware that State Statutes do not provide umbrella protection except in the case of fire suppressions in ORS 476 that deals with the Oregon State Emergency Conflagration Act.

5. **State Government**

The State emergency organization as defined in the State of Oregon Emergency Operations Plan can be activated through the Department of State Police, Emergency Management Division. This division provides a duty officer at all times. The State provides direct state agency support to the local level, and serves as a channel for obtaining resources from outside the State structure, including the assistance provided by Federal Agencies. Local resources (personnel, equipment, funds, etc.) should be exhausted or projected to be exhausted before the County requests state assistance.

6. **Federal Government**

a. The County shall make requests for Federal disaster assistance to the State of Oregon Emergency Management Division.

b. Federal resources may be requested and provided prior to the formal declaration of a disaster in emergency response situations.

c. A Presidential Disaster Declaration makes available extensive disaster response and recovery assistance, including financial support to governments, businesses, and individual citizens.

F. **Direction and Control**

1. **Executive Actions**

a. In accordance with ORS 401.025, the responsibility for Emergency Management and direction and control in time of disaster belongs to the elected Board of County Commissioners.

b. The Chairperson of the BOC is empowered to assume executive

control over all departments, divisions and offices of Polk County during a state of emergency. The Chairperson is responsible for performing such duties as imposing regulations, causing emergency measures to be enforced, and designating emergency areas.

c. In the event the Chairperson is unable to perform the above duties, the persons listed in the **Polk County Ordinance 91-3** shall perform the duties. The Chairperson may declare a "state of emergency" and may place this plan into effect, and may activate and staff the County EOC on full or partial basis. In the event one or more of the above actions are implemented, a report of such action will be made to the Polk County BOC at the first available opportunity.

d. The Emergency Management Director of Polk County is responsible for assuring that coordinated and effective emergency response systems are developed and maintained. Existing agencies of government will perform emergency activities closely related to those they perform routinely.

e. Specific positions and agencies are responsible for fulfilling their obligations as presented in the Emergency Operations Plan and individual annexes. As the EOC controller, BOC Chairperson will provide overall direction of response activities of all Polk County departments. Department heads will retain control over their employees and equipment unless directed otherwise by the Emergency Management Director. Each agency will be responsible for having its own Standard operating procedures to be followed during response operations.

f. Outside assistance, whether from other political jurisdictions or from organized volunteer groups, will be requested and used only as an adjunct to existing Polk County services, and then only when the situation threatens to expand beyond Polk County response capabilities.

2. Lines Of Succession/Continuity Of Government

a. Polk County Governing Body

In event that the Chairperson of the Polk County BOC is unavailable or unable to perform his/her duties under this plan, the duties shall be performed by:

1. Second Commissioner
2. Third Commissioner
3. Sheriff
4. County Administrator
5. Community Development Director
6. Public Works Director
7. Polk County Fire Defense Board Chief

b. County Departments

The executive head of each County department shall establish,

in writing, an ongoing line of succession of authority.

c. **Incorporated Cities**

Lines of succession of authority within incorporated cities in Polk County shall be in accordance with plans or procedures developed by each city.

3. **Emergency Authority**

In accordance with ORS 401 Emergency Management series, as amended, the BOC Chairperson may take extraordinary measures in the interest of effective emergency management.

4. **Vital Records**

All elements of local government will provide for the preservation of important records on hand prior to the emergency. Emergency operations activity reports also constitute vital records and should be accumulated and preserved to ensure continued operation and reconstitution of local government during and after catastrophic disasters.

VI. ORGANIZATION AND ASSIGNMENT OF RESPONSIBILITIES

A. General

The Polk County BOC is charged by ORS 401.305 with the responsibility of establishing an emergency management organization, which has been implemented through the adoption of the Polk County Ordinances 91-3. The Sheriff has been appointed by the BOC as the Emergency Management Director (EMD). The EMD has appointed an Emergency Manager to conduct emergency management duties. The EMD is responsible for developing a countywide emergency management program that, through cooperative planning efforts with the five (5) incorporated communities of Polk County, will provide a coordinated response to a major emergency or disaster

The following outline of organizational responsibilities and task assignments for disaster response is primarily from the county government perspective. However, it includes certain agencies and organizations that are not a part of government but have an assigned role to play with the County in disaster response.

B. Organization

As stated above, the **County's Emergency Management Organization** was created to coordinate the on-going activities of the emergency management program and is located within the Sheriff's Office. A larger organization, the Operations Organization, consisting of two teams, the Policy Group and the Emergency Operations Center (EOC) Team, has been established to direct emergency response operations.

The governing body of County government, the BOC, is the nucleus around which the Policy Group is developed. This group will be composed of both elected and appointed officials from county departments, city and/or state government, as determined by the needs of the situation and at the discretion of the BOC Chairperson. They will oversee the countywide response, as coordinated by the

county EOC Team.

The EOC Team is composed of representatives of County Emergency Management, County Departments (with major emergency response responsibilities), city and state government and other community agencies, as determined by the needs of the situation. The EOC Team will work under the Incident Command System (ICS) structure.

C. Responsibilities

The County Emergency Management Director is responsible for emergency management planning and operations for that area of the county outside the corporate limits of the incorporated municipalities of the county and coordinating a countywide disaster response with the state and federal governments.

Each county department, and any other agency referenced in this plan, is responsible for developing and maintaining its own emergency operating plans and procedures that are consistent with this plan, in addition to carrying out specific duties that may be assigned as a part of this plan. Such plans and procedures will be referenced, as appropriate, in the annexes to the EOP.

If a major emergency/disaster occurs during non-working hours, critical county employees, who have direct public safety responsibilities or have been designated by their department, have a responsibility to report to work as soon as self-preservation concerns for themselves and their families have been met (advance family planning and preparations shall be made to the extent possible, to allow immediate return to work).

All other county employees should follow departmental procedure for emergency situations, if possible, or tune to local radio/television for Emergency Alert System (EAS) broadcasts and listen for direction.

Those cities developing their own EOP would be expected to create a similar outline of disaster response tasking and to use the Incident Command System (ICS) for the purpose of effectively interfacing with the County's response system.

Those cities without an EOP would be expected to work directly with the County, within the framework of this plan.

D. Task Assignments

Task assignments for major emergency response operations are primarily an extension of services that are provided on a daily basis by any department and agency. This list should not be considered all inclusive but should cover most major emergency operations and is generally consistent with the state and federal response plans. Additional, detailed information is available in the respective annexes.

There may be disaster situations that will require the services of all County employees. This could mean that many would assist in the public safety response effort, which would require working outside the scope of their day-to-day duties. Most of the emergency support functions contained in the Federal Response Plan are covered by this plan.

1. Emergency Management Services

When the County Emergency Management Organization is implemented in response to an emergency, a Commissioner, as the representative of the Policy Group, will work with the Emergency Management Director and the EOC Team at the Sheriff's Office, which is the designated EOC, to coordinate the community's response (only designated members of the EOC team are to report to the EOC, unless additional personnel are requested by the BOC or EMD).

The other two Commissioners and department heads, continuing in their role of managing County government, should report to the Commissioners Conference room or the Courthouse Conference room to oversee the continuance/restoration of other critical county services, in addition to their role in emergency response policy making for the Policy Group, as needed.

2. Emergency Operations Center

Response activities will be coordinated from the Emergency Operating Center, which is located in the County Sheriff's Office. The EOC will be activated upon notification of a possible or actual emergency. EOC responsibilities and activation procedures are addressed in the Basic Plan portion of this EOP, and **Emergency Operations Center Management Annex "A"**. During large-scale emergencies the EOC will in fact become the seat of government for the duration of the crisis.

a. EOC Activation

During emergency operations and upon activation, the EOC staff will assemble and exercise direction and control as outlined below.

1. The Emergency Management Director under the direction of the BOC Chairperson will activate the EOC. He/she will assume responsibility for all operations and direction and control of response functions.

2. The Emergency Management Director will determine the level of staffing required and will alert the appropriate personnel, agencies and organizations.

3. The BOC Chairperson will serve as the overall EOC controller.

4. County (City) departments augmented as required by trained reserves, volunteer groups will conduct emergency operations, and forces supplied through mutual aid agreements. State and Federal support will be requested if the situation dictates.

5. Communications equipment in the EOC will be used to receive information, disseminate instructions, and coordinate emergency operations.

6. The Emergency Management Director may establish an on-scene command post at the scene to maintain close

contact and coordination with the EOC.

7. Heads of departments and organizations are responsible for emergency functions assigned to their activity as outlined in their appropriate annex.

8. The EOC will operate on a 24-hour basis, rotating on 12-hour shifts.

9. The Emergency Program Manager will immediately notify the State Emergency Management office **(1-800-452-0311)** upon activation. Periodic updates will be made as the situation requires.

10. Each EOC member will have a designated alternate (assigned prior) in case absence or operational activities preclude presence. This insures "Continuity of Government," a smooth transition during shift changes, and prevents any unforeseen breakdowns in the process.

11. The primary EOC will be located in the Sheriff's Office meeting room in the Polk County Courthouse.

12. The secondary EOC (if for any reason the primary location is unusable) will be in the Program Room at the Polk County Jail **OR** a public building in the city/town nearest the disaster site. Care must be taken to not jeopardize operations by placing the EOC in a position of being consumed by the event.

    a. Provisions for sufficient food, water, sanitary facilities, and sleeping arrangements will be made.

13. The use of reports and records will vary according to the type of emergency. However, "complete and accurate" records **must** be maintained in order to prevent post-legal entanglements, sequence of events, and proper documentation for requesting assistance whether from local, State, or Federal sources.

    a. Forms and references are located at the end of this Emergency Operations Plan and appendices of the **Damage Assessment and Disaster Recovery Annex "N".**

14. Appropriate security to the EOC will be maintained to prevent persons not connected with the emergency situation entrance. Provisions outside the EOC will be insured for people from the media, with updates as the situation dictates.

Re: **Emergency Operations Center Annex "A"**

3. Warning

Willamette Valley 9-1-1 Center (Salem) is the County's primary warning point and is responsible for establishing and maintaining an alert and warning system, which includes:

a. Serving as the warning point for the Polk County Emergency Management Organization and all agencies receiving dispatch services.

b. Implementation of the National Warning System (NAWAS).

c. Assisting in accessing the Emergency Alert System (EAS) for warnings as may be necessary or as requested by an incident commander.

d. Continuous receipt and dissemination of emergency and warning information to the public and user agency personnel.

The Polk County Emergency Management Organization is responsible for further distribution to County agencies once notified by the 9-1-1 Center and ensuring that the necessary flow of information is occurring throughout the County.

Re: **Warning Annex "B"**

4. Law Enforcement Services

The Sheriff is responsible for law enforcement activities and serving as the law enforcement representative for the Emergency Management Organization, as necessary, to provide the following:

a. Overseeing and directing all public safety personnel and maintaining law and order.

b. Security measures, including crowd, traffic and restricted area control.

c. Evacuation of affected populations, including prisoners, when required.

d. Search and rescue operations for missing people, including support in all body recovery operations.

e. Recruit, dispatch and train all volunteers to ensure adequate labor forces within the law enforcement agency during emergency conditions.

f. Designating a department coordinator/liaison to participate in all phases of the County's emergency management program, when necessary, or as requested.

Re: **Law Enforcement Services Annex "C" and Evacuation Management Annex "J" (To Be Developed)**

5. Fire Services

The Polk County Fire Defense Board Chief is responsible for organizing, integrating and coordinating the operations of all fire fighting forces through mutual aid for response to major emergencies/disasters and serving as the fire services representative for the Emergency Management Organization, as necessary, to provide the following:

a. Coordinate the activities of all emergency fire services for fire prevention & suppression.

b. Overseeing the delivery of Emergency Medical Services (EMS) by ambulance service providers.

c. Inspection of damaged area for fire hazards.

d. Hazardous spills containment and clean-up.

e. Inspection of shelters for fire hazards.

f. Warning dissemination as may be necessary in a major emergency/disaster and assisting in evacuation, as needed.

g. Aid in rescue operations, traffic control and evacuation procedures if not otherwise engaged in fire related activities.

h. Designating a coordinator/liaison to participate in all phases of the County emergency management program, when necessary, or as requested.

Re: **Polk County Fire Defense Services Annex "D" and Hazard Response Annex "R"**

6. Environmental Health Division

The Director of Community Development is responsible for coordinating environmental health issues and services required to cope with disasters in urban or rural areas in Polk County and serving as a representative for the County Emergency Management Organization, as necessary, to provide the following:

a. Identifying health hazards, including those from damage to water and sewer systems and disseminating emergency information on sanitary measures to be taken.

b. Coordinating with the appropriate agencies the provision of food and potable water to victims whose normal supply channels are closed.

c. Designating a coordinator/liaison to participate in all phases of the County emergency management program, when necessary, or as requested.

7. Public Health and Human Services

The Director of the Human Services Department is responsible for coordinating public health and welfare services required to cope with disasters in urban or rural areas in Polk County and serving as the Human

Services/Health Department representative for the County Emergency Management Organization, as necessary, to provide the following:

a. Inspecting occupied emergency shelters and feeding areas.

b. Coordinating with hospitals, clinics, nursing homes/care centers and mental health organizations, including making provisions for the "special needs" population.

c. Coordinating with the Medical Examiner and Funeral Directors to provide identification and disposition of the dead.

d. Providing emergency counseling for disaster victims and emergency response personnel suffering from mental and emotional disturbances.

e. Coordinate for council of churches and other volunteer agencies.

f. Identify emergency feeding sites (coordinate with ARC and Salvation Army).

g. Identify sources of clothing for disaster victims (may coordinate with Salvation Army or other disaster relief organization).

h. Secure source of emergency food supplies (with ARC and Salvation Army).

i. Coordinate operations of shelter facilities, whether the City and County, local volunteers or organized disaster relief agencies such as American Red Cross operate them.

j. Coordinate special care requirements for sheltered groups such as unaccompanied children, the aged, and others.

k. Designating a coordinator/liaison to participate in all phases of the County emergency management program, when necessary, or as requested.

Re: **Health and Medical Services Annex "G", Human Services Annex "I", and Shelter and Mass Care Annex "H"**

8. Shelter and Mass Care

The Willamette Valley Chapter of the American Red Cross, through contractual agreement, serves as a member of the County Emergency Operations Organization and is responsible for ensuring the mass care needs of the affected population, such as sheltering, feeding, providing first aid and reuniting families, are met.

a. Maintain the Community Shelter Plan.

b. Supervise the Shelter Management program, (stocking, marking and equipping, etc.) for natural disaster.

c. Coordinate support with other City and County departments, relief

agencies and volunteer groups.

d. Designating a coordinator/liaison to participate in all phases of the County emergency management program, when necessary, or as requested.

Re: **Shelter And Mass Care Annex "H"**

9. Public Works

The County Public Works Director is responsible for providing the following:

a. Inspecting bridges for structural damage immediately following the occurrence of a natural disaster (earthquake, flood, etc).

b. Barricading of hazardous areas.

c. Clearing debris and making temporary repairs of critical arterial routes and bridges.

d. Supporting police and fire rescue efforts and traffic control measures.

e. Assisting with transportation resources for evacuations if necessary.

f. Coordinating restoration of public facilities, roads and bridges.

g. Assist General Services in the acquisition and deployment of private resources.

h. Assist General Services in the transport of supplies and equipment.

i. Assisting Community Development/Environmental Health with emergency waste disposal and sanitation, as necessary.

j. Designating a department coordinator/liaison to participate in all phases of the County's Emergency Management Organization, when necessary, or as requested.

Re: **Public Works Annex "E", Damage Assessment and Disaster Recovery Annex "N", and Debris Disposal Annex "O"**

10. Communications Services

Polk County Sheriff's Office/Emergency Management is responsible for:

a. Identifying a communications system that is capable of reaching all areas of the county so that emergency communications may be maintained among all levels of government during a disaster response.

b. Managing and coordinating all emergency communication

operations within the EOC once activated.

c. Providing the EOC with the necessary communications capabilities and staffing to insure communications operations for direction and control.

d. Developing and maintaining an Emergency Alert System (EAS) plan and providing a communications capability to the primary EAS Station.

Re: **Communications Services Annex "F"**

11. Damage Assessment

The Community Development Director and the Assessor are responsible for the coordination of damage assessment reporting process. This process provides for the initial collection of field reports, categorizing and totaling damage sustained during disasters. Additionally the Community Development Director and Assessor are to:

a. Establish a damage assessment team from among county departments with assessment capabilities and responsibilities;

b. Train and provide damage-plotting team to EOC;

c. Develop systems for reporting and compiling information on deaths, injuries, and dollar damage to tax-supported facilities and to private property;

d. Assist in determining geographic extent of damaged area;

e. Compile estimates of damage for use by County or City officials in requesting disaster assistance;

f. Evaluate effect of damage on County or City economic index, tax base, bond ratings, insurance ratings, etc., for use in long range recovery planning;

g. Supervision of activities of all emergency environmental health services, and;

h. Coordinate emergency building inspections.

Re: **Damage Assessment and Disaster Recovery Annex "N"**

12. Emergency Public Information

The Emergency Management Director is responsible for ensuring:

a. Conduct of on-going hazard awareness and public education programs.

b. Compile and prepare emergency information for the public in case of emergency.

c. Arrange for media representatives to receive regular briefings on the County status during extended emergency situations.

d. Secure printed and photographic documentation of the disaster situation.

e. Handle unscheduled inquiries from the media and the public.

Re: **Emergency Public Information Annex "L"**

13. Resource Management

The BOC has the overall authority for management, with the operational responsibility for coordination delegated to the County Administrator, during a disaster response. Individual department directors will be responsible for managing those resources within their departments and coordinating requests for additional resources. Individual department directors will:

a. Establish procedures for accessing emergency resources and supplies for disaster operations;

b. Establish and maintain a personnel reserve and coordinate deployment of reserve personnel to County (City) departments requiring augmentation;

c. Establish emergency purchasing procedures and/or a disaster contingency fund, and;

d. Maintain records of emergency related expenditures for purchases and personnel and maintain disaster cost assessment with the aid of the County Assessor and other department heads.

Re: **Resource Management Annex "K" and Polk County Confidential Resource Manual**

14. Evacuation

The implementation of an evacuation procedure is the responsibility of the Sheriff or Chief of the law enforcement agency responsible for the majority of the population affected. The Sheriff or Chief will:

a. Define responsibilities of County (or City) departments and private sector groups.

b. Identify high hazard areas and corresponding number of potential evacuees.

c. Coordinate evacuation planning to include:

1). Movement control.

2). Health & medical requirements.

3). Transportation needs.

4). Emergency Public Information materials.

5). Shelter & Reception locations.

Re: **Evacuation Management Annex "J" (To Be Developed) and Law Enforcement Services Annex "C"**

15. Volunteer Services

The Polk County Emergency Management Director is responsible for coordinating the services of both emergent and registered volunteers to assist in the County's disaster response. The Polk County Sheriff's Office Volunteer Council will work with Polk County to address volunteer service needs for disaster victims in Polk County.

Re: **Volunteer Services Annex "M" (To Be Developed)**

16. Legal Services

County Counsel is responsible for:

a. Providing legal services to the BOC and key responders for problems related to disasters and recovery operations.

b. The review of the basic and related emergency operations plan to determine if there are any legal implications for responsible officials.

c. Being familiar with federal and state laws, county and city codes pertaining to disasters.

d. Maintaining a position in the Policy group and serving as a resource to the EOC, keeping abreast of developments in order to consult and advise officials on all legal matters related to disaster and recovery operations.

e. Maintaining liaison with the State Attorney General to obtain additional opinions, when needed.

f. Notify Insurance Carriers, obtain and process insurance materials during emergency situation for recovery and continuance of county operations.

g. The preparation of standby documents such as permits of entry forms, state of emergency declarations, and mutual aid formats.

Re: **Legal Services Annex "P"**

17. Risk Management

The County Administrator will be responsible for the duties of coordinating risk management for the County Emergency Management Organization. The County administrator will:

a. Participate in the review of the basic and related emergency

operations plans to avoid liability incidents when an emergency situation occurs.

b. Maintain a close advisory status with the Policy Group and resource management activity during a disaster response.

c. Assess hazardous/unsafe situations and develop measures for ensuring the safety of disaster response personnel.

18. Information Services and Geographical Information Systems

Information Services provides mainframe, personal computer and network support for all County departments. Services during an emergency include:

a. Set up of EOC computers, and network support.

The G.I.S. program supports County departments with the input/update, display, analysis, and management of geographically referenced data including roads, zoning, taxlots, parcels, surveys, corners, plans and demographics. Maintains all hardware, vendor software, and application software required by departments to effectively use and maintain their data. Provides County decision makers and the public with user-friendly access to the GIS. Services during an emergency include:

a. Map creation - hard copy and digital maps for damage assessment use and planning needs.

b. Data analysis – i.e., high waters trends, patterns, buffers, predictions, models.

c. Routing - Determination of fastest routes and alternative routes for evacuation.

d. Geocoding of disaster events, reported damage, potential threatened geographical areas, mass casualties etc.

e. In the event the network is unavailable, hard copy maps are available in the EOC, the Assessors office and the GIS Offices.

E. Other Agencies' Responsibilities

Other County (City) department and agency heads not assigned a specific function in this plan will be prepared to make their resources (to include personnel) available for emergency duty at the direction of the County Administrator or City Manager.

VII. ADMINISTRATION AND SUPPORT

A. Support

Requests for state or federal assistance, including the Oregon National Guard or other military services, will be made to the Oregon Emergency Management office in Salem. All requests will be made by the BOC Chairperson or by another duly authorized official. In situations involving disaster activities in Polk County cities, each city must coordinate its request through the County system. A city must first

exhaust its related resources, then request assistance from the County or Mutual Aid sources. Once County resources have been expended, a declaration may be requested through the State.

B. Agreements And Understandings

Should local resources prove to be inadequate during an emergency, requests will be made for assistance from other local jurisdictions and other agencies in accordance with existing or emergency negotiated mutual aid agreements and understandings. Such assistance may take the form of equipment, supplies, personnel or other available capabilities. All agreements will be entered into by duly authorized officials and will be formalized in writing whenever possible.

C. Reports And Records

Required reports will be submitted to the appropriate authorities in accordance with individual annexes.

D. Relief Assistance

All individual relief assistance will be provided in accordance state and federal policies.

VIII. PLAN DEVELOPMENT, MAINTENANCE AND IMPLEMENTATION

A. If a plan is to be effective, its contents must be known and understood by those who are responsible for its implementation. The Emergency Management Director will brief the appropriate public and private officials concerning their role in emergency management and ensure proper distribution of the plan, including any amendments made to the plan.

B. All agencies will be responsible for the development and maintenance of their respective annexes and SOP's as identified on the "Annex Assignment" page located in the front of this plan.

C. The Emergency Management Director will be responsible for ensuring that an annual review of the plan is conducted by all officials involved, and that the plan is re-certified biennially by the chief elected officials of Polk County.

D. The plan will be updated, as necessary, based upon deficiencies identified by drills and exercises, changes in local government structure, or technological changes, etc. The Emergency Management Director will incorporate approved changes to the plan and will forward changes to all organizations and individuals identified as having responsibility for implementation. The plan will be activated at least once a year in the form of a simulated emergency in order to provide practical experience for with EOC responsibilities.

E. This plan supersedes and rescinds all previous editions of the Polk County Emergency Operations Plan and is effective upon signing by the BOC Chairperson. **If any portion of this plan is held invalid by judicial or administrative ruling, such ruling shall not affect the validity of the remaining portions of the plan.**

IX. DISTRIBUTION

Polk County Emergency Management is responsible for the distribution of this plan and for maintaining a control system. It is the responsibility of all departments and agencies that

hold copies of this plan to affix partial updated and supplemented portions of the plan in the appropriate location.

X. APPENDICES

1. Emergency Confidential Call Out List for Polk County Government
2. EOC Notification Checklist
3. EOC Staffing Roster
4. Message Format
5. Initial Damage Assessment Report Form
6. Operational Situation Report
7. ORS 401

Appendix E:

Acronyms

The Polk 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)
OECDD	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