LINCOLN COUNTY, WASHINGTON

MULTI-HAZARD MITIGATION PLAN

JANUARY 2011

Prepared By

Northwest Management, Inc.

Foreword

"Hazard mitigation is any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards. Mitigation activities may be implemented prior to, during, or after an incident. However, it has been demonstrated that hazard mitigation is most effective when based on an inclusive, comprehensive, long-term plan that is developed before a disaster occurs."[1]

The **Lincoln County, Washington Multi - Hazard Mitigation Plan** was developed in 2010 by the Lincoln County MHMP planning committee in cooperation with Northwest Management, Inc. of Moscow, Idaho.

This Plan satisfies the requirements for a local multi-hazard mitigation plan and a flood mitigation plan under 44 CFR Part 201.6 and 79.6.

[1] Federal Emergency Management Agency. "Local Multi-Hazard Mitigation Planning Guidance." July 1, 2008.

Lincoln County Resolution of Adoption

City of Davenport Resolution of Adoption

City of Sprague Resolution of Adoption

Town of Almira Resolution of Adoption

Town of Harrington Resolution of Adoption

Town of Creston Resolution of Adoption

Town of Odessa Resolution of Adoption

Town of Reardan Resolution of Adoption

Town of Wilbur Resolution of Adoption

Lincoln Hospital District Resolution of Adoption

Odessa Memorial Healthcare Center Resolution of Adoption

Table of Contents

Foreword **1**

Chapter 1 – Plan Overview **7**

Overview of this Plan and its Development **7**

Phase I Hazard Assessment *8*

Goals and Guiding Principles *10*

Chapter 2 – Planning Process **21**

Documenting the Planning Process **21**

Description of the Planning Process *21*

The Planning Team *21*

Planning Committee Meetings *23*

Public Involvement *24*

Chapter 3 – Community Profile **29**

Lincoln County Characteristics **29**

Description of the Region *29*

Geography and Natural Resources *29*

Demographics *32*

Socioeconomics *33*

Development Trends *34*

Hazard Management Capabilities *35*

Regional Hazard Profile *35*

Chapter 4 – Hazard Risk Assessment **39**

Lincoln County Risk Assessments **39**

Flood *39*

Earthquake *45*

Landslide *51*

Severe Weather *55*

Wildland Fire *57*

Avalanche *66*

Tsunami *68*

Volcano *70*

Drought *74*

Chapter 5 – Jurisdictional Vulnerability Assessment **79**

Lincoln County Annex **79**

City of Davenport Annex *105*

City of Sprague Annex *112*

Town of Almira Annex *119*
Town of Creston Annex *126*
Town of Harrington Annex *133*
Town of Odessa Annex *141*
Town of Reardan Annex *148*
Town of Wilbur Annex *155*
Lincoln Hospital District Annex *162*
Odessa Memorial Healthcare Center Annex *165*

Chapter 6 – Mitigation Strategy 169

Administration and Implementation of Action Items 169
Plan Monitoring and Maintenance *169*
Prioritization of Action Items *171*
Jurisdictional Mitigation Strategies *172*

Chapter 7 – Appendices 195

Supporting Information 195
List of Tables *195*
List of Figures *196*
List of Figures *196*
Planning Committee Minutes *197*
Public Meeting Slideshow *202*
Potential Funding Sources *205*

This page was intentionally left blank.

Chapter 1

Plan Overview

IN THIS SECTION:

- Planning Participants
- Phase I Hazard Assessment
- Goals and Guiding Principles

Chapter 1 – Plan Overview

Overview of this Plan and its Development

This regional Multi - Hazard Mitigation Plan is the result of analyses, professional cooperation and collaboration, assessments of hazard risks and other factors considered with the intent to reduce the potential for hazards to threaten people, structures, infrastructure, and unique ecosystems in Lincoln County, Washington. The planning team responsible for implementing this project was led by Lincoln County Emergency Management. Agencies and organizations that participated in the planning process included:

- Lincoln County Commissioners and County Departments
- Lincoln County Fire District #5
- City of Davenport
- Town of Reardan
- Town of Odessa
- Lincoln County Fire District #4
- Northwest Management, Inc.
- Amateur Radio Group
- Lincoln Hospital District
- Davenport Ambulance
- Avista Utilities
- Lincoln County Public Health District
- Town of Creston
- Odessa Fire Department
- Town of Wilbur
- Lincoln County Fire District #7
- Town of Harrington
- City of Sprague
- National Park Service

In June of 2010, Lincoln County Emergency Management solicited competitive bids from companies to provide the service of leading the assessment, developing the data, and writing the Lincoln County, Washington Multi - Hazard Mitigation Plan. Northwest Management, Inc. (NMI) was selected to provide this service to the County. NMI is a natural resources consulting firm located in Moscow, Idaho.

Phase I Hazard Assessment

The Multi - Hazard Mitigation Plan is developed in accordance with the Federal Emergency Management Agency's (FEMA) and Washington Military Department, Emergency Management Division requirements for a county level pre-disaster mitigation plan. The State of Washington Hazard Mitigation Plan identifies nine natural hazards affecting the State. In an effort to be consistent, the planning committee developed annexes for the same natural hazards. The hazards addressed in this Plan are:

- Flood
- Earthquake
- Landslide
- Severe Weather
- Wildland Fire
- Avalanche
- Tsunami
- Volcano
- Drought

Additional hazard annexes may be added to this Plan as funding allows. The highest priority hazards to be considered for future evaluation are:

- Hazardous Materials
- Crop Loss
- Dam Failure
- Pandemic
- Terrorism/Civil Unrest

A Phase I Assessment was facilitated with each county planning committee to determine the relative frequency of a hazard's occurrence and the potential impact a hazard event will have on people, property, infrastructure, and the economy based on local knowledge of past occurrences. A matrix system with hazard magnitude on the x axis and frequency on the y axis was used to score each hazard.

Magnitude of Hazards						
Value	**Reconstruction Assistance From**	**Geography (Area) Affected**	**Expected Bodily Harm**	**Loss Estimate Range**	**Population Sheltering Required**	**Warning Lead Times**
1	Family	Parcel	Little to No Injury / No Death	$1000s	No Sheltering	Months
2	City	Block or Group of Parcels	Multiple Injuries with Little to No Medical Care / No Death	$10,000s	Little Sheltering	Weeks
2	County	Section or Numerous Parcels	Major Medical Care Required / Minimal Death	$100,000s	Sheltering Required Neighboring Counties Help	Days
4	State	Multiple Sections	Major Injuries / Requires Help from Outside County / A Few Deaths	$1,000,000s	Long Term Sheltering Effort	Hours
8	Federal	Countywide	Massive Casualties / Catastrophic	$10,000,000s	Relocation Required	Minutes

A scoring system (shown above) was also used to categorize the relative magnitude each hazard may have on the community. Frequency was rated as "High" for hazards occurring multiple times per year of 5 year period, "Medium" for hazards occurring every 5 to 25 years, or "Low" for hazards occurring more than 25 years apart.[2]

The following table summarizes the Phase I Hazard Assessments for Lincoln County.

		Magnitude		
		Low	Medium	High
Frequency	Low	**Avalanche**	**Landslide Tsunami**	**Earthquake Volcano**
	Medium	**Flood**	**Drought**	
	High		**Wildland Fire Severe Weather**	

The inclusion of additional hazards was considered; however, due to funding limitations, participating jurisdictions chose not to assess technological, man-caused, or other hazards until additional funding becomes available. At such a time, the Multi - Hazard Mitigation Plan will be revised to include hazards such as hazardous materials, dam failure, and pandemic.

[2] Custer County, Idaho. Scoring system partially adapted from the Custer County Multi-Jurisdiction All Hazard Mitigation Plan. 2008. Pp 165-168.

Goals and Guiding Principles

Federal Emergency Management Agency Philosophy

Effective November 1, 2004, a Multi - Hazard Mitigation Plan approved by the Federal Emergency Management Agency (FEMA) is required for Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation Program (PDM) eligibility. The HMGP and PDM program provide funding, through state emergency management agencies, to support local mitigation planning and projects to reduce potential disaster damages.

The new local Multi - Hazard Mitigation Plan requirements for HMGP and PDM eligibility is based on the Disaster Mitigation Act of 2000, which amended the Stafford Disaster Relief Act to promote an integrated, cost effective approach to mitigation. Local Multi - Hazard Mitigation Plans must meet the minimum requirements of the Stafford Act-Section 322, as outlined in the criteria contained in 44 CFR Part 201. The plan criteria cover the planning process, risk assessment, mitigation strategy, plan maintenance, and adoption requirements.

In order to be eligible for project funds under the Flood Mitigation Assistance (FMA) program, communities are required under 44 CFR Part 79.6(d)(1) to have a mitigation plan that addresses flood hazards. On October 31st, 2007, FEMA published amendments to the 44 CFR Part 201 at 72 Federal Reg. 61720 to incorporated mitigation planning requirements for the FMA program (44 CFR Part 201.6). The revised Local Mitigation Plan Review Crosswalk (July 2008) used by FEMA to evaluate local hazard mitigation plans is consistent with the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended by Section 322 of the Disaster Mitigation Act of 2000, the National Flood Insurance Act of 1968, as amended by the National Flood Insurance Reform Act of 2004 and 44 Code of Federal Regulations (CFR) Part 201 – Mitigation Planning, inclusive of all amendments through October 31, 2007 was used as the official guide for development of a FEMA-compatible Lincoln County, Washington Multi-Hazard Mitigation Plan. [3]

FEMA will only review a local Multi - Hazard Mitigation Plan submitted through the appropriate State Hazard Mitigation Officer (SHMO). Draft versions of local Multi - Hazard Mitigation Plans will not be reviewed by FEMA. FEMA will review the final version of a plan prior to local adoption to determine if the plan meets the criteria, but FEMA will be unable to approve it prior to adoption.

In Washington the SHMO is:

Mark Stewart
Washington Military Department
Emergency Management Division
Building 20, M/S: TA-20
Camp Murray, WA 98430-5122

A FEMA designed plan will be evaluated on its adherence to a variety of criteria.

[3] Federal Emergency Management Agency. "Local Multi-Hazard Mitigation Planning Guidance." July 1, 2008.

- Adoption by the Local Governing Body
- Multi-jurisdictional Plan Adoption
- Multi-jurisdictional Planning Participation
- Documentation of Planning Process
- Identifying Hazards
- Profiling Hazard Events
- Assessing Vulnerability: Identifying Assets
- Assessing Vulnerability: Estimating Potential Losses
- Assessing Vulnerability: Analyzing Development Trends
- Multi-jurisdictional Risk Assessment
- Local Hazard Mitigation Goals
- Identification and Analysis of Mitigation Measures
- Implementation of Mitigation Measures
- Multi-jurisdictional Mitigation Strategy
- Monitoring, Evaluating, and Updating the Plan
- Implementation Through Existing Programs
- Continued Public Involvement

Planning Philosophy and Goals

Lincoln County Planning Philosophy

This effort will utilize the best and most appropriate science from all partners and will integrate local and regional knowledge about natural hazards while meeting the needs of local citizens, the regional economy.

Mission Statement

To make residents, communities, state agencies, local governments, and businesses less vulnerable to the effects of hazards through the effective administration of hazard mitigation grant programs, hazard risk assessments, wise and efficient infrastructure hardening, and a coordinated approach to mitigation policy through federal, state, regional, and local planning efforts. Our combined priorities will be the protection of people, structures, infrastructure, and unique ecosystems that contribute to our way of life and the sustainability of the local and regional economy.

Jurisdictional Planning and Mitigation Goals

Lincoln County:

1. *Planning* – Educate communities about the unique challenges of natural hazard preparedness in the County.
2. *Mitigation* – Reduce the impact of hazard events and potential losses incurred by both public and private residents and entities.
3. *Mitigation* – Establish mitigation priorities and develop feasible solutions to hazard-related issues.

4. *Planning* – Strategically locate and plan infrastructure projects that take into consideration the impacts of natural hazards.
5. *Planning* – Seek opportunities to protect, enhance, and integrate emergency and essential services with land use planning and natural resource management.
6. *Mitigation* – Develop mitigation strategies that will alleviate or lessen the impacts of severe weather events throughout the County.
7. *Planning* – Continue to work with local partners to reduce the risks of ignitions and potential losses from wildland fire events.
8. *Planning* – Develop protocol prioritization for the protection of people, structures, infrastructure, and unique ecosystems that contribute to the sustainability of the regional economy and our way of life.

City of Davenport

1. *Planning* – Through pre-planning and mitigation strategies, reduce the mortality and morbidity in citizens resulting from disasters.
2. *Planning* – Protect life and property by planning for disasters and developing mitigation strategies.
3. *Planning* – Develop land use policies to alleviate hazard risks and impacts for future development.
4. *Planning* – Strengthen emergency operations plans and procedures by increasing collaboration among public agencies, non-profit organizations, business, and industry.
5. *Mitigation* – Reduce the impact of hazards events and potential losses incurred by both public and private residents and entities.
6. *Mitigation* – Establish county and city participation in the National Flood Insurance Program and strive to reduce premiums by lowering their Community Rating System score.
7. *Planning* – Educate communities about the unique challenges of natural hazard preparedness in the county.
8. *Planning* – Work with local organizations to improve sheltering capacity during severe weather events.

City of Sprague

1. *Planning* – Establish mitigation priorities and develop mitigation strategies.
2. Planning - Reduce the impact of hazard events and potential losses incurred by both public and private residents and entities.
3. *Planning* - Strengthen emergency operations plans and procedures by increasing collaboration among public agencies, non-profit organizations, business, and industry.
4. *Planning* - Work with local organizations to improve sheltering capacity during severe weather events.

Town of Almira

1. *Mitigation* – Prepare and implement emergency plans in order to reduce the impacts from weather.
2. *Planning* - Bring new businesses to Almira to help improve the sustainability of the community.
3. *Planning* - Replace the town's 80 year old water system including the water tower, the main line, and improvement existing municipal wells.
4. *Planning* – Establish feasible mitigation strategies and priorities.

Town of Creston

1. *Planning* – Minimize the impacts of emergencies and disasters on the people, property, environment, and economy of the Town of Creston.
2. *Planning* - Educate the community about natural and man made hazard emergency situations.
3. *Mitigation* – Reduce the impact of hazard events and potential losses when possible through emergency warning notifications.
4. *Planning* - Establish mitigation priorities and develop strategies.
5. *Mitigation* - Work with Lincoln County in identifying hazardous material flow through the County.
6. *Mitigation* - Work with local organizations to improve sheltering capacity during severe weather events.

Town of Harrington

1. *Planning* - Work with the local school district to improve sheltering capacity during severe weather events including the use of the Harrington Memorial Hall.
2. *Mitigation* – Enforce regulations and restrictions for building in areas of special flood hazard (Ordinance 451) that meet requirements for National Flood Insurance as set out in Harrington's Comprehensive Plan.
3. *Planning* – Work with local partners to coordinate mitigation planning and disaster response.
4. *Planning* – Continue to work with the International Code Council to meet the detailed requirements of the 1991 Uniform Building Code.

Town of Odessa

1. *Planning* – Through the continued progression of mitigation with county operations and services, the advancement of emergency services will provide continued protection for the citizens of the Town of Odessa, reducing the morbidity and mortality in the event of a devastating event.

2. *Mitigation* – Safeguard the well being of all individuals in our community and their properties; while protecting and preserving the natural properties of our environment.

Town of Reardan

1. *Planning* – Protect residents during hazards by immediate notification and possible evacuation and prompt cleanup efforts.
2. *Planning* – Prioritize the protection of people, structures, infrastructure, and unique ecosystems that contribute to our way of life and the sustainability of the local and regional economy.

Town of Wilbur

1. *Planning* – Educate communities about the unique challenges of natural hazard preparedness in the County.
2. *Mitigation* – Establish mitigation priorities and develop feasible solutions.
3. *Planning* – Strategically locate and plan infrastructure projects that take into consideration the impacts of natural hazards.

Lincoln Hospital District

1. *Planning* – Effectively and efficiently respond to a variety of emergent or critical situations affecting routine operations and Lincoln Hospital.
2. *Planning* – Through pre-planning and mitigation strategies, reduce the mortality and morbidity in Lincoln County citizens resulting from disasters.
3. *Planning* – Protect life and property in Lincoln County by planning for disasters and developing mitigation strategies.

Odessa Memorial Healthcare Center

1. *Planning* – Establish mitigation priorities and develop mitigation strategies.
2. *Planning* – Strategically locate and plan infrastructure projects that take into consideration the impacts of natural hazards.
3. *Planning* – Strengthen emergency operations plans and procedures by increasing collaboration among public agencies, non-profit organizations, business, and industry.
4. *Planning* - Seek opportunities to protect, enhance, and integrate emergency and essential services.
5. *Mitigation* - Odessa Memorial Healthcare Center will work with the town of Odessa and local organizations to improve sheltering capacity during severe weather events.
6. *Planning* - Continue to work on action items and proposed projects identified in the Lincoln County Community Wildfire Protection Plan.

Integration with Other Local Planning Documents

During the development of this Multi - Hazard Mitigation Plan several planning and management documents were reviewed in order to avoid conflicting goals and objectives. Existing programs and policies were reviewed in order to identify those that may weaken or enhance the hazard mitigation objectives outlined in this document. The following narratives help identify and briefly describe some of the existing planning documents and ordinances considered during the development of this plan.

Lincoln County Comprehensive Emergency Management Plan (2009)

The purpose of the Comprehensive Emergency Management Plan (CEMP) is to guide the Lincoln County Department of Emergency Management in its responsibility to preserve lives, protect property and the environment, and to ensure public health in times of natural or technological disasters. The organization also provides for the coordination of recovery efforts following disasters, and will provide actions to mitigate the effects of such disasters, to the extent possible.

The CEMP is an all hazard plan that is promulgated by Lincoln County Board of Commissioners and Mayors of the participating cities and towns within the county and applies to all local public and private entities and organizations participating and included in the plan.

The CEMP is an all hazard approach to emergency and disaster situations likely to occur in the county, as described in the Lincoln County Hazard Identification/Vulnerability Analysis (HIVA), and provides the foundation for:

1. The establishment of an organization and guidelines for efficient and effective use of government, private sector and volunteer resources.
2. An outline of local government responsibilities in emergency management activities as described under RCW 38.52 and other applicable laws.
3. An outline of other participants' responsibilities in emergency management activities as agreed upon by the participating agencies and organizations.

Lincoln County Comprehensive Plan (1983)

The Comprehensive Plan is a legal document for guiding the future development of Lincoln County and is currently undergoing a revision process to be concluded in 2010-2011. The Plan is based upon the stated long-term goals and objectives of the county residents. The 1983 document covers land use, recreation, transportation, and economic elements.

Lincoln County Code: Title 16 – Land Divisions

The process by which land is divided is a matter of concern and should be administered in a uniform manner by cities, towns and counties throughout the state. The purpose of this title is to regulate the division of land and to promote the public health, safety, and general welfare in accordance with established standards to prevent the overcrowding of land; to lessen congestion on the streets and highways; to promote effective use of land; to promote safe and convenient travel by the public on streets and highways; to provide adequate provisions for light and air; to facilitate adequate provisions for water, sewerage, parks and recreation areas, sites for schools and school grounds and other public requirements; to provide for proper ingress and egress; to provide for the expeditious review and approval of proposed

subdivisions, which conforms to zoning and development standards and commercial needs of the citizens of the County and where to require uniform monumenting of land subdivisions and conveyancing by accurate legal description. In accordance with Chapter 58.17 RCW, Lincoln County has prescribed a method for controlling the division of land in unincorporated areas. Whereas the board of county commissioners deems the controls, standards, procedures and penalties set forth in this title to be essential to the protection of the public health, safety and general welfare of the citizens of Lincoln County and the adoption to be in the public interest.

Lincoln County Code – Flood Damage Prevention

Chapter 15.16 of the Lincoln County Code[4] says that the flood hazard areas of Lincoln County are subject to periodic inundation, which results in loss of life and property, health and safety hazards, disruption of commerce and governmental services, extraordinary public expenditures for flood protection and relief and impairment of the tax base, all of which adversely affect the public health, safety and general welfare. These flood losses are caused by the cumulative effect of obstructions in areas of special flood hazards, which increase flood heights and velocities and when inadequately anchored, damage uses in other areas. Uses that are inadequately flood-proofed, elevated or otherwise protected from flood damage, also contribute to the flood loss. In order to accomplish its purposes, this chapter includes methods and provisions for:

- Restricting or prohibiting uses which are dangerous to health, safety and property due to water or erosion hazards or which result in damaging increases in erosion or in flood heights or velocities;
- Requiring that uses vulnerable to floods, including facilities, which serve such uses, be protected against flood damage at the time of initial construction;
- Controlling the alteration of natural flood plains, stream channels and natural protective barriers, which help accommodate or channel flood waters;
- Controlling filling, grading, dredging and other development, which may increase flood damage; and
- Preventing or regulating the construction of flood barriers, which will unnaturally divert flood waters or may increase flood hazards in other areas.

Creston Flood Damage Prevention Ordinance

The purpose of Creston's Flood Damage Prevention Ordinance is to promote public health, safety, and general welfare; reduce the annual cost of flood insurance; and minimize public and private losses due to flood conditions in specific areas. The flood hazard areas of Creston are subject to periodic inundation which results in loss of life and property, health and safety hazards, disruption of commerce and

[4] Lincoln County, Washington. January 2005. Lincoln County Code – Title 15 Building and Construction, Chapter 15.16 Flood Damage Prevention. Lincoln County Planning Services. Lincoln County Board of Commissioners. Davenport, Washington.

governmental services, extraordinary public expenditures for flood protection and relief, and impairment of the tax base. In order to accomplish its purposes, the ordinance includes methods and provisions for:

1. Restricting or prohibiting uses which are dangerous to health, safety, and property due to water or erosion hazards, or which result in damaging increases in erosion or in flood heights or velocities;
2. Requiring that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction;
3. Controlling the alteration of natural flood plains, stream channels, and natural protective barriers, which help accommodate or channel flood waters;
4. Controlling filling, grading, dredging, and other development which may increase flood damage; and
5. Preventing or regulating the construction of flood barriers that unnaturally divert floodwaters or may increase flood hazards in other areas.

Creston Critical Area Ordinance

This ordinance establishes that wetlands, aquifer protection areas, critical wildlife habitat, frequently flood areas, and geologically hazardous areas are classified as critical areas. Cities and counties are required to use best available science in developing policies and regulations to protect the functions and values of critical areas. Any development proposed within a designated critical area shall be subject to project review.

Lake Roosevelt National Recreation Area Fire Management Plan (2000)

The preparation of a Wildland Fire Management Plan is required by the National Park Service (NPS) Wildland Fire Management Guidelines (DO-18), which states: "All parks with vegetation that can sustain fire must have a fire management plan. The resource management objectives of the park may determine whether a prescribed fire component is needed". Vegetation at Lake Roosevelt National Recreation (LRNRA) Area includes at least three fire prone ecosystems, these being steppe (semi-arid grassland), shrub/steppe, and ponderosa pine forests.

The NPS at LRNRA needs this plan to guide management decisions in response to wildland fire incidents occurring within LRNRA and adjacent to the area's boundary. Presently and in the future all wildland fires will be suppressed. The size and configuration of LRNRA's land base eliminates the option of using wildland fire to obtain other resource objectives that may be possible in a park with a large aggregate acreage. In contrast, the preferred alternative proposes to add a prescribed fire component that would enhance the NPS's ability to manage and improve the park's ecosystem components and processes while providing for firefighter and public safety.

Lake Roosevelt National Recreation Area Shoreline Management Plan Environmental Assessment (2009)

The Shoreline Management Plan is intended to evaluate the need to modify visitor access opportunities along the shoreline, whether it is accessed from the lake or from land. Alternatives in the Management Plan make recommendations regarding future management of the shoreline to accommodate visitors and fluctuating lake levels, to better protect natural, cultural and scenic resources, and to more effectively distribute visitor use.

Swanson Lakes Wildlife Area Management Plan (2006)

Management goals for the Washington State Department of Fish and Wildlife (WADFWS) Swanson Lakes Wildlife Area are to preserve habitat and species diversity for wildlife resources, maintain healthy populations of game and non-game species, protect and restore native plant communities, and provide diverse opportunities for the public to encounter, utilize, and appreciate wildlife and wild areas.

One of the agency's goals, as outlined in the Wildlife Area Management Plan, is to provide fire management on agency lands, which they do by maintaining fire protection contracts with the local fire districts. One of the agency's concerns regarding wildland fire is that it threatens sensitive habitats within the Wildlife Area. Swanson Lakes Wildlife Area contains fire-sensitive habitat that is critical to the survival of the Columbian sharp-tailed grouse. Deciduous trees and shrubs provide critical winter habitat, and the cover associated with tall bunchgrasses provides needed hiding and escape cover for sharp-tailed grouse.

Lincoln County Livestock Evacuation Program (Ongoing)

Lincoln County is currently working on an effort to provide for the evacuation of all livestock during emergency situations, particularly wildland fire. This effort is organized by a team of volunteers that helps contact livestock owners in the affected areas and work together to either cut fences to allow animals to escape on their own or evacuate the animals to designed round up grounds. The volunteers involved in this program have organized the necessary equipment including trucks, trailers, and communication devices as well as on-call veterinarians to quickly and safely provide for the safety of the animals. The group involved in this program is working closely with the Sheriff's office to develop a formal plan outlining the program and its implementation.

Bureau of Land Management, Spokane Field Office Fire Management Plan (2004)

The purpose of the BLM's Spokane District Office Fire Management Plan (FMP) is to identify and integrate all wildland fire management guidance, direction, and activities required to implement national fire policy and fire management direction from the following: Federal Wildland Fire Management Policy and Program Review-1995 and 2001; The Interagency Fire Management Plan Template; and A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment: 10-Year Comprehensive Strategy Implementation Plan.

The FMP was developed around the Spokane District office fire management program and addresses all aspects of it, including wildland urban interface (WUI), rural fire assistance, prescribed fire, fuels management, prevention, and suppression. The FMP identifies a fire program that meets its identified fire management objectives.

This page was intentionally left blank.

Chapter 2

Planning Process

IN THIS SECTION:

- Description of the Planning Process
- The Planning Team
- Planning Committee Meetings
- Public Involvement

Chapter 2 – Planning Process

Documenting the Planning Process

Documentation of the planning process, including public involvement, is required to meet FEMA's DMA 2000 (44CFR§201.4(c)(1) and §201.6(c)(1)). This section includes a description of the planning process used to develop this plan, including how it was prepared, who was involved in the process, and how all of the involved agencies participated.

Description of the Planning Process

The Lincoln County Multi - Hazard Mitigation Plan was developed through a collaborative process involving all of the organizations and agencies detailed in Chapter 1 of this document. The planning effort began by organizing and convening a countywide planning committee.

The planning process included five distinct phases which were in some cases sequential (step 1 then step 2) and in some cases intermixed (step 4 completed throughout the process):

1. **Collection of Data** about the extent and periodicity of hazards in Lincoln County to ensure a robust dataset for making inferences about hazards.

2. **Field Observations and Estimations** about risks, juxtaposition of structures and infrastructure to risk areas, access, and potential mitigation projects.

3. **Mapping** of data relevant to pre-disaster mitigation control and mitigation, structures, resource values, infrastructure, risk assessments, and related data.

4. **Facilitation of Public Involvement** from the formation of the planning committee to news releases, public meetings, public review of draft documents, and acknowledgement of the final plan by the signatory representatives.

5. **Analysis and Drafting of the Report** to integrate the results of the planning process, providing ample review and integration of committee and public input, followed by signing of the final document.

The Planning Team

The Lincoln County Emergency Manager, Sheriff Wade Magers, lead the planning committee efforts. Northwest Management, Inc. Project Co-Managers were Tera R. King and Vaiden Bloch.

These individuals led a team of resource professionals that included county and city elected officials and staff, fire protection districts, law enforcement, hospital and school district representatives, public health districts, and local interest groups.

The planning committees met with many residents of the County during the community risk assessments and at public meetings. Additionally, the press releases encouraged interested citizens to contact their county emergency manager or attend planning committee meetings to ensure that all issues, potential solutions, and ongoing efforts were thoroughly discussed and considered by the committee. When the public meetings were held, many of the committee members were in attendance and shared their support and experiences with the planning process and their interpretations of the results.

The planning philosophy employed in this project included the open and free sharing of information with interested parties. Information from federal and state agencies was integrated into the database of knowledge used in this project. Meetings with the committee were held throughout the planning process to facilitate a sharing of information between cooperators.

Multi Jurisdictional Participation

CFR requirement §201.6(a)(3) calls for multi-jurisdictional planning in the development of Hazard Mitigation Plans that impact multiple jurisdictions. To be included as an adopting jurisdiction in the Lincoln County Multi-Hazard Mitigation Plan, jurisdictions were required to participate in at least one planning committee meeting, provide a goals statement, and submit at least one mitigation strategy.

The following is a list of jurisdictions that have met the requirements for an adopting jurisdiction and are thereby included in the Multi - Hazard Mitigation Plan:

Lincoln County

- City of Davenport
- City of Sprague
- Town of Harrington
- Town of Almira
- Town of Reardan
- Town of Odessa
- Town of Creston
- Town of Wilbur
- Lincoln Hospital District
- Odessa Memorial Healthcare Center

These jurisdictions were represented on the planning committee and at public meetings and participated in the development of hazard profiles, risk assessments, and mitigation measures.

The monthly planning committee meetings were the primary venue for authenticating the planning record. However, additional input was gathered from each jurisdiction in a combination of the following ways:

- Planning committee leadership visits to local government meetings where planning updates were provided and information was exchanged. Scott Hutsell, Board of Commissioners, represented Lincoln County on the planning committee and reported progress and findings to the Board during their regular meetings. Sheriff Magers also reported to the Board regarding the progress of the Plan. Additionally, representatives on the planning committee periodically attended city council

meetings to provide municipality leadership with updates on the project and request reviews of draft material. All of the adopting jurisdictions maintained active participation in the monthly planning committee meetings.

- One-on-one correspondence and discussions between the planning committee leadership and the representatives of the municipalities and special districts was facilitated as needed to ensure understanding of the process, collect data and other information, and develop specific mitigation strategies. NMI representatives emailed and/or called each jurisdiction individually at least once during the planning process to answer questions and request additional information. Additionally, NMI participated in conference calls with the city of Sprague, the town of Harrington, and the Odessa Memorial Healthcare Center in order to explain the process and gather data for risk assessments and mitigation strategies.

- Public meetings were hosted by the towns of Reardan, Wilbur, Odessa, and Davenport.. Each meeting was attended by involved elected officials, county and municipality representatives, local volunteers, and local citizenry.

- Written correspondence was provided at least monthly between the planning committee leadership and each participating jurisdictions updating the cooperators on the document's progress, making requests for information, and facilitating feedback. NMI representatives used an email distribution list of all the stakeholders to announce meetings, distribute meeting minutes, provide draft sections for review, and request information. All of the participating jurisdictions provided comments to the draft document during the data gathering phase as well as during the various committee and public review processes.

- At the request of planning committee leadership, several participating jurisdictions hosted copies of the draft Lincoln County Multi-Hazard Mitigation Plan and provided staff to be on hand to answer any questions during the public review phase of the planning process.

Like other rural areas of Washington and the USA, the planning area organizations' human resources have many demands put on them in terms of time and availability. Several of the elected officials (County Commissioners and City Mayors) do not serve in a full-time capacity. Many of them have other employment and serve the community through a convention of public service. Recognizing this, many of the jurisdictions decided to identify a representative to serve as a conduit between the planning committee and the jurisdiction.

Planning Committee Meetings

The following list of people participated in at least one of the planning committee meetings and volunteered time or responded to elements of the Multi - Hazard Mitigation Plan's preparation. A few participants served on the committee as dual representatives of more than one jurisdiction.

Lincoln County Participants:

*Indicates Adopting Jurisdiction

- *City of Davenport……Steve Goemmel
- *City of Sprague ……Arletta Hoffman
- *Lincoln County (Board of Commissioners) ……Scott Hutsell
- *Lincoln County (Emergency Management & Sheriff's Office) ……Wade Magers
- *Lincoln County (Fire District #4) ……Carol Paul
- *Lincoln County (Fire District #5) ……Mike Piper
- *Lincoln County (Public Health District) ……Ed Dzedzy
- *Lincoln County (Public Works) ……Phil Nollmeyer
- *Lincoln County (Public Works) ……Rick Becker
- *Lincoln County (Sheriff's Office) ……Brian Telford
- *Lincoln Hospital District and *City of Davenport (Ambulance) ……Eric Cassidy
- *Lincoln Hospital District……Sandy Buchanon
- *Odessa Memorial Healthcare Center …… Carol Schott
- *Town of Creston (Schools) …… Bill Wadlington
- *Town of Creston……Karen Paulsen
- *Town of Harrington (Mayor) …… Paul M. Gillilaud
- *Town of Odessa (EMS) ……Brian Finkbeine
- *Town of Odessa (Fire Department) ……Don Strebeck
- *Town of Odessa (Mayor) ……Doug Plinski
- *Town of Reardan (Mayor) ……Sherman Johnson
- *Town of Wilbur (Fire Chief) and Lincoln County (Fire District #7) ……Craig Haden
- *Town of Wilbur ……Lynn McWhorter
- *Town of Wilbur and Lincoln County (Fire District #7) ……Rob Coffman
- Amateur Radio Group ……James Wilson
- Avista Utilities …… Dave Ayres
- National Park Service……Marty Huseman
- Northwest Management, Inc……Tera King
- Northwest Management, Inc……Vaiden Bloch

Committee Meeting Minutes

Planning committee meetings were held from June 2010 through September 2010. The minutes of each planning committee meeting are included in the Appendices.

Public Involvement

Public involvement in this plan was made a priority from the inception of the project. There were a number of ways that public involvement was sought and facilitated. In some cases, this led to members of the public providing information and seeking an active role in protecting their own homes and businesses, while in other cases it led to the public becoming more aware of the process without becoming directly involved in the planning.

News Releases

Under the auspices of the Lincoln County planning committee, news releases were submitted to the *Davenport Times, Wilbur Register, Odessa Record, Star, Huckleberry Press,* and the *Lincoln Advertiser*. Informative flyers were also distributed around towns and to local offices within communities.

Figure 2.1. Press Release #1.

Multi-Hazard Mitigation Planning Underway!

Davenport, WA – The planning process has been launched to complete a multi-jurisdictional Multi - Hazard Mitigation Plan for Lincoln County, Washington as part of the FEMA Pre-Disaster Mitigation program. This project is being funded through a FEMA Pre-Disaster Mitigation grant. The Lincoln County Multi - Hazard Mitigation Plan will include risk analyses, vulnerability assessments, and a summary of mitigation recommendations for disasters such as floods, landslides, wildfire, earthquakes, severe storms, and drought.

Northwest Management, Inc. has been retained by Lincoln County to provide risk assessments, mapping, field inspections, interviews, and to collaborate with the planning committee to author the Plan. The coordinating team includes all area fire districts, land managers, elected officials, county departments, law enforcement, local agencies, city officials, and others. Northwest Management specialists will conduct analyses and work with the committees to formulate recommendations for treatments and other action items that will help lessen potential impacts and losses from various natural hazards.

One of the goals of the planning process will be to increase the participating jurisdictions' eligibility for additional grants that will help reduce the risk and potential impacts of disaster events. The planning team will be conducting public meetings to discuss preliminary findings and to seek public input on the Plan's recommendations later this summer. For more information on the Lincoln County Multi - Hazard Mitigation Plan project, contact Sheriff Wade Magers at 509-725-9264 or Tera King, Northwest Management, at 208-883-4488 ext 133.

Public Meetings

Public meetings were scheduled in a variety of communities during the hazard assessment phase of the planning process. Public meetings focused on sharing information regarding the planning process, presenting details of the hazard assessments, and discussing potential mitigation treatments. Attendees at the public meetings were asked to give their impressions of the accuracy of the information generated and provide their opinions of potential treatments.

Public meetings were held in Reardan, Wilbur, Davenport, and Odessa. These meetings were attended by a number of individuals on the committee and from the general public. The public meeting announcement was sent to the local newspapers and distributed by committee members. A sample of the flyer is included below in Figure 2.2.

Figure 2.1. Public Meeting Flyer.

Lincoln County

Multi - Hazard Mitigation Plan

Public Meetings!

September 27 - Community Hall (120 N Lake) in Reardan at 6:30pm
September 28 - Senior Center (101 NE Main St) in Wilbur at 6:30pm
September 29 - Memorial Hall (511 Park St) in Davenport at 7pm
September 30 - Old Town Hall (104 W 1st Ave) in Odessa at 6:30pm

These public meetings will address the **Multi - Hazard Mitigation Plan** being developed for Lincoln County, Washington. These meetings are open to the public and will include a slideshow presentation from Northwest Management, Inc and the planning team on the identified hazards and potential mitigation projects. Public input is being sought in order to better frame the region's efforts for hazard reduction projects, resource enhancements, and emergency preparedness.

Each meeting will last approximately 1 hour.

Learn about the assessments for flood, landslides, severe weather, wildland fire, earthquake, avalanche, inland tsunami, volcano, and drought in Lincoln County. Discuss YOUR priorities for how local communities can best reduce the impacts of these events.

Winter 2009 - Lincoln County, Washington

Funnel Cloud in North Lincoln County - June 2009

For more information on the Lincoln County Multi-Hazard Mitigation Plan, please contact Lincoln County Sheriff, Wade Magers, at 509-725-9254.

The slideshow presentation used during the public meetings is included in the Appendices.

Documented Review Process

Review and comment on this Plan has been provided through a number of avenues for the committee members as well as for members of the general public.

During regularly scheduled committee meetings in 2010, the committees met to discuss findings, review mapping and analysis, and provide written comments on draft sections of the document. During the public meetings attendees observed map analyses, photographic collections, discussed general findings from the community assessments, and made recommendations on potential project areas.

The first draft of the document was presented to the committee during the September 2010 planning committee meeting for full committee review. The completed draft document was released for public review on January 3rd, 2011. The public review period remained open until January 24th, 2011.

Continued Public Involvement

Lincoln County is dedicated to involving the public directly in review and updates of this Multi - Hazard Mitigation Plan. The County Emergency Manager, through the planning committee, is responsible for the annual review and update of the Plan as recommended in the Chapter 6, "Mitigation Strategy" section of this document.

The public will have the opportunity to provide feedback about the Plan annually on the anniversary of the adoption at a meeting of the County Board of Commissioners. Copies of the Plan will be kept at the County Courthouse. The Plan also includes contact information for the Emergency Manager, who is responsible for keeping track of public comments.

A public meeting will also be held as part of each annual evaluation or when deemed necessary by the planning committee. The meetings will provide the public a forum for which they can express concerns, opinions, or ideas about the Plan. The County Commissioner's Office will be responsible for using County resources to publicize the annual meetings and maintain public involvement through the County's webpage and local newspapers.

Chapter 3

Community Profile

IN THIS SECTION:

- Description of the Region
- Geography and Vegetation
- Demographics
- Socioeconomics
- Development Trends
- Hazard Management Capabilities
- Regional Hazard Profile

Chapter 3 – Community Profile

Lincoln County Characteristics

The information in this chapter has been excerpted from the Lincoln County Community Wildfire Protection Plans.[5]

Description of the Region

Prior to the 1800's, Lincoln County was inhabited by several groups of Native Americans. The rolling plains were considered wasteland by early military authorities. The first permanent settlers arrived in the mid-1800's and settled in the bottomlands close to the water sources. More people settled in Lincoln County with the construction of the Northern Pacific rail lines. The new arrivals discovered that the best agricultural land was on the deep soils of the rolling hills. Lincoln County was officially established in 1883 (Lincoln County Comprehensive Plan 1983). Currently, Lincoln County covers 2,311 square miles with 4.4 persons per square mile.

Geography and Natural Resources

Lincoln County is located on the Columbia Plateau, which was created by lava flows hundreds of feet thick, modified by glacial action and scoured by repeated floods during the Miocene and Pliocene eras. This fairly level, rough topography is called the Channeled Scablands and includes features such as plateaus, buttes, and channels. Channels are made up of outwash terraces, bars, loess islands and basins. The plateaus contain circular mounds of loess (biscuits) surrounded by cobble-size fragments of basalt. Soils generally consist of silt loams with varying amounts of rock or gravel, and basaltic rock outcroppings. Generally, the soils along on the northern-most end of the county are derived from the local parent material, which includes granite and basalt, covered by and mixed with imported material, which includes glacial, fluvial, and wind-deposited material. The topsoil layers are most often very thin and vulnerable (WDFW 2006).

The average daily temperature varies from a low of -13 degrees Fahrenheit to a high of 100 degrees Fahrenheit, averaging 46 degrees. There are 120 to 160 frost-free days in the growing season with annual precipitation averaging between 12 and 16 inches.[6]

Lincoln County is a diverse ecosystem with a complex array of vegetation, wildlife, and fisheries that have developed with, and adapted to fire as a natural disturbance process. Nearly a century of wildland fire suppression coupled with past land-use practices (primarily timber harvesting and agriculture) has altered plant community succession and has resulted in dramatic shifts in the fire regimes and species composition.

---

[5] King, Tera and V. Bloch. 2009. Lincoln County Washington Community Wildfire Protection Plan. Northwest Management, Inc. Moscow, Idaho.

[6] Washington Department of Fish and Wildlife. 2006. Swanson Lakes Wildlife Area Management Plan. Wildlife Management Program, Washington Department of Fish and Wildlife, Olympia. 40 pp.

As a result, some forests and rangelands in Lincoln County have become more susceptible to large-scale, higher-intensity fires posing a threat to life, property, and natural resources including wildlife and plant populations. High-intensity, stand-replacing fires have the potential to seriously damage soils and native vegetation. In addition, an increase in the number of large, high-intensity fires throughout the nation's forest and rangelands has resulted in significant safety risks to firefighters and higher costs for fire suppression.

Vegetation

Much of the terrain in Lincoln County is dominated by shrub-steppe communities, with some grassland interspersed with rock outcrops. The dominant grass and shrub-steppe communities are primarily composed of Bluebunch wheatgrass, Idaho fescue, Wyoming big sage, and rigid sage. Common shrub species are snowberry, rose, serviceberry, and Wax current. Although riparian areas are few, they offer important vertical structure in the vast extent of open grassland. These stands of trees and/or shrubs provide hiding, escape and thermal cover, shade, foraging and nesting sites, perches, and water sources. Overstory trees in riparian zones include quaking aspen, black cottonwood, and water birch, while the understory vegetation is composed of hydrophytic shrub species such as mock orange, alder, Rocky Mountain maple, black hawthorn, and willow.[7]

Located in a semi-arid transition zone, plant communities along the Lake Roosevelt National Recreation Area gradually change from steppe and shrub-steppe communities to ponderosa pine forest. As this is a transition zone between grassland and forest environment, large block definitions can be difficult due to affects of varying aspect and soil types. The three predominant plant communities include bunchgrass grasslands (steppe); shrub-steppe; and transition ponderosa pine forest. Other communities of note include wetland/riparian, lithosolic (rocky soil), rocky outcrops, and mixed-conifer forests.[8]

Table 3.1. Vegetative Cover Types in Lincoln County.

Cover	Acres	Percent
Herbaceous/Nonvascular-dominated	916,299	61%
No Dominant Lifeform	41,479	3%
Non-vegetated	17,945	1%
Shrub-dominated	455,676	30%
Tree-dominated	65,084	4%
Total	**1,496,482**	**100%**

Hydrology

The Washington Department of Ecology & Water Resources Program is charged with the development of the Washington State Water Plan. Included in the State Water Plan are the statewide water policy plan and component basin and water body plans, which cover specific geographic areas of the state. The Washington

[7] Washington Department of Fish and Wildlife. 2006. Swanson Lakes Wildlife Area Management Plan. Wildlife Management Program, Washington Department of Fish and Wildlife, Olympia. 40 pp.

[8] Hebner, Scott. 2000. Fire Management Plan Environmental Assessment. Lake Roosevelt National Recreation Area. October 2000. 63 pp.

Department of Ecology has prepared general lithologies of the major ground water flow systems in Washington.

The state may assign or designate beneficial uses for particular Washington water bodies to support. These beneficial uses are identified in section WAC 173-201A-200 of the Washington Surface Water Quality Standards (WQS). These uses include:

- Aquatic Life Uses: char; salmonid and trout spawning, rearing, and migration; nonanadromous interior redband trout, and indigenous warm water species
- Recreational Uses: primary (swimming) and secondary (boating) contact recreation
- Water Supply Uses: domestic, agricultural, and industrial; and stock watering

While there may be competing beneficial uses in streams, federal law requires protection of the most sensitive of these beneficial uses.

A correlation to mass wasting due to the removal of vegetation caused by high intensity wildland fire has been documented. Burned vegetation can result in changes in soil moisture and loss of rooting strength that can result in slope instability, especially on slopes greater than 30%. The greatest watershed impacts from increased sediment will be in the lower gradient, depositional stream reaches.

Of critical importance to Lincoln County will be the maintenance of the domestic watershed supplies in the Lower Spokane Watershed (WRIA 54), Lower Lake Roosevelt Watershed (WRIA 53), and Upper Crab-Wilson Watershed (WRIA 43).

Air Quality

The primary means by which the protection and enhancement of air quality is accomplished is through implementation of National Ambient Air Quality Standards (NAAQS). These standards address six pollutants known to harm human health including ozone, carbon monoxide, particulate matter, sulfur dioxide, lead, and nitrogen oxides.[9]

The Clean Air Act, passed in 1963 and amended in 1977, is the primary legal authority governing air resource management. The Clean Air Act provides the principal framework for national, state, and local efforts to protect air quality. Under the Clean Air Act, OAQPS (Office for Air Quality Planning and Standards) is responsible for setting standards, also known as national ambient air quality standards (NAAQS), for pollutants which are considered harmful to people and the environment. OAQPS is also responsible for ensuring these air quality standards are met, or attained (in cooperation with state, Tribal, and local

[9] USDA-Forest Service (United States Department of Agriculture, Forest Service). 2000. Incorporating Air Quality Effects of Wildland Fire Management into Forest Plan Revisions – A Desk Guide – Draft. April 2000.

governments) through national standards and strategies to control pollutant emissions from automobiles, factories, and other sources.[10]

Smoke emissions from fires potentially affect an area and the airsheds that surround it. Climatic conditions affecting air quality in northeast Washington are governed by a combination of factors. Large-scale influences include latitude, altitude, prevailing hemispheric wind patterns, and mountain barriers. At a smaller scale, topography and vegetation cover also affect air movement patterns. Air quality in the area is generally moderate to good. However, locally adverse conditions can result from occasional wildland fires in the summer and fall, and prescribed fire and agricultural burning in the spring and fall. All major river drainages are subject to temperature inversions which trap smoke and affect dispersion, causing local air quality problems. This occurs most often during the summer and fall months and would potentially affect all communities in Lincoln County. Winter time inversions are less frequent, but are more apt to trap smoke from heating, winter silvicultural burning, and pollution from other sources.

Demographics

Lincoln County grew in population to a peak of over 17,000 around 1910. During this time, there were more than 2,000 farms in the county and almost twice as many people lived in the rural areas as in the towns. Presently, farms are much larger in average acreage, but fewer in number. [11]

The U.S. Census Bureau estimates that Lincoln County has only experienced a 0.7% increase in population since 2000 compared to a 9.7% increase statewide. The Census Bureau also reported that there were 297 private nonfarm establishments (2006) and 4,151 households (2000). The median income for a household in Lincoln County in 2007 was $41,954, which is less than the statewide median of $55,628.

[10] Louks, B. 2001. Air Quality PM 10 Air Quality Monitoring Point Source Emissions; Point site locations of DEQ/EPA air monitoring locations with monitoring type and pollutant. Oregon Department of Environmental Quality. Feb. 2001. As GIS Data set. Boise, Id.

[11] Lincoln County. 1983. Lincoln County Comprehensive Plan. Lincoln County Planning Commission. Davenport, Washington. 34 pp.

Table 3.2. Lincoln County Historical Population Data.[12]	
Census	**Population**
1890	9,312
1900	11,969
1910	17,539
1920	15,141
1930	11,876
1940	11,361
1950	10,970
1960	10,919
1970	9,572
1980	9,604
1990	8,864
2000	10,184

Socioeconomics

This region has a total of 5,298 housing units and a population density of 4.4 persons per square mile as reported in the 2000 Census. Ethnicity is distributed as: white 95.6%, black or African American 0.2%, American Indian or Alaskan Native 1.6%, Asian 0.2%, and Hispanic or Latino 1.9.

Table 3.3. Income Categories (1999 data).		
	Number of Households	**Percent**
Households	**4,180**	**100.0**
Less than $10,000	395	9.4
$10,000 to $14,999	315	7.5
$15,000 to $24,999	673	16.1
$25,000 to $34,999	686	16.4
$35,000 to $49,999	804	19.2
$50,000 to $74,999	783	18.7
$75,000 to $99,999	291	7.0
$100,000 to $149,999	163	3.9
$150,000 to $199,999	41	1.0
$200,000 or more	29	0.7
Median household income (dollars)	35,255	(X)

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations*, directs federal agencies to identify and address any disproportionately high adverse human health or environmental effects of its projects on minority or low-income populations. In Lincoln County, approximately 8.4% of families with children under 18 years of age ate at or below the poverty level..

[12] Lincoln County. 1983. Lincoln County Comprehensive Plan. Lincoln County Planning Commission. Davenport, Washington. 34 pp.

With unemployment rates at 3.4% in Lincoln County, the regional unemployment rate was close to or below the national unemployment rate of 4.4% (1999 unemployment rates). The natural resource field comprises approximately 17.6% of the employed population in Lincoln County. As a result, much of the indirect employment within this region relies on the employment created through these resource-based occupations.

Table 3.4. Employment and Industry Statistics.

	Number of Employed Workers	Percent
OCCUPATION		
Management, professional, and related occupations	1,537	37.0
Service occupations	659	15.9
Sales and office occupations	945	22.8
Farming, fishing, and forestry occupations	180	4.3
Construction, extraction, and maintenance occupations	464	11.2
Production, transportation, and material moving occupations	367	8.8
INDUSTRY		
Agriculture, forestry, fishing and hunting, and mining	731	17.6
Construction	284	6.8
Manufacturing	129	3.1
Wholesale trade	193	4.6
Retail trade	418	10.1
Transportation and warehousing, and utilities	236	5.7
Information	54	1.3
Finance, insurance, real estate, and rental and leasing	176	4.2
Professional, scientific, management, administrative, and waste management services	197	4.7
Educational, health and social services	1,011	24.3
Arts, entertainment, recreation, accommodation and food services	203	4.9
Other services (except public administration)	199	4.8

Employment within this region leans heavily towards private wage and salary workers which together, comprise more than 60% of the workforce. Government workers represent a significantly smaller proportion of the work force at approximately 25%.[13]

Development Trends

The vast majority of Lincoln County is privately owned. Most of the land is used for ranching and farming purposes; although, more and more residents are moving into the rural areas along the Lake Roosevelt shoreline. Numerous subdivisions and housing clusters are developing along the northern border of the county.

[13] U.S. Census Bureau. 2000. American FactFinder Quick Tables for Lincoln County, Washington. Available online at http://factfinder.census.gov/home/saff/main.html?_lang=en.

Table 3.5. Ownership Categories in Lincoln County.		
Land Owner	**Acres**	**Percent**
Bureau of Land Management	80,875	5%
Bureau of Reclamation	6,093	0%
Lincoln County	758	0%
Washington Department of Natural Resources	44,176	3%
Private	1,346,138	90%
School District	95	0%
The Nature Conservancy	346	0%
Washington Department of Fish and Wildlife	17,638	1%
Washington Department of Transportation	364	0%
Total	**1,496,482**	**100%**

Hazard Management Capabilities

The Lincoln County Department of Emergency Management is responsible for the administration and overall coordination of the emergency management program for Lincoln County and the cities of within the county. The Incident Command System (ICS) is the basis for all direction, control and coordination of emergency response and recovery efforts. Emergency response and supporting agencies and organizations have agreed to carry out their objectives in support of the incident command structure to the fullest extent possible.

The Lincoln County Central Dispatch / 911 Center, with support of the Emergency Operations Center, is designated as the primary communications center for Lincoln County. It maintains 24-hour emergency alerting and communications capability for receiving, coordinating and disseminating emergency information. The Lincoln County Central Dispatch / 911 Center provides communications coverage over the entire Lincoln County area. It is the central receiving point for emergency notification and warning information and disseminates pertinent emergency information to support agencies.

Amateur Radio Services volunteers may provide additional local or statewide communications networks. This capability can also provide backup communication systems at the Lincoln County Emergency Operations Center if required.

All fire districts and agencies providing fire protection services in Lincoln County have reciprocal memorandums of understanding with each other.

Regional Hazard Profile

SHELDUS is a county-level hazard data set for the U.S. for 18 different natural hazard event types such thunderstorms, hurricanes, floods, wildfires, and tornados. For each event, the database includes the beginning date, location (county and state), property losses, crop losses, injuries, and fatalities that affected each county.

The data were derived from several existing national data sources such as National Climatic Data Center's monthly Storm Data publications and NGDC's Tsunami Event Database. With the release of SHELDUS 7.0,

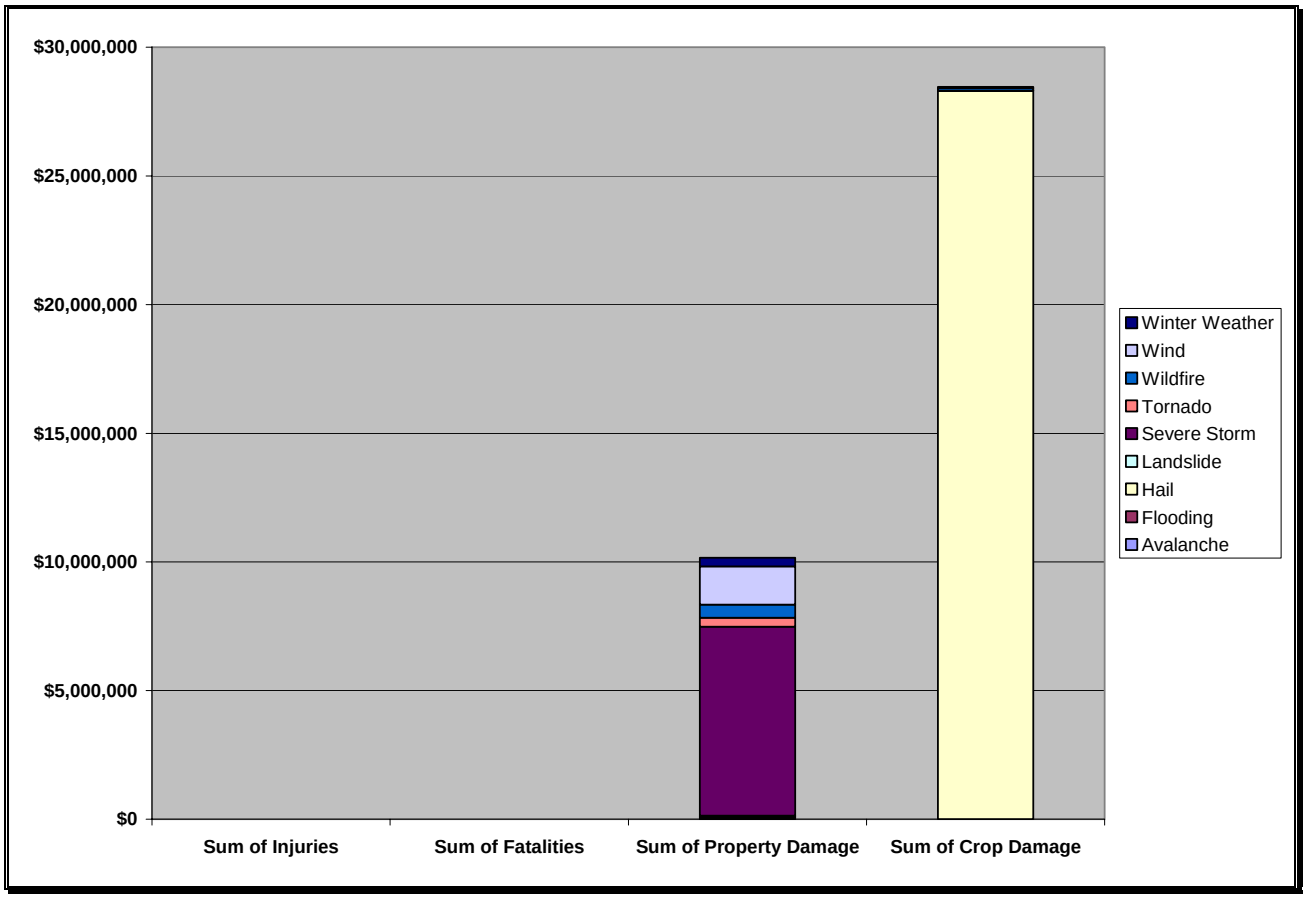
the database includes loss causing and/or deadly event between 1960 through 1975 and from 1995 onward. Between 1976 and 1995, SHELDUS reflects only events that caused at least one fatality or more than $50,000 in property or crop damages.

Prior to 2001, property and crop losses occurring on the same day within the same geography (i.e. county) are aggregated by hazard type. For events that covered multiple counties, the dollar losses, deaths, and injuries were equally divided among the counties (e.g. if 4 counties were affected, then each was given 1/4 of the dollar loss, injuries and deaths). Where dollar loss estimates were provided in ranges (e.g. $50,000 - 100,000) - such as in NCDC Storm data until 1995 - the lowest value in the range of the category was used. This results in the most conservative estimate of losses during the time period of 1960-1995. Since 1995 all events that were reported by the National Climatic Data Center (NCDC) with a specific dollar amount are included in the database.[14]

It is important to keep in mind that the SHELDUS database does not include every hazard event that occurred within an area. Only those events that met a specific reporting criterion as explained above are listed. This means that many local events are not included in this database. Some of the missing events are considered to be major local hazard events such as the 1995 flooding in Harrington or the 1997 flooding in Sprague and Harrington.

[14] HVRI. Natural Hazards Losses 1960-2008 (SHELDUS). Hazards &Vulnerability Research Institute. University of South Carolina. Columbia, South Carolina. Available online at http://webra.cas.sc.edu/hvrj/. February 2010.

Figure 3.1. Summary of SHELDUS Hazard Profile.



Chapter 4

Hazard Risk Assessment

IN THIS SECTION:

- Flood Annex
- Earthquake Annex
- Landslide Annex
- Severe Storm Annex
- Wildland Fire Annex
- Avalanche Annex
- Tsunami Annex
- Volcano Annex
- Drought Annex

Chapter 4 – Hazard Risk Assessment

Lincoln County Risk Assessments

Flood

Floods have been a serious and costly natural hazard affecting Washington. Floods damage roads, farmlands, and structures, often disrupting lives and businesses. Simply put, flooding occurs when water leaves the river channels, lakes, ponds, and other confinements where we expect it to stay. Flood-related disasters occur when human property and lives are impacted by flood waters. An understanding of the role of weather, runoff, landscape, and human development in the floodplain is therefore the key to understanding and controlling flood-related disasters. Major disasters declarations related to flooding were made for Washington in 1956, 1957, 1963, 1964, 1971, 1972, 1974, 1975, 1977, 1979, 1983, 1986 (x3), 1989, 1990 (x2), 1996, 1997 (x3), 1998, 2003, 2006 (x2), 2007, and 2009. Every county has received a Presidential Disaster Declaration since 1970. Since 1980, federal, state, and local governments have invested more than $522 million to repair public facilities, help individuals recover from flood disasters, and pay for measures to prevent future flood damage. This is nearly 40% of the more than 1.37 billion spent on disaster relief and hazard mitigation during this time.[15]

Riverine flooding includes those events that are classically thought of as flooding; i.e., a gradual rise of volume of a stream until that stream exceeds its normal channel and spills onto adjacent lands. Such events are generally associated with major meteorological events: spring runoff, winter rain/snowmelt events, and ice jams. Riverine floods typically have low velocities, affect large land areas, and persist for a prolonged period.

In contrast, **flash floods** may have a higher velocity in a smaller area and may recede relatively quickly. Such floods are caused by the introduction of a large amount of water into a limited area (e.g., extreme precipitation events in watersheds less than 50 square miles), crest quickly (e.g., eight hours or less), and generally occur in hilly or otherwise confined terrain. Steep mountainous terrain in Idaho is particularly susceptible to flash floods and debris flows which can occur within thirty (30) minutes of the onset of heavy rain. Flash floods occur in both urban and rural settings, principally along smaller rivers and drainage ways that do not typically carry large amounts of water.

Occasionally, floating ice or debris can accumulate at a natural or man-made obstruction and restrict the flow of water. **Ice and debris jams** can result in two types of flooding:

- Water held back by the ice jam or debris dam can cause flooding upstream, inundating a large area and often depositing ice or other debris which remains after the waters have receded. This inundation may occur well outside of the normal floodplain.

[15] Washington Military Department Emergency Management Division. Washington State Hazard Mitigation Plan. Available online at http://www.emd.wa.gov/plans/washington_state_hazard_mitigation_plan.shtml. January 2008.

- High velocity flooding can occur downstream when the jam breaks. These flood waters can have additional destructive potential due to the ice and debris load that they may carry.[16]

The most commonly reported flood magnitude measure is the "base flood." This is the magnitude of a flood having a one-percent chance of being equaled or exceeded in any given year. Although unlikely, "base floods" can occur in any year, even successive ones. This magnitude is also referred to as the "100-year Flood" or "Regulatory Flood" by State government. Floods are usually described in terms of their statistical frequency. A "100-year flood" or "100-year floodplain" describes an event or an area subject to a 1% probability of a certain size flood occurring in any given year. This concept does not mean such a flood will occur only once in one hundred years. Whether or not it occurs in a given year has no bearing on the fact that there is still a 1% chance of a similar occurrence in the following year. Since floodplains can be mapped, the boundary of the 100-year flood is commonly used in floodplain mitigation programs to identify areas where the risk of flooding is significant. Any other statistical frequency of a flood event may be chosen depending on the degree of risk that is selected for evaluation, e.g., 5-year, 20-year, 50-year, 500-year floodplain.

The areas adjacent to the channel that normally carry water are referred to as the floodplain. In practical terms, the floodplain is the area that is inundated by flood waters. In regulatory terms, the floodplain is the area that is under the control of floodplain regulations and programs (such as the National Flood Insurance Program which publishes the FIRM maps). The floodplain is often defined as:

"That land that has been or may be covered by floodwaters, or is surrounded by floodwater and inaccessible, during the occurrence of the regulatory flood."[17]

Winter weather conditions are the main driving force in determining where and when base floods will occur. The type of precipitation that a winter storm produces is dependent on the vertical temperature profile of the atmosphere over a given area. Lincoln County experiences riverine flooding from two distinct types of meteorological events; spring runoff and winter rain-on-snow events.

The major source of flood waters in Washington is normal spring snow melt. As spring melt is a "natural" condition, the stream channel is defined by the features established during the average spring high flow (bank-full width). Small flow peaks exceeding this level and the stream's occupation of the floodplain are common events.

Unusually heavy snow packs or unusual spring temperature regimes (e.g., prolonged warmth) may result in the generation of runoff volumes significantly greater than can be conveyed by the confines of the stream and river channels. Such floods are often the ones that lead to widespread damage and disasters. Floods caused by spring snow melt tend to last for a period of several days to several weeks, longer than the floods caused by other meteorological sources.

---

[16] Idaho Bureau of Homeland Security. 2007. State of Idaho Hazard Mitigation Plan. Hazard Mitigation Program. November 2007. Available online at http://www.bhs.idaho.gov/Resources/PDF/SHMPFinalw-signatures.pdf.

[17] FEMA. Federal Emergency Management Agency. National Flood Insurance Program. Washington D.C. Available online at www.fema.gov.

Floods that result from rainfall on frozen ground in the winter, or rainfall associated with a warm, regional frontal system that rapidly melts snow at low and intermediate altitudes (rain-on-snow) can be the most severe. Both of these situations quickly introduce large quantities of water into the stream channel system, easily overloading its capacity.

On small drainages, the most severe floods are usually a result of rainfall on frozen ground; however, moderate quantities of warm rainfall on a snow pack, especially for one or more days, can also result in rapid runoff and flooding in streams and small rivers. Although meteorological conditions favorable for short-duration warm rainfall are common, conditions for long-duration warm rainfall are relatively rare. Occasionally, however, the polar front becomes situated along a line from Hawaii through Oregon, and warm, moist, unstable air moves into the region.

In general, the meteorological factors leading to flooding are well understood. They are also out of human control, so flood mitigation must address the other contributing factors.

The nature and extent of a flood event is the result of the hydrologic response of the landscape. Factors that affect this hydrologic response include soil texture and permeability, land cover and vegetation, land use and land management practices. Precipitation and snow melt, known collectively as runoff, follow one of three paths, or a combination of these paths, from the point of origin to a stream or depression: overland flow, shallow subsurface flow, or deep subsurface ("ground water") flow. Each of these paths delivers water in differing quantities and rates. The character of the landscape will influence the relative allocation of the runoff and will, accordingly, affect the hydrologic response.

Unlike precipitation and ice formation, steps can be taken to mitigate flooding through manipulation or maintenance of the floodplain. Insufficient natural water storage capacity and changes to the landscape can be offset through water storage and conveyance systems that run the gamut from highly engineered structures to constructed wetlands.

Careful planning of land use can build on the natural strengths of the hydrologic response. Re-vegetation of burned slopes diverts overland flow (fast and flood producing) to subsurface flow (slower and flood moderating). Details on rehabilitating burned areas to reduce flash floods, debris flows and landslides can be found in the Landslide section of this chapter.

Floods generally come with warnings and flood waters rarely go where they are totally unexpected by experts. Those warnings are not always heeded, though, and despite the predictability, flood damage continues.

The failure to recognize or acknowledge the extent of the natural hydrologic forces in an area has led to development and occupation of areas that can clearly be expected to flood on a regular basis. Despite this, communities are often surprised when the stream leaves its channel to occupy its floodplain. A past reliance on structural means to control floodwaters and "reclaim" portions of the floodplain has also contributed to inappropriate development and continued flood-related damages.

Development in or near floodplains increases the likelihood of flood damage in two ways. First, new developments near a floodplain add structures and people in flood areas. Secondly, new construction alters

surface water flows by diverting water to new courses or increases the amount of water that runs off impervious pavement and roof surfaces. This second effect diverts waters to places previously safe from flooding. Unlike the weather and the landscape, this flood-contributing factor can be controlled. Development and occupation of the floodplain places individuals and property at risk. Such use can also increase the probability and severity of flood events (and consequent damage) downstream by reducing the water storage capacity of the floodplain, or by pushing the water further from the channel or in larger quantities downstream.

There are three types of flash flooding:

- Extreme precipitation and runoff events
- Inadequate urban drainage systems overwhelmed by small intense rainstorms
- Dam failures

Debris flows are hazards that are closely related to flash floods, triggered by heavy rainfall, and are more commonly considered as a type of earth movement (a geological hazard).

Extreme Precipitation and Runoff Events: Events that may lead to flash flooding include:

- Significant rainfall and/or snowmelt on frozen ground in the winter and early spring months.
- High intensity thunderstorms, usually during the summer months.
- Rainfall onto burn areas (such as those affected by wildfire) where high heat has caused the soil to become hydrophobic or water repellent which dramatically increases runoff and flash flood potential.

Flash floods from thunderstorms do not occur as frequently as those from general rain and snowmelt conditions but are far more severe. The onset of these flash floods varies from slow to very quick and is dependent on the intensity and duration of the precipitation and the soil types, vegetation, topography, and slope of the basin. When intensive rainfall occurs immediately above developed areas, the flooding may occur in a matter of minutes. Sandy soils and sparse vegetation, especially recently burned areas, are conducive to flash flooding. Mountainous areas are especially susceptible to damaging flash floods, as steep topography may stall thunderstorms in a limited area and may also funnel runoff into narrow canyons, intensifying flow. A flash flood can, however, occur on any terrain when extreme amounts of precipitation accumulate more rapidly than the terrain can allow runoff. [18] Flash floods are most common in Washington during the spring and summer months due to thunderstorm activity.

Flooding from ice jams is relatively common in Idaho. Ice jam formation depends on air temperature and physical conditions in the river channel. Ice cover on a river (a precursor to the ice jam) is formed when water reaches the freezing point and air temperature is sub-freezing; large quantities of ice are produced, flow downstream, and consolidate.

An ice jam is a stationary accumulation of ice that restricts flow. Ice jams can cause considerable increases in upstream water levels, while at the same time downstream water levels may drop, exposing water intakes for power plants or municipal water supplies. Types of ice jams include freezeup jams, made primarily of frazil ice; breakup jams, made primarily of fragmented ice pieces; and combinations of both.

---

[18] Idaho Bureau of Homeland Security. 2007. State of Idaho Hazard Mitigation Plan. Hazard Mitigation Program. November 2007. Available online at http://www.bhs.idaho.gov/Resources/PDF/SHMPFinalw-signatures.pdf.

River geometries, weather characteristics, and floodplain land-use practices contribute to the ice jam flooding threat at a particular location. Ice jams initiate at a location in the river where the ice transport capacity or ice conveyance of the river is exceeded by the ice transported to that location by the river's flow.

Change in Slope: The most common location for an ice jam to form is in an area where the river slope changes from relatively steep to mild. Since gravity is the driving force for an ice run, when the ice reaches the milder slope, it loses its momentum and can stall or arch across the river and initiate an ice jam. Water levels in reservoirs often affect the locations of ice jams upstream as a result of a change in water slope where reservoir water backs up into the river. Islands, sandbars, and gravel deposits often form at a change in water slope for the same reasons that ice tends to slow and stop. Because such deposits form in areas conducive to ice jamming, they are often mistakenly identified as the cause of ice jams. While these deposits may affect the river hydraulics enough to cause or exacerbate an ice jam, the presence of gravel deposits is usually an indication that the transport capacity of the river is reduced for both ice and sediment. Ice jams located near gravel deposits should be carefully studied to determine whether the gravel deposit is the cause of the jam or a symptom of the actual cause.

Confluences: Ice jams also commonly form where a tributary stream enters a larger river, lake, or reservoir. Smaller rivers normally respond to increased runoff more quickly than larger rivers, and their ice covers may break up sooner as a result of more rapid increases in water stage. Ice covers on smaller rivers will typically break up and run until the broken ice reaches the strong, intact ice cover on the larger river or lake, where the slope is generally milder. The ice run stalls at the confluence, forming a jam, and backing up water and ice on the tributary stream.

Channel Features: Natural and constructed features in a river channel may play a role in the locations of ice jams. River bends are frequently cited as ice jam instigators. While river bends may contribute to jamming by forcing the moving ice to change its direction and by causing the ice to hit the outer shoreline, water slope is often a factor in these jams as well. Obstructions to ice movement, such as closely spaced bridge or dam piers, can cause ice jams. In high runoff situations, a partially submerged bridge superstructure obstructs ice movement and may initiate a jam. In smaller rivers, trees along the bank sometimes fall across the river causing an ice jam. Removing or building a dam may cause problems. In many parts of the country, small dams that once functioned for hydropower have fallen into disrepair. Communities may remove them as part of a beautification scheme or to improve fish habitat. However, the effects of an existing dam on ice conditions should be considered before removing or substantially altering it. It is possible that the old dams control ice by delaying ice breakup or by providing storage for ice debris. Dam construction can also affect ice conditions in a river by creating a jam initiation point. On the other hand, the presence of a dam and its pool may be beneficial if frazil ice production and transport decrease as a result of ice cover growth on the pool.[19]

The magnitude of most floods in Lincoln County depend on the particular combinations of intensity and duration of rainfall, pre-existing soil conditions, area of a basin, elevation of the rain or snow level, and

[19] Idaho Bureau of Homeland Security. 2007. State of Idaho Hazard Mitigation Plan. Hazard Mitigation Program. November 2007. Available online at http://www.bhs.idaho.gov/Resources/PDF/SHMPFinalw-signatures.pdf.

amount of snow pack. Man-made changes to a basin also can affect the size of floods. Although floods can happen at any time during the year, there are typical seasonal patterns for flooding in eastern Washington, based on the variety of natural processes that cause floods:

- Heavy rainfall on wet or frozen ground, before a snow pack has accumulated, typically cause fall and early winter floods
- Rainfall combined with melting of the low elevation snow pack typically cause winter and early spring floods
- Late spring floods in Lincoln County result primarily from melting of the snow pack

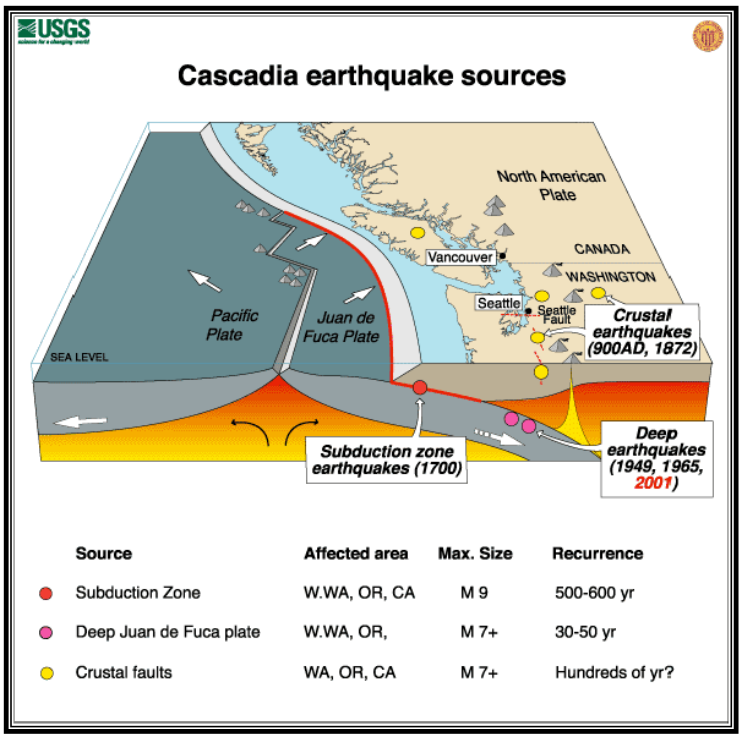
Several rivers in eastern Washington flood every two to five years, including the Spokane, Okanogan, Methow, Yakima, Walla Walla, and Klickitat, but damaging events occur less frequently. Flooding on rivers east of the Cascades usually results from periods of heavy rainfall on wet or frozen ground, mild temperatures, and from the spring runoff of mountain snow pack. Lincoln County is also prone to flash flooding. Thunderstorms, combined with steep ravines, alluvial fans, dry or frozen ground, and lightly vegetated ground that does not absorb water, can cause flooding.

Occasionally, communities experience surface water flooding due to high groundwater tables or inadequate urban storm drainage. This occurred during the 1996-97 winter storms. In many communities, residents outside the flood plain had several inches of water in basements due to groundwater seepage. These floods contaminated domestic water supplies, fouled septic systems, and inundated electrical and heating systems. Firefighting access was restricted, leaving homes vulnerable to fire. Lake levels were the highest in recent history, and virtually every county had areas of ponding not previously seen.

Earthquake

An earthquake is trembling of the ground resulting from the sudden shifting of rock beneath the earth's crust. Earthquakes may cause landslides and rupture dams. Severe earthquakes destroy power and telephone lines, gas, sewer, or water mains, which, in turn, may set off fires and/or hinder firefighting or rescue efforts. Earthquakes also may cause buildings and bridges to collapse.

Figure 4.1. Cascadia Earthquake Sources.



By far, earthquakes pose the largest single natural hazard exposure faced by Washington. They may affect large areas, cause great damage to structures, cause injury, loss of life and alter the socioeconomic functioning of the communities involved. The hazard of earthquakes varies from place to place, dependent upon the regional and local geology.

Earthquakes occur along faults, which are fractures or fracture zones in the earth across which there may be relative motion. If the rocks across a fault are forced to slide past one another, they do so in a *stick-slip* fashion; that is, they accumulate strain energy for centuries or millennia, then release it almost instantaneously. The energy released radiates outward from the source, or focus, as a series of waves - an earthquake. The primary hazards of earthquakes are ground breaking, as the rocks slide past one another, and ground shaking, by seismic waves. Secondary earthquake hazards result from distortion of the surface materials such as water, soil, or structures.

Ground shaking may affect areas 65 miles or more from the epicenter (the point on the ground surface above the focus). As such, it is the greatest primary earthquake hazard. Ground shaking may cause seiche, the rhythmic sloshing of water in lakes or bays. It may also trigger the failure of snow (avalanche) or earth materials (landslide). Ground shaking can change the mechanical properties of some fine grained, saturated soils, whereupon they *liquefy* and act as a fluid (liquefaction). The dramatic reduction in bearing strength of such soils can cause buried utilities to rupture and otherwise undamaged buildings to collapse.

The earth's crust breaks along uneven lines called faults. Geologists locate these faults and determine which are active and inactive. This helps identify where the greatest earthquake potential exists. Many faults mapped by geologists, are inactive and have little earthquake potential; others are active and have a higher earthquake potential.

Ground shaking from earthquakes can collapse buildings and bridges; disrupt gas, electric, and phone service; and sometimes trigger landslides, avalanches, flash floods, fires, and huge, destructive ocean waves (tsunamis). Buildings with foundations resting on unconsolidated landfill and other unstable soil, or trailers and homes not tied to their foundations are at risk because they can be shaken off their mountings during an earthquake. When an earthquake occurs in a populated area, it may cause deaths and injuries and extensive property damage.

Aftershocks are smaller earthquakes that follow the main shock and can cause further damage to weakened buildings. Aftershocks can occur in the first hours, days, weeks, or even months after the quake. Be aware that some earthquakes are actually foreshocks, and a larger earthquake might occur.

Ground movement during an earthquake is seldom the direct cause of death or injury. Most earthquake-related injuries result from collapsing walls, flying glass, and falling objects as a result of the ground shaking, or people trying to move more than a few feet during the shaking.[20]

Damaging Pacific Northwest earthquakes can arise from three distinct source zones:

- Deep earthquakes beneath the Puget Sound have damaged Seattle and Olympia
- Shallow faults can cause intense local shaking – urban areas are especially vulnerable
- An offshore subduction zone fault can cause strong shaking across the entire region.[21]

More than 1,000 earthquakes are recorded in Washington each year; a dozen or more of these produce significant shaking or damage. Large earthquakes in 1949 and 1965 killed 15 people and caused more than $200 million (1984 dollars) property damage.

Earth scientists believe that most earthquakes are caused by slow movements inside the Earth that push against the Earth's brittle, relatively thin outer layer, causing the rocks to break suddenly. This outer layer is fragmented into a number of pieces, called plates. Most earthquakes occur at the boundaries of these plates. In Washington, the small Juan de Fuca plate off the coast of Washington, Oregon, and northern California is slowly moving eastward beneath a much larger plate that includes both the North American continent and the land beneath part of the Atlantic Ocean. Plate motions in the Pacific Northwest result in shallow earthquakes widely distributed over Washington and deep earthquakes in the western parts of Washington and Oregon. The movement of the Juan de Fuca plate beneath the North America plate is in many respects similar to the movements of plates in South America, Mexico, Japan, and Alaska, where the world's largest earthquakes occur.

We cannot predict precisely where, when, and how large the next destructive earthquake will be in Washington, but seismological and geological evidence supports several possibilities. Large earthquakes reported historically in Washington have most frequently occurred deep beneath the Puget Sound region. The most recent and best documented of these were the 1949 Olympia earthquake and the 1965 Seattle-

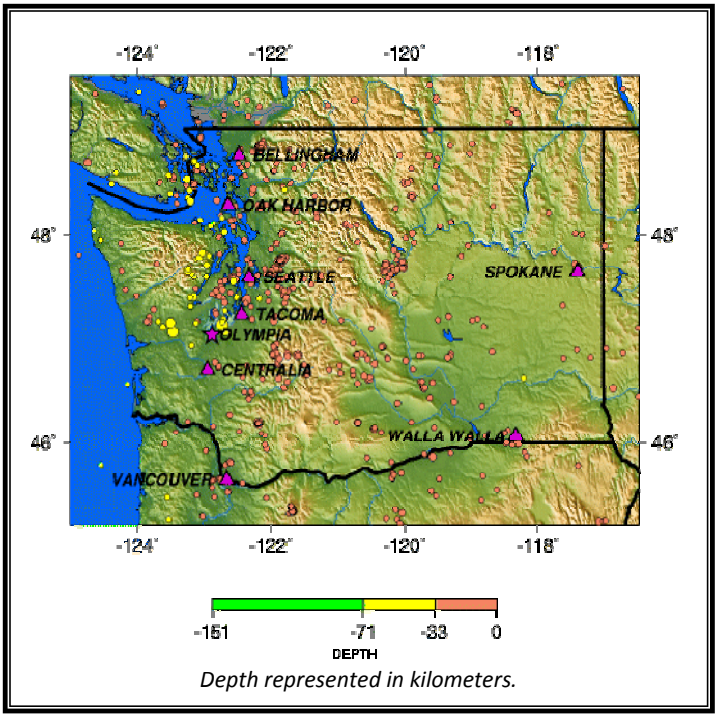
---

[20] FEMA. Federal Emergency Management Agency. Available online at www.fema.gov. September 2007.

[21] USGS. "Earthquake Hazards in Washington and Oregon Three Source Zones." U.S. Geological Survey. The Pacific Northwest Seismic Network. Available online at http://www.geophys.washington.edu/SEIS/PNSN/. August 2008.

Tacoma earthquake. The pattern of earthquake occurrence observed in Washington so far indicates that large earthquakes similar to the 1965 Seattle-Tacoma earthquake are likely to occur about every 35 years and large earthquakes similar to the 1949 Olympia earthquake about every 110 years.

Figure 4.2. Seismicity of Washington 1990-2006.



The northeastern Oregon Milton-Freewater earthquake of July 15, 1936, is the most destructive recorded earthquake of the eastern Washington-Oregon border region. Its intensity was greatest (VII) at Freewater, State Line, and Umapine in Oregon. Moderate damage occurred in Athena and Milton. Windows broke, walls cracked, a few chimneys collapsed, a two-story concrete house near Umapine lost part of the top of its second story, and some standing railroad cars near Milton were derailed. Two schools in Umapine were damaged and water issued from cracks as much as 60 meters long. Numerous aftershocks were reported until November 1936.

The largest earthquake reported in Washington did not occur in the Puget Sound region, but rather at a shallow depth under the North Cascade Mountains. Recent studies in the southern Cascades near Mount St. Helens indicate that other areas in the Cascades may produce large, shallow earthquakes, comparable in size to the 1949 and 1965 Puget Sound earthquakes. The average interval of time between occurrences of such earthquakes in the Cascade Mountains is uncertain because they have occurred infrequently.

Earthquakes are measured in two ways. One determines the power, the other describes the physical effects. Magnitude is calculated by seismologists from the relative size of seismograph tracings. This measurement has been named the Richter scale, a numerical gauge of earthquake energy ranging from 1.0 (very weak) to 9.0 (very strong). The Richter scale is most useful to scientists who compare the power in earthquakes. Magnitude is less useful to disaster planners and citizens, because power does not describe and classify the damage an earthquake can cause. The damage we see from earthquake shaking is due to several factors like distance from the epicenter and local rock types. Intensity defines a more useful measure of earthquake shaking for any one location. It is represented by the modified Mercalli scale. On the Mercalli scale, a value of I is the least intense motion and XII is the greatest ground shaking. Unlike magnitude, intensity can vary from place to place. In addition, intensity is not measured by machines. It is evaluated and categorized from people's reactions to events and the visible damage to man-made structures. Intensity is more useful to planners and communities because it can reasonably predict the effects of violent shaking for a local area.

Table 4.1. Largest Known Earthquakes Felt in Washington.[22]

Year	Max. Modified Mercalli Intensity	Felt Area (sq km)	Location
1872	IX(3)	1,010,000	North Cascades
1877	VII(9)	48,000	Portland
1880	VII(10)		Puget Sound
1891	VII(10)		Puget Sound
1893	VII(8)	21,000	Southeastern Washington
1896	VII(12)		Puget Sound
1904	VII(5)	50,000	Olympic Peninsula
1909	VII(5)	150,000	Puget Sound
1915	VI(5)	77,000	North Cascades
1918	VIII(5)	650,000	Vancouver Island
1920	VII(14)	70,000	Puget Sound
1932	VII(15)	41,000	Central Cascades
1936	VII(14)	270,000	Southeastern Washington
1939	VII(14)	200,000	Puget Sound
1945	VII(14)	128,000	Central Cascades
1946	VII(14)	270,000	Puget Sound
1946	VIII(4)	1,096,000	Vancouver Island
1949	VIII(22)	594,000	Puget Sound
1949	VIII	2,220,000	Queen Charlotte Island
1959	VI(12)	64,000	North Cascades
1959	X(26)	1,586,000	Hebgen Lake (Montana)
1962	VII(14)	51,000	Portland
1965	VIII(14)	500,000	Puget Sound
1980	IV		Mount St Helens
1981	VII(39)	104,000	South Cascades
1983	VII(42)	800,000	Borah Peak (Idaho)
1993	VII		Klamath Falls, Or
2001			Nisqually, Wa

The largest earthquake now considered a possibility in the Pacific Northwest is a shallow subduction-style earthquake similar to recent destructive earthquakes in Alaska and Mexico, which had magnitudes greater than 8. An earthquake this large would be expected to occur along the coast of Washington or Oregon. Although we have no record of such large earthquakes in the Pacific Northwest within the last 150 years, some scientists believe that rocks and sediments exposed along the coasts of Washington and Oregon show evidence that as many as eight such earthquakes have occurred in the last several thousand years. This evidence indicates an average interval of time between subduction earthquakes of several hundred years. A

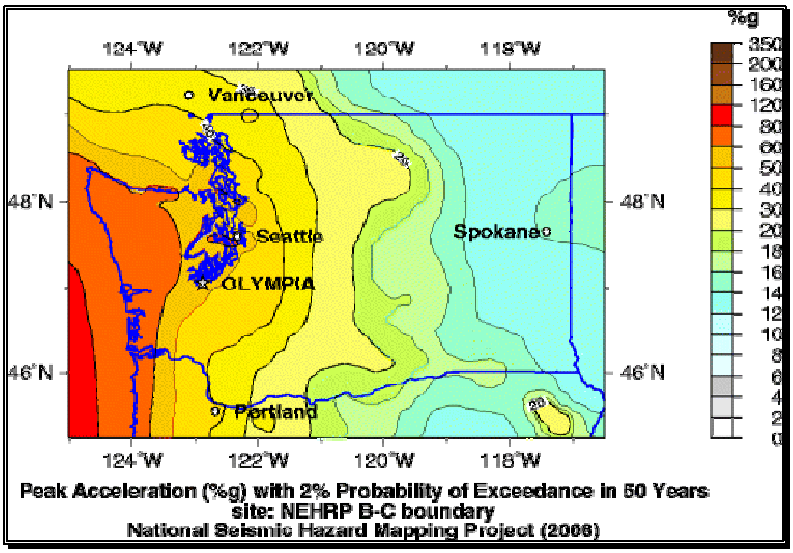
[22] Noson, Linda Lawrance, et al. Washington State Earthquake Hazards. Washington Division of Geology and Earth Resources Information Circular 85. Olympia, Washington. 1988.

magnitude 8 subduction earthquake would not only cause widespread dangerous ground shaking but would also likely produce water waves capable of inundating coastal areas in a matter of minutes.

Earthquake damage is primarily caused by ground shaking. However, wood frame houses, well attached to their foundations and built on firm ground, generally sustain little structural damage during earthquakes. In contrast, unreinforced brick buildings commonly suffer severe damage. Ground shaking may also displace and distort the non-structural parts of a building including windows, ceiling tiles, partitions and furniture-producing property damage and endangering life. Other hazards such as ground liquefaction are commonly triggered by strong ground shaking.

The U.S. Geological Survey has gathered data and produced maps of the nation, depicting earthquake shaking hazards. This information is essential for creating and updating seismic design provisions of building codes in the United States. The USGS Shaking Hazard maps for the United States are based on current information about the rate at which earthquakes occur in different areas and on how far strong shaking extends from quake sources. The values shown on the map are "peak ground acceleration (PGA) in percent of g with 2% probability of exceedance in 50 years". Therefore, the map represents longer-term likelihood of ground accelerations. The "2% probability of exceedance in 50 years" refers to the fact that earthquakes are somewhat random in occurrence. One can not predict exactly whether an earthquake of a given size will or will not occur in the next 50 years. The map takes the random nature of earthquakes into account. It was constructed so that there is a 2% chance (2 chances in 100) that the ground acceleration values shown on the map will be exceeded in a 50 year time period. This map is based on seismic activity and fault-slip rates and takes into account the frequency of occurrence of earthquakes of various magnitudes.[23] Locally, this hazard may be greater than that shown, because site geology may amplify ground motions.

Figure 4.3. Washington Peak Acceleration Map.



[23] Qamar, Anthony. "Earthquake Hazards in the Pacific Northwest." Cascadia Region Earthquake Workgroup. University of Washington Geophysics. January 2008.

The International Building Code (IBC), a nationwide industry standard, sets construction standards for different seismic zones in the nation. IBC seismic zone rankings for Washington are among the highest in the nation. When structures are built to these standards they have a better chance to withstand earthquakes.

Structures that are in compliance with the 1970 Uniform Building Codes (UBC), which are now replaced by the International Building Code, are generally less vulnerable to seismic damages because that was when the UBC started including seismic construction standards to be applied based on regional location. This stipulated that all structures be constructed to at least seismic risk Zone 2 Standards. The State of Washington adopted the UBC as its state building code in 1972, so it is assumed that buildings built after that date were built in conformance with UBC seismic standards and have a lesser degree of vulnerability. Obviously, issues such as code enforcement and code compliance are factors that could impact this assumption. However, for planning purposes, establishing this line of demarcation can be an effective tool for estimating vulnerability. In 1994, seismic risk Zone 3 Standards of the UBC went into effect in Washington, requiring all new construction to be capable of withstanding the effects of 0.3 times the force of gravity. More recent housing stock is in compliance with Zone 3 standards. In 2009, the state again upgraded the building code to follow International Building Code Standards.

The Washington State Legislature has also adopted the 2009 version of the International Residential Code as the official state building code starting on July 1, 2010. The 2009 IRC governs the new construction of detached one- and two-family dwellings and multiple single-family dwellings (townhouses) not more than three stories in height with separate means of egress. Provisions in the 2009 IRC for earthquake structural and foundation design are determined by the seismic design category of a proposed structure.[24]

Future injuries and property losses from earthquake hazards can be reduced by considering these hazards when making decisions about land use, by designing structures that can undergo ground shaking without collapse, by securely attaching the non-structural elements of a building, and by educating the public about what to do before, during, and after an earthquake to protect life and property.[25]

---

[24] Washington State Building Code. 2006. International Residential Code. State Building Code Council. Available online at http://sbcc.wa.gov/page.aspx?nid=3.

[25] Noson, Linda Lawrance, et al. Washington State Earthquake Hazards. Washington Division of Geology and Earth Resources Information Circular 85. Olympia, Washington. 1988.

Landslide

Landslide is a general term for a wide variety of down slope movements of earth materials that result in the perceptible downward and outward movement of soil, rock, and vegetation under the influence of gravity. The materials may move by falling, toppling, sliding, spreading, or flowing. Some landslides are rapid, occurring in seconds, whereas others may take hours, weeks, or even longer to develop. Although landslides usually occur on steep slopes, they also can occur in areas of low relief. Landslides can occur as ground failure of river bluffs, cut and-fill failures that may accompany highway and building excavations, collapse of mine-waste piles, and slope failures associated with quarries and open-pit mines. While gravity is the primary reason for landslides, there can be other contributing factors, including:

- Saturation, by snowmelt or heavy rains, that weaken rock or soils on slopes
- Erosion by rivers, glaciers, or ocean waves that create over-steepened slopes
- Topography of slope – its shape, size, degree of slope and drainage
- Stress from earthquakes magnitude 4.0 and greater can cause weak slopes to fail
- Volcanic eruptions that produce loose ash deposits and debris flows
- Excess weight, from accumulation of rain or snow, from stockpiling of rock or ore, from waste piles, or from manmade structures, may stress weak slopes to failure
- Human action, such as construction, logging or road building that disturbs soils and slopes

Determining probability of future landslide events in specific locations is difficult because so many factors can contribute to the cause of a landslide or ground failure. Landslides typically occur on slopes and in areas where they have taken place before. Areas historically subject to landslides in Washington include the Columbia River Gorge, the banks of Lake Roosevelt, the Interstate 5 corridor, U.S. 101 Highway corridor along the Pacific Coast and from the coast to Olympia, in the Cascades, Olympics, and Blue Mountains and along Puget Sound coastal bluffs.

Washington State has six landslide provinces, each with its own characteristics. Southeastern Washington is part of the Columbia Basin province. This province has extensive layers of sediments intermingling with basalt flows; sediments generally are thicker in the western part of the province. Landslides in this province include slope failures in bedrock and landslides in overlying sediments. Bedrock slope failures are most common in the form of very large ancient slumps or earth flows. A final triggering mechanism appears to have been over-steepening of a slope or removal of toe support by streams or glacial floods. Sediments contemporary with or overlying Columbia River basalt make up a major part of the large landslide complexes in the province. Major landslide problems occurred during the relocation of transportation routes required by the filling of the reservoir behind the John Day dam.[26] Irrigation in the Columbia Basin compounds the province's landslide problems. For example, irrigation near Pasco has increased drainage and landslide problems ten-fold since 1957.

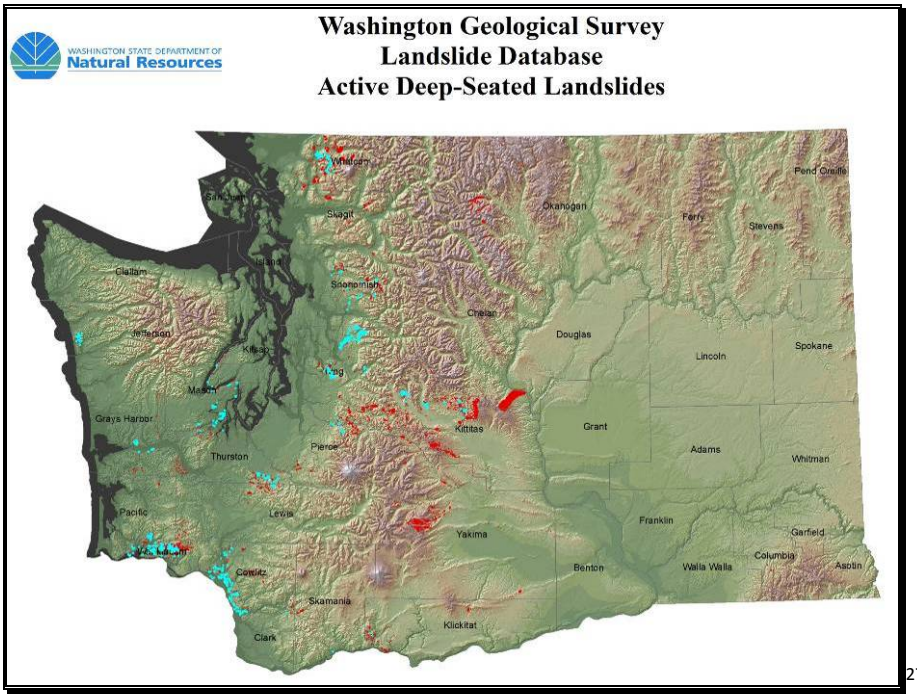
---

[26] WAEMD. 2008. Washington State Hazard Mitigation Plan. Washington Military Department Emergency Management Division. Available online at http://www.emd.wa.gov/plans/washington_state_hazard_mitigation_plan.shtml.

Landslides range from shallow debris flows to deep-seated slumps. They destroy homes, businesses, and public buildings, undermine bridges, derail railroad cars, interrupt transportation infrastructure, damage utilities, and take lives. Sinkholes affect roads and utilities. Losses often go unrecorded because insurance claims are not filed, no report is made to emergency management, there is no media coverage, or the transportation damages are recorded as regular maintenance.

Significant landslide events (those resulting in disasters) are rarer but several have been recorded in the State. Major events had a significant impact on transportation, communities, and natural resources in 1977, 1979, 1986, 1989, 1997, 1998, 2006 (x2), 2007 (x2), and 2009.

Figure 4.4. Washington Geological Survey Landslide Database.



[27]

Land stability cannot be absolutely predicted with current technology. The best design and construction measures are still vulnerable to slope failure. The amount of protection, usually correlated to cost, is proportional to the level of risk reduction. Debris and vegetation management is integral to prevent landslide damages. Corrective measures help, but can often leave the property vulnerable to risk.

These are characteristics that may be indicative of a landside hazard area:

- Bluff retreat caused by sloughing of bluff sediments, resulting in a vertical bluff face with little vegetation.
- Pre-existing landside area.
- Tension or ground cracks along or near the edge of the top of a bluff.

[27] Washington DNR. Washington Geological Survey, Landslide Database. "Washington Landslide Blog." Washington Department of Natural Resources. Available online at http://slidingthought.files.wordpress.com.

- Structural damage caused by settling and cracking of building foundations and separation of steps from the main structure.
- Toppling bowed or jack sawed trees.
- Gullying and surface erosion.
- Mid-slope ground water seepage from a bluff face.

By studying the effects of landslides in slide prone areas we can plan for the future. More needs to be done to educate the public and to prevent development in vulnerable areas. WAC 365-190-080 states that geologically hazardous areas pose a threat to the health and safety of citizens when incompatible development is sited in areas of significant hazard. Some hazards can be mitigated by engineering, design, or construction so that risks are acceptable. When technology cannot reduce the risk to acceptable levels, building in hazardous areas should be avoided.

The primary factors that increase landslide risk are slope and certain soil characteristics. In general, the potential for landslide occurrence intensifies as slope increases on all soil types and across a wide range of geological formations. Landslide may occur on slopes steepened by man during construction, or on natural ground never disturbed. However, most slides occur in areas that have had sliding in the past. All landslides are initiated by factors such as weaknesses in the rock and soil, earthquake activity, the occurrence of heavy snow or rainfall, or construction activity that changes a critical factor involved with maintaining stability of the soil or geology of the area. A prime example of this includes previously stable slopes where home construction utilizing independent septic systems are added. The increased moisture in the ground, when coupled with an impermeable layer below the septic systems has led to surface soil movements and mass wasting.

Landslides can be triggered by natural changes in the environment or by human activities. Inherent weaknesses in the rock or soil often combine with one or more triggering events, such as heavy rain, snowmelt, or changes in ground water level. Late spring-early summer is slide season, particularly after days and weeks of greater than normal precipitation. Long-term climate change may result in an increase in precipitation and ground saturation and a rise in ground-water level, reducing the shear strength and increasing the weight of the soil.

Stream and riverbank erosion, road building or other excavation can remove the toe or lateral slope and exacerbate landslides. Seismic or volcanic activity often triggers landslides as well. Urban and rural living with excavations, roads, drainage ways, landscape watering, logging, and agricultural irrigation may also disturb the solidity of landforms, triggering landslides. In general, any land use changes that affects drainage patterns or that increase erosion or change ground-water levels can augment the potential for landslide activity.

Landslides are a recurrent menace to waterways and highways and a threat to homes, schools, businesses, and other facilities. The unimpeded movement over roads—whether for commerce, public utilities, school, emergencies, police, recreation, or tourism—is essential to the normal functioning of Lincoln County. The disruption and dislocation of these or any other routes caused by landslides can quickly jeopardize travel and vital services. Although small slumps on cut and fill slopes along roads and highways is relatively common, nearly all of the landslide risk in Lincoln County is associated with the steeper slopes along the

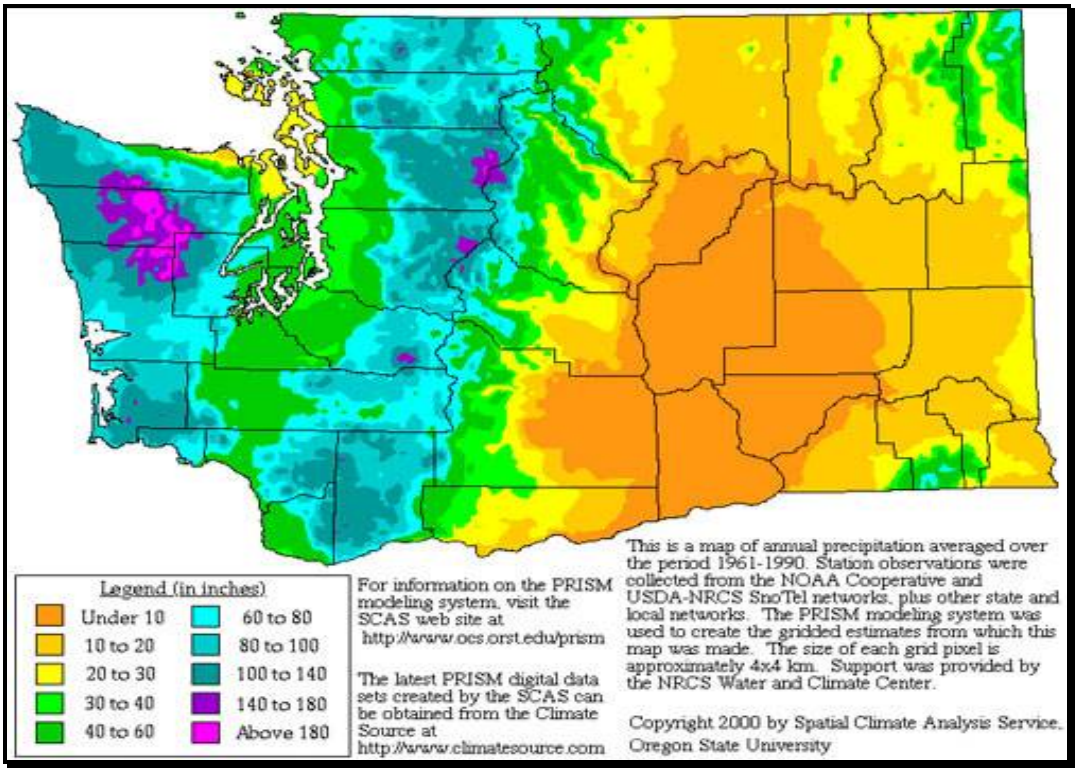
Columbia River on the northern border. There are increasingly more structures and infrastructure at risk in the landslide prone areas of Lincoln County. A major slide could cause severe damage to the watershed, which would have significant negative impacts on communities downstream.

Severe Weather

The overall weather patterns that affect Lincoln County are prevalent throughout Eastern Washington. This section of the State is part of the large inland basin between the Cascade and Rocky Mountains. In an easterly and northerly direction, the Rocky Mountains shield the inland basin from the winter season's cold air masses traveling southward across Canada. In a westerly direction, the Cascade Range forms a barrier to the easterly movement of moist and comparatively mild air in winter and cool air in summer. Some of the air from each of these source regions reaches this section of the State and produces a climate which has some of the characteristics of both continental and marine types. Most of the air masses and weather systems crossing eastern Washington are traveling under the influence of the prevailing westerly winds. Infrequently, dry continental air masses enter the inland basin from the north or east.

East of the Cascades, summers are warmer, winters are colder and precipitation is less than in western Washington. Annual precipitation ranges from seven to nine inches near the confluence of the Snake and Columbia Rivers and 15 to 30 inches along the eastern state line. During July and August, it is not unusual for four to eight weeks to pass with only a few scattered showers. Thunderstorms can be expected on one to three days each month from April through September. Most thunderstorms in the warmest months occur as isolated cells covering only a few square miles. A few damaging hailstorms are reported each summer. Maximum rainfall intensities to expect in one out of ten years are .6 of an inch in one hour; 1.0 inch in three hours; 1.0 to 1.5 inches in six hours; and 1.2 to 2.0 inches in 12 hours.

Figure 4.5. Annual Precipitation Map for Washington.



During the coldest months, a loss of heat by radiation at night and moist air crossing the Cascades and mixing with the colder air in the inland basin results in cloudiness and occasional freezing drizzle. A "chinook" wind which produces a rapid rise in temperature occurs a few times each winter. Frost penetration in the soil depends to some extent on the vegetative cover, snow cover and the duration of low temperatures. In an average winter, frost in the soil can be expected to reach a depth of 10 to 20 inches. During a few of the colder winters, with little or now snow cover, frost has reached a depth of 25 to 35 inches.

Winter season snowfall in the valleys varies from 40 to 80 inches. Both rainfall and snowfall increase along the slopes of the mountains. Snow can be expected in the higher elevations in October and in the lower valleys by the last of November. In the lower elevations, snow reaches a depth of 15 to 30 inches and remains on the ground most of the time from the first of December until March. The few snow survey reports available for elevations above 5,000 feet indicate six to eight feet of snow on the ground the first of April and four to five feet the first of May.

Cold continental air moving southward through Canada will occasionally cross the higher mountains and follow the north-south valleys into the Columbia Basin. On clear, calm winter nights, the loss of heat by radiation from over a snow cover produces ideal conditions for low temperatures. The lowest temperature in the State, -48° F, was recorded December 30, 1965, at Mazama and Winthrop. In January, the average maximum temperature is near 30° F and the minimum temperature is 15° F. Minimum temperatures from -10° to -20°F are recorded almost every winter and temperatures ranging from -25° to -42° F have been recorded in the colder valleys. In July, the average maximum temperature is 85° to 90° and the minimum temperature 45° to 50° F. Maximum temperatures reach 100° F on a few afternoons each summer and temperatures between 105° to 110° F have been recorded. The record high temperature of 118° F was recorded at Ice Harbor Dam on August 5, 1961. Temperatures in the mountains decrease three to five degrees Fahrenheit with each 1,000 feet increase in elevation. The average date of the freezing temperatures can be expected in the colder valleys by the first of September and before mid-October in the warmer areas.

Storms are naturally occurring atmospheric disturbances manifested in strong winds accompanied by rain, snow, or other precipitation, and often by thunder or lightning. All areas within this region are vulnerable to severe local storms. The affects are generally transportation problems and loss of utilities. When transportation accidents occur, motorists are stranded and schools and businesses close. The affects vary with the intensity of the storm, the level of preparation by local jurisdictions and residents, and the equipment and staff available to perform tasks to lessen the effects of severe local storms.

Major disaster declarations related to severe storms in Washington occurred in 1962, 1972, 1974, 1975, 1977, 1979, 1983, 1986 (x3), 1990 (x2), 1991, 1993, 1996, 1997, 2003, 2006 (x2), 2007 (x2), and 2009 (x2). Regional operational plans should reflect warning and notification of the public, prioritization of roads and streets to be cleared, provision of emergency services, mutual aid with other public entities, and procedures for requesting state and federal assistance if needed. To prepare for severe local storms, local jurisdictions should provide public information on emergency preparedness and self-help.

Wildland Fire

An informed discussion of fire mitigation is not complete until basic concepts that govern fire behavior are understood. In the broadest sense, wildland fire behavior describes how fires burn; the manner in which fuels ignite, how flames develop and how fire spreads across the landscape. The three major physical components that determine fire behavior are the fuels supporting the fire, topography in which the fire is burning, and the weather and atmospheric conditions during a fire event. At the landscape level, both topography and weather are beyond our control. We are powerless to control winds, temperature, relative humidity, atmospheric instability, slope, aspect, elevation, and landforms. It is beyond our control to alter these conditions, and thus impossible to alter fire behavior through their manipulation. When we attempt to alter how fires burn, we are left with manipulating the third component of the fire environment; fuels which support the fire. By altering fuel loading and fuel continuity across the landscape, we have the best opportunity to determine how fires burn.

A brief description of each of the fire environment elements follows in order to illustrate their effect on fire behavior.

Weather

Weather conditions contribute significantly to determining fire behavior. Wind, moisture, temperature, and relative humidity ultimately determine the rates at which fuels dry and vegetation cures, and whether fuel conditions become dry enough to sustain an ignition. Once conditions are capable of sustaining a fire, atmospheric stability and wind speed and direction can have a significant affect on fire behavior. Winds fan fires with oxygen, increasing the rate at which fire spreads across the landscape. Weather is the most unpredictable component governing fire behavior, constantly changing in time and across the landscape.

Topography

Fires burning in similar fuel conditions burn dramatically different under different topographic conditions. Topography alters heat transfer and localized weather conditions, which in turn influence vegetative growth and resulting fuels. Changes in slope and aspect can have significant influences on how fires burn. Generally speaking, north slopes tend to be cooler, wetter, more productive sites. This can lead to heavy fuel accumulations, with high fuel moistures, later curing of fuels, and lower rates of spread. In contrast, south and west slopes tend to receive more direct sun, and thus have the highest temperatures, lowest soil and fuel moistures, and lightest fuels. The combination of light fuels and dry sites lead to fires that typically display the highest rates of spread. These slopes also tend to be on the windward side of mountains. Thus these slopes tend to be “available to burn” a greater portion of the year.

Slope also plays a significant roll in fire spread, by allowing preheating of fuels upslope of the burning fire. As slope increases, rate of spread and flame lengths tend to increase. Therefore, we can expect the fastest rates of spread on steep, warm south and west slopes with fuels that are exposed to the wind.

Fuels

Fuel is any material that can ignite and burn. Fuels describe any organic material, dead or alive, found in the fire environment. Grasses, brush, branches, logs, logging slash, forest floor litter, conifer needles, and

buildings are all examples. The physical properties and characteristics of fuels govern how fires burn. Fuel loading, size and shape, moisture content and continuity and arrangement all have an affect on fire behavior. Generally speaking, the smaller and finer the fuels, the faster the potential rate of fire spread. Small fuels such as grass, needle litter and other fuels less than a quarter inch in diameter are most responsible for fire spread. In fact, "fine" fuels, with high surface to volume ratios, are considered the primary carriers of surface fire. This is apparent to anyone who has ever witnessed the speed at which grass fires burn. As fuel size increases, the rate of spread tends to decrease, as surface to volume ratio decreases. Fires in large fuels generally burn at a slower rate, but release much more energy, burn with much greater intensity. This increased energy release, or intensity, makes these fires more difficult to control. Thus, it is much easier to control a fire burning in grass than to control a fire burning in timber.

When burning under a forest canopy, the increased intensities can lead to torching (single trees becoming completely involved) and potentially development of crown fire (fire carried from tree crown to tree crown). That is, they release much more energy. Fuels are found in combinations of types, amounts, sizes, shapes, and arrangements. It is the unique combination of these factors, along with the topography and weather, which determine how fires will burn.

The study of fire behavior recognizes the dramatic and often-unexpected affect small changes in any single component has on how fires burn. It is impossible to speak in specific terms when predicting how a fire will burn under any given set of conditions. However, through countless observations and repeated research, some of the principles that govern fire behavior have been identified and are recognized.

Wildfire Hazard Assessment

Lincoln County was analyzed using a variety of models managed on a Geographic Information System (GIS) system. Physical features of the region including roads, streams, soils, elevation, and remotely sensed images were represented by data layers. Field visits were conducted by specialists from Northwest Management, Inc. and others. Discussions with area residents and local fire suppression professionals augmented field visits and provided insights into forest health issues and treatment options. This information was analyzed and combined to develop an objective assessment of wildland fire risk in the region.

Historic Fire Regime

Historical variability in fire regime is a conservative indicator of ecosystem sustainability, and thus, understanding the natural role of fire in ecosystems is necessary for proper fire management. Fire is one of the dominant processes in terrestrial systems that constrain vegetation patterns, habitats, and ultimately, species composition. Land managers need to understand historical fire regimes, the fire return interval (frequency) and fire severity prior to settlement by Euro-Americans, to be able to define ecologically appropriate goals and objectives for an area. Moreover, managers need spatially explicit knowledge of how historical fire regimes vary across the landscape.

Many ecological assessments are enhanced by the characterization of the historical range of variability which helps managers understand: (1) how the driving ecosystem processes vary from site to site; (2) how these processes affected ecosystems in the past; and (3) how these processes might affect the ecosystems

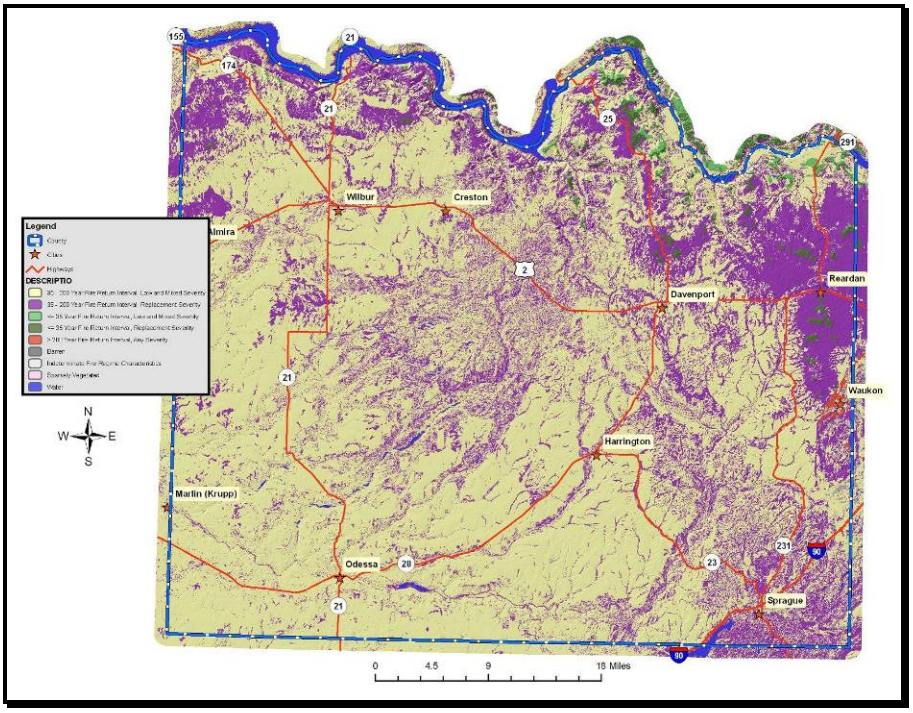
of today and the future. Historical fire regimes are a critical component for characterizing the historical range of variability in fire-adapted ecosystems. Furthermore, understanding ecosystem departures provides the necessary context for managing sustainable ecosystems. Land managers need to understand how ecosystem processes and functions have changed prior to developing strategies to maintain or restore sustainable systems. In addition, the concept of departure is a key factor for assessing risks to ecosystem components. For example, the departure from historical fire regimes may serve as a useful proxy for the potential of severe fire effects from an ecological perspective.

Table 4.2. Assessment of Historic Fire Regimes in Lincoln County, Washington.

Regime	Description	Percent	Acres
1	<= 35 Year Fire Return Interval, Low and Mixed Severity	0%	5,993
2	<= 35 Year Fire Return Interval, Replacement Severity	1%	10,910
3	35 - 200 Year Fire Return Interval, Low and Mixed Severity	71%	1,066,984
4	35 - 200 Year Fire Return Interval, Replacement Severity	26%	388,048
5	> 200 Year Fire Return Interval, Any Severity	0%	3,578
	Water	1%	16,665
	Barren	0%	1,280
	Sparsely Vegetated	0%	4
	Indeterminate Fire Regime Characteristics	0%	3,020
	Total	**100%**	**1,496,482**

The table above shows the amount of acreage in each defined historic fire regime in Lincoln County. The historic fire regime model in Lincoln County shows that much of the northern rim and channeled scabland areas historically had a 35 to 200-year fire return interval and typically experienced stand replacement severity fires. Areas historically characterized as open rangelands that have now been converted to agriculture also had a greater than 35-year fire return interval, but these areas burned at lower intensities. There are also small pockets in the northeastern corner of Lincoln County that historically had a less than 35-year fire return interval and burned at low to mixed severity. This difference is likely due to the more variable topography and presence of forest stands in this area.

Figure 4.6. Historic Fire Regime in Lincoln County, Washington.



Fire Regime Condition Class

A natural fire regime is a general classification of the role fire would play across a landscape in the absence of modern human mechanical intervention, but including the influence of aboriginal burning.[28, 29] Coarse scale definitions for historic fire regimes have been developed by Hardy et al[30] and Schmidt et al[31] and interpreted for fire and fuels management by Hann and Bunnell.

A fire regime condition class (FRCC) is a classification of the amount of departure from the historic regime.[32] The three classes are based on low (FRCC 1), moderate (FRCC 2), and high (FRCC 3) departure from the

[28] Agee, J. K. Fire Ecology of the Pacific Northwest forests. Oregon: Island Press. 1993.

[29] Brown. J. K. "Fire regimes and their relevance to ecosystem management." *Proceedings of Society of American Foresters National Convention*. Society of American Foresters. Washington, D.C. 1995. Pp 171-178.

[30] Hardy, C. C., et al. *"Spatial data for national fire planning and fuel management."* International Journal of Wildland Fire. 2001. Pp 353-372.

[31] Schmidt, K. M., et al. *"Development of coarse scale spatial data for wildland fire and fuel management."* General Technical Report, RMRS-GTR-87. U.S. Department of Agriculture, Forest Service. Rocky Mountain Research Station. Fort Collins, Colorado. 2002.

[32] Hann, W. J. and D. L. Bunnell. "Fire and land management planning and implementation across multiple scales." International Journal of Wildland Fire. 2001. Pp 389-403.

central tendency of the natural (historical) regime.[33,34] The central tendency is a composite estimate of vegetation characteristics (species composition, structural stages, stand age, canopy closure, and mosaic pattern); fuel composition; fire frequency, severity, and pattern; and other associated natural disturbances. Low departure is considered to be within the natural (historical) range of variability, while moderate and high departures are outside.

An analysis of Fire Regime Condition Classes in Lincoln County shows that a significant portion of the county is either moderately departed (30%) or severely departed (9%) from its natural fire regime and associated vegetation and fuel characteristics. In most scenarios, the more departed an area is from its natural fire regime, the higher the wildfire potential; however, this is not true 100% of the time.

Table 4.3. Assessment of Fire Regime Condition Class in Lincoln County, Washington.

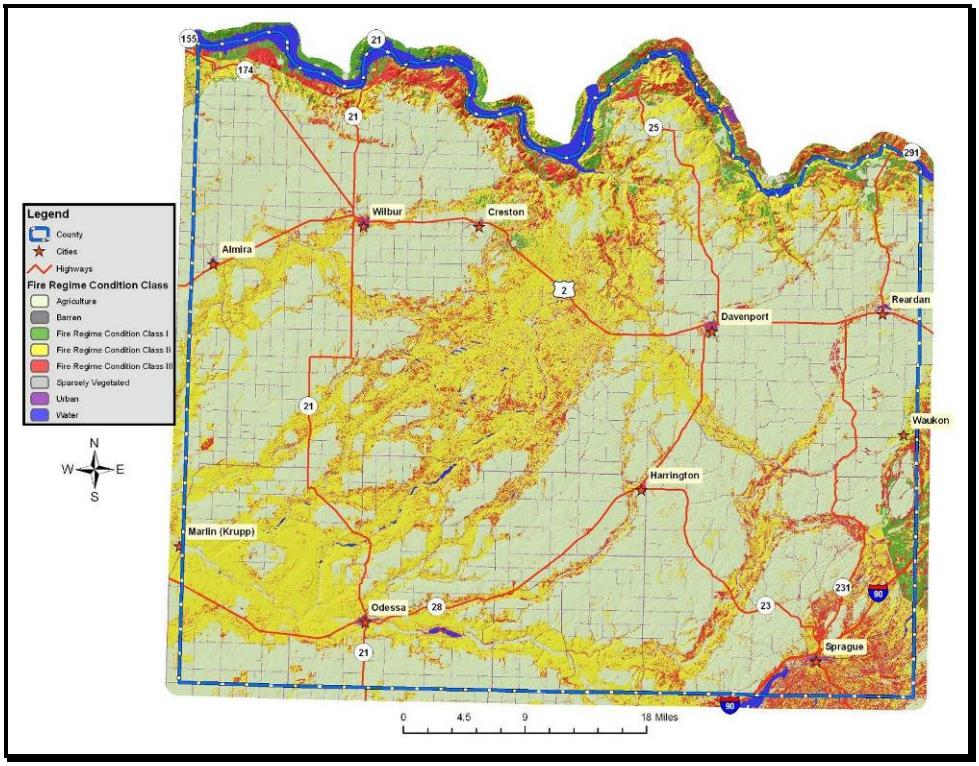
Condition Class	Acres	Percent
Fire Regime Condition Class I	2%	25,353
Fire Regime Condition Class II	30%	448,064
Fire Regime Condition Class III	9%	130,418
Water	1%	16,665
Urban	3%	41,462
Barren	0%	1,280
Sparsely Vegetated	0%	4
Agriculture	56%	833,236
Total	**100%**	**1,496,482**

Of the acres in Lincoln County that have not been converted for agricultural uses, there are very few areas that still maintain their historic fire regime. Most of the channeled scabland areas are defined as Condition Class 2 or moderately departed from the historical regime. The most severely departed areas (Condition Class 3) occur in the southeastern corner of the County near Sprague and along the river breaks on the northern end of the County, particularly along Columbia River.

[33] Hardy, C. C., et al. *"Spatial data for national fire planning and fuel management."* International Journal of Wildland Fire. 2001. Pp 353-372.

[34] Schmidt, K. M., et al. *"Development of coarse scale spatial data for wildland fire and fuel management."* General Technical Report, RMRS-GTR-87. U.S. Department of Agriculture, Forest Service. Rocky Mountain Research Station. Fort Collins, Colorado. 2002.

Figure 4.7. Fire Regime Condition Class in Lincoln County, Washington.



Wildland Urban Interface

The wildland-urban interface (WUI) has gained attention through efforts targeted at wildfire mitigation; however, this analysis technique is also useful when considering other hazards because the concept looks at where people and structures are concentrated in any particular region.

A key component in meeting the underlying need for protection of people and structures is the protection and treatment of hazards in the wildland-urban interface. The wildland-urban interface refers to areas where wildland vegetation meets urban developments or where forest fuels meet urban fuels such as houses. The WUI encompasses not only the interface (areas immediately adjacent to urban development), but also the surrounding vegetation and topography. Reducing the hazard in the wildland-urban interface requires the efforts of federal, state, and local agencies and private individuals.[35] "The role of [most] federal agencies in the wildland-urban interface includes wildland firefighting, hazard fuels reduction, cooperative prevention and education, and technical experience. Structural fire protection [during a wildfire] in the wildland-urban interface is [largely] the responsibility of Tribal, state, and local governments".[36] The role of the federal agencies in Lincoln County is and will be much more limited. Property owners share a responsibility to protect their residences and businesses and minimize danger by creating defensible areas

[35] Norton, P. Bear Valley National Wildlife Refuge Fire Hazard Reduction Project: Final Environmental Assessment. Fish and Wildlife Services, Bear Valley Wildlife Refuge. June 20, 2002.

[36] USFS. 2001. United States Department of Agriculture, Forest Service. Wildland Urban Interface. Web page. Date accessed: 25 September 2001. Accessed at: http://www.fs.fed.us/r3/sfe/fire/urbanint.html

around them and taking other measures to minimize the risks to their structures.[37] With treatment, a wildland-urban interface can provide firefighters a defensible area from which to suppress wildland fires or defend communities against other hazard risks. In addition, a wildland-urban interface that is properly treated will be less likely to sustain a crown fire that enters or originates within it. [38]

By reducing hazardous fuel loads, ladder fuels, and tree densities, and creating new and reinforcing existing defensible space, landowners can protect the wildland-urban interface, the biological resources of the management area, and adjacent property owners by:

- minimizing the potential of high-severity ground or crown fires entering or leaving the area;
- reducing the potential for firebrands (embers carried by the wind in front of the wildfire) impacting the WUI. Research indicates that flying sparks and embers (firebrands) from a crown fire can ignite additional wildfires as far as 1¼ miles away during periods of extreme fire weather and fire behavior;[39]
- improving defensible space in the immediate areas for suppression efforts in the event of wildland fire.

Three WUI conditions have been identified (Federal Register 66(3), January 4, 2001) for use in wildfire control efforts. These include the Interface Condition, Intermix Condition, and Occluded Condition. Descriptions of each are as follows:

- **Interface Condition** – a situation where structures abut wildland fuels. There is a clear line of demarcation between the structures and the wildland fuels along roads or back fences. The development density for an interface condition is usually 3+ structures per acre;
- **Intermix Condition** – a situation where structures are scattered throughout a wildland area. There is no clear line of demarcation; the wildland fuels are continuous outside of and within the developed area. The development density in the intermix ranges from structures very close together to one structure per 40 acres; and
- **Occluded Condition** – a situation, normally within a city, where structures abut an island of wildland fuels (park or open space). There is a clear line of demarcation between the structures and the wildland fuels along roads and fences. The development density for an occluded condition is usually similar to that found in the interface condition and the occluded area is usually less than 1,000 acres in size.

---

[37] USFS. 2001. United States Department of Agriculture, Forest Service. Wildland Urban Interface. Web page. Date accessed: 25 September 2001. Accessed at: http://www.fs.fed.us/r3/sfe/fire/urbanint.html

[38] Norton, P. Bear Valley National Wildlife Refuge Fire Hazard Reduction Project: Final Environmental Assessment. Fish and Wildlife Services, Bear Valley Wildlife Refuge. June 20, 2002.

[39] McCoy, L. K., et all. Cerro Grand Fire Behavior Narrative. 2001.

In addition to these classifications detailed in the Federal Register, Lincoln County has included two additional classifications to augment these categories:

- **Rural Condition** – a situation where the scattered small clusters of structures (ranches, farms, resorts, or summer cabins) are exposed to wildland fuels. There may be miles between these clusters.

- **High Density Urban Areas** – those areas generally identified by the population density consistent with the location of incorporated cities, however, the boundary is not necessarily set by the location of city boundaries or urban growth boundaries; it is set by very high population densities (more than 7-10 structures per acre).

Lincoln County's wildland-urban interface (WUI) is based on population density. Relative population density across the county is estimated using a GIS-based kernel density population model that uses object locations to produce, through statistical analysis, concentric rings or areas of consistent density. To graphically identify relative population density across the county, structure locations are used as an estimate of population density. For this analysis, physical addresses were used as an estimate of structure location. Lincoln County's GIS department produced a 911 address data layer that was used to represent structure location as input for the model. The resulting output identified the extent and level of population density throughout the county. Highly populated areas are easily discernable from low population areas using this method, which enables the determination of urban verses rural populations. Rural areas of the WUI have an approximate density of one structure per 40 acres. The model also showed several small islands where no structures were recorded. Based on the planning committee's review and discussion, the final WUI boundary output was adjusted to incorporate the non-populated areas (no structures) due to their small size and scattered nature as well as their location in high fire risk areas.

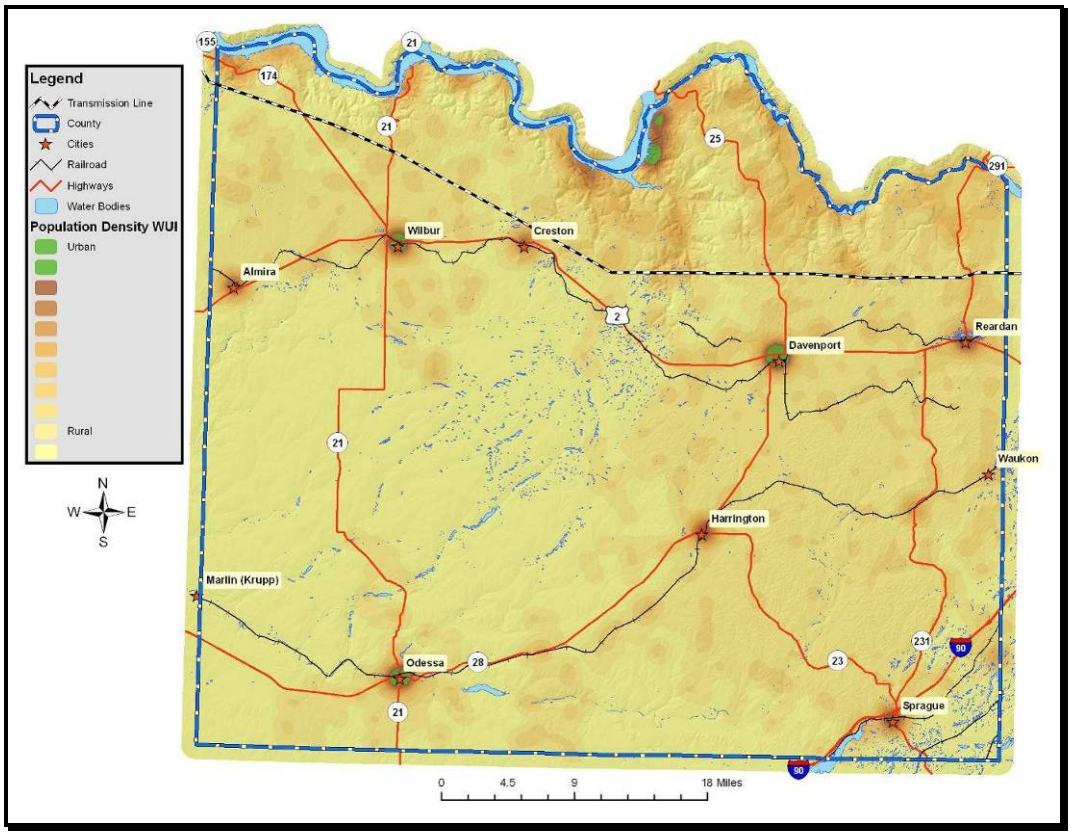
By evaluating structure density in this way, WUI areas can be identified on maps by using mathematical formulae and population density indexes. The resulting population density indexes create concentric circles showing high density areas, interface, and intermix condition WUI, as well as rural condition WUI (as defined above). This portion of the analysis allows us to "see" where the highest concentrations of structures are located in reference to high risk landscapes, limiting infrastructure, and other points of concern.

The WUI, as defined here, is unbiased and consistent, allows for edge matching with other counties, and most importantly – it addresses all of the county, not just federally identified communities at risk. It is a planning tool showing where homes and businesses are located and the density of those structures leading to identified WUI categories. It can be determined again in the future, using the same criteria, to show how the WUI has changed in response to increasing population densities. It uses a repeatable and reliable analysis process that is unbiased.

The Healthy Forests Restoration Act makes a clear designation that the location of the WUI is at the determination of the county or reservation when a formal and adopted CWPP is in place. It further states that the federal agencies are obligated to use this WUI designation for all Healthy Forests Restoration Act purposes. The Lincoln County Community Wildfire Protection Plan planning committee evaluated a variety of different approaches to determining the WUI for the county and selected this approach and has adopted

it for these purposes. In addition to a formal WUI map for use by the federal agencies, it is hoped that it will serve as a planning tool for the county, the Washington Department of Natural Resources, and local fire districts.

Figure 4.8. Wildland-Urban Interface Map for Lincoln County, Washington.



Avalanche

An avalanche is a rapid flow of snow downslope from either natural triggers or human activity. Typically occurring in mountainous terrain, an avalanche can mix air and water with the descending snow. Powerful avalanches have the capability to entrain ice, rocks, trees, and other material on the slope. Avalanches are primarily composed of flowing snow, and are distinct from mudslides, rock slides, rock avalanches, and serac collapses on an icefall. In mountainous terrain, avalanches are among the most serious objective hazards to life and property, with their destructive capability resulting from their potential to carry an enormous mass of snow rapidly over large distances.

There are two types of avalanches, loose and slab, and two types of slab avalanches, dry and wet. Although the most dangerous avalanche is the slab avalanche, loose slides can and do produce injury and death. Loose avalanches occur when grains of snow cannot hold onto a slope and begin sliding downhill, picking up more snow and fanning out in an inverted V. Slab avalanches occur when a cohesive mass of snow breaks away from the slope all at once. Most slides in the Northwest are slab avalanches. Dry slab avalanches occur when the stresses on a slab overcome the internal strength of the slab and its attachment to surrounding snow. A decrease in strength produced through warming, melting snow, or rain, or an increase in stress produced by the weight of additional snowfall, a skier or a snowmobile cause this type of avalanche. Dry slab avalanches can travel 60 to 80 miles per hour or more, reaching these speeds within five seconds after the fracture; they account for most avalanche fatalities. Wet slab avalanches occur when water percolating through the top slab weakens it and dissolves its bond with a lower layer, decreasing the ability of the weaker, lower layer to hold on to the top slab, as well as decreasing the slab's strength.

For a slope to generate an avalanche it must be simultaneously capable of retaining snow and allowing snow to accelerate once set in motion. The angle of the slope that can hold snow depends on the ductile and shear strength of the snow, which is determined by the temperature and moisture content. Drier and colder snow, with lower ductile and shear strength, will only bond to lower angle slopes; while wet and warm snow, with higher ductile and shear strength, can bind to very steep surfaces. Snow that has been water saturated to the point of slush can accelerate on shallow angled terrain; while a cohesive snow pack will not accelerate on steep slopes.

A number of weather and terrain factors determine avalanche danger:

Weather:

- Storms – A large percentage of all snow avalanches occur during and shortly after storms.
- Rate of snowfall – Snow falling at a rate of one inch or more per hour rapidly increases avalanche danger.
- Temperature – Storms starting with low temperatures and dry snow, followed by rising temperatures and wetter snow, are more likely to cause avalanches than storms that start warm and then cool with snowfall.
- Wet snow – Rainstorms or spring weather with warm, moist winds and cloudy nights can warm the snow cover resulting in wet snow avalanches. Wet snow avalanches are more likely on sun-exposed terrain (south-facing slopes) and under exposed rocks or cliffs.

Terrain:

- Ground cover – Large rocks, trees and heavy shrubs help anchor snow.
- Slope profile – Dangerous slab avalanches are more likely to occur on convex slopes.
- Slope aspect – Leeward slopes are dangerous because windblown snow adds depth and creates dense slabs. South facing slopes are more dangerous in the springtime.
- Slope steepness – Snow avalanches are most common on slopes of 30 to 45 degrees.

Avalanches have killed more than 190 people in the past century in Washington State, exceeding deaths from any other natural hazard. One of the nation's worst avalanche disasters occurred in 1910 when massive avalanches hit two trains stopped on the west side of Stevens Pass; 96 people were killed. Avalanches kill one to two people, on average, every year in Washington, although many more are involved in avalanche accidents that do not result in fatalities. Avalanches occur in four mountain ranges in the state – the Cascade Range, which divides the state east and west, the Olympic Mountains in northwest Washington, the Blue Mountains in southeast Washington, and the Selkirk Mountains in northeast Washington. The avalanche season begins in November and continues until early summer for all mountain areas of the state.

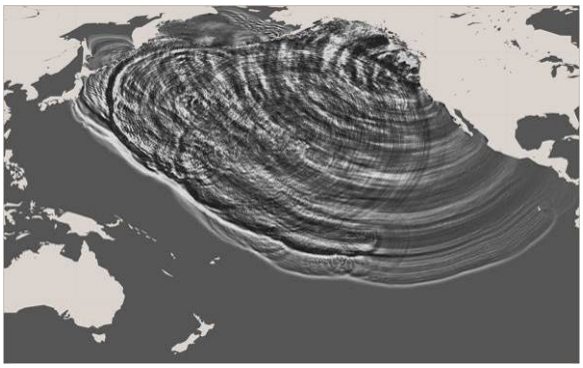
Tsunami

Tsunamis (pronounced soo-ná-mees), also known as seismic sea waves (mistakenly called "tidal waves"), are a series of enormous waves created by an underwater disturbance such as an earthquake, landslide, volcanic eruption, or meteorite. A tsunami can move hundreds of miles per hour in the open ocean and smash into land with waves as high as 100 feet or more.

From the area where the tsunami originates, waves travel outward in all directions. Once the wave approaches the shore, it builds in height. The topography of the coastline and the ocean floor will influence the size of the wave. There may be more than one wave and the succeeding one may be larger than the one before. That is why a small tsunami at one beach can be a giant wave a few miles away.

All tsunamis are potentially dangerous, even though they may not damage every coastline they strike. A tsunami can strike anywhere along most of the U.S. coastline. The most destructive tsunamis have occurred along the coasts of California, Oregon, Washington, Alaska, and Hawaii.[40]

Washington State has a long history of tsunamis from sources near and far. The grandest of the nearby sources, the Cascadia subduction Zone, produced its most recent great tsunami in 1700. The region's backyard tsunamis also include a Puget Sound tsunami from the Seattle Fault between 900 and 930, a Tacoma Narrows tsunami from a landslide in 1949, a fatal wave from a rockslide into the Columbia River in 1965, and a great slosh from Spirit Lake during the 1980 eruption of Mount St. Helens. The State's greatest Pacific Ocean tsunamis in recent memory came from Chile in 1960 and Alaska in 1964. Tsunamis generated elsewhere on the Pacific Rim are the ones that strike Washington most often. The Washington portion of the Cascadia Subduction Zone produces a great earthquake (magnitude 8 or 9) and associated tsunami often enough for the next of these to have a one-in-ten chance, or better, of occurring in the next fifty years.[41]



A computer simulation of the 1700 magnitude 9 Cascadia earthquake tsunami after 10 hours. It created a tsunami that crossed the entire Pacific Ocean and caused damage along parts of the Japanese coast. (USGS)

Lincoln County has virtually no risk of being impacted by a tsunami that hits the Pacific Coast. Nevertheless, there have been recorded incidents of inland tsunamis in Washington State. This type of tsunami is typically caused by a large landslide or earthquake. The frequency of tsunamis from inland sources has not

[40] FEMA. "Tsunami." U.S. Department of Homeland Security. Federal Emergency Management Agency. Washington, D.C. Available online at http://www.fema.gov/hazard/tsunami/index.shtm. December 2009.

[41] State of Washington. Washington State Hazard Mitigation Plan. Hazard Profile - Tsunami. Washington Military Department. Emergency Management Division. November 2007.

been determined; however, Lincoln County is subject to inland tsunamis on Lake Roosevelt, which forms the county's northern border. Landslides into Lake Roosevelt generated numerous tsunamis from 1944 to 1953 after Grand Coulee Dam created the lake on the Columbia River. An earthquake in A.D. 900- 930 on the Seattle Fault caused uplift that triggered a tsunami in the central Puget Sound. And, a landslide into the Tacoma Narrows set off a tsunami a few days after the 1949 Olympia earthquake.

Lake Roosevelt Tsunamis

Most tsunamis generated large waves (30 to 60 feet in height) that struck the opposite shore of the lake, with some waves observed miles from the source. Two tsunamis reportedly caused damage:

February 23, 1951 – A 100,000 to 200,000 cubic yard landslide just north of Kettle Falls created a wave that picked up logs at the Harter Lumber Company Mill and flung them through the mill 10 feet above lake level.

October 13, 1952 – A landslide 98 miles upstream of Grand Coulee Dam created a wave that broke tugboats and barges loose from their moorings at the Lafferty Transportation Company six miles away. It also swept logs and other debris over a large area above lake level.

1980 Spirit Lake Tsunami

The May 18, 1980 eruption of Mount St. Helens caused a massive tsunami in Spirit Lake. The sliding north face of the volcano slammed into the west arm of the lake, raising its surface an estimated 207 feet and sending a tsunami surging around the lake basin as high as 820 feet above the previous lake level. Displaced water rinsed the valley sides clean of timber and sediment, jamming logs and boulders against the landslide debris. In the east arm of Spirit Lake, the tsunami wave reached nearly 740 feet above the old level of the lake, also washing trees off the sides of the valley and into the lake.[42]

Although highly sophisticated tsunami warning systems exist along the Pacific coast, inland tsunamis have the potential to cause extreme damage to waterways and shoreline communities due to their infrequency and the lack of a warning system. These types of events will most likely occur with no warning and be over in a matter of minutes due to the relatively small size of the water body. Residences, businesses, and other resources along the Lake Roosevelt shoreline where these localized events occur may be severely damaged by a series of high waves.

[42] State of Washington. Washington State Hazard Mitigation Plan. Hazard Profile - Tsunami. Washington Military Department. Emergency Management Division. November 2007.

Volcano

The Cascade Range of the Pacific Northwest has more than a dozen potentially active volcanoes. Cascade volcanoes tend to erupt explosively, and on average two eruptions occur per century—the most recent were at Mount St. Helens, Washington (1980–86 and 2004–8), and Lassen Peak, California (1914–17). On May 18, 1980, after 2 months of earthquakes and minor eruptions, Mount St. Helens, Washington, exploded in one of the most devastating volcanic eruptions of the 20th century. Although less than 0.1 cubic mile of molten rock (magma) was erupted, 57 people died, and damage exceeded $1 billion. Fortunately, most people in the area were able to evacuate safely before the eruption because public officials had been alerted to the danger by U.S. Geological Survey (USGS) and other scientists. To help protect the Pacific Northwest's rapidly expanding population, USGS scientists at the Cascades Volcano Observatory in Vancouver, Washington, monitor and assess the hazards posed by the region's volcanoes.[43]

There are no active volcanoes in Lincoln County; however, communities in this area could be directly affected by an eruption from any one of the Cascade volcanoes. During an eruption, such as the 1980 eruption of Mount St. Helens, Lincoln County is not likely to be directly affected by lava flows, pyroclastic flows, landslides, or lahars; however, this region may be indirectly impacted due to damming of waterways, reduced air and water quality, acid rain, and ash fallout.

An explosive eruption blasts solid and molten rock fragments (tephra) and volcanic gases into the air with tremendous force. The largest rock fragments (bombs) usually fall back to the ground within 2 miles of the vent. Small fragments (less than about 0.1 inch across) of volcanic glass, minerals, and rock (ash) rise high into the air, forming a huge, billowing eruption column.

Eruption columns can grow rapidly and reach more than 12 miles above a volcano in less than 30 minutes, forming an eruption cloud. The volcanic ash in the cloud can pose a serious hazard to aviation. During the past 15 years, about 80 commercial jets have been damaged by inadvertently flying into ash clouds, and several have nearly crashed because of engine failure. Large eruption clouds can extend hundreds of miles downwind, resulting in ash fall over enormous areas; the wind carries the smallest ash particles the farthest. Ash from the May 18, 1980, eruption of Mount St. Helens, Washington, fell over an area of 22,000 square miles in the Western United States. Heavy ash fall can collapse buildings, and even minor ash fall can damage crops, electronics, and machinery.

Volcanoes emit gases during eruptions. Even when a volcano is not erupting, cracks in the ground allow gases to reach the surface through small openings called fumaroles. More than ninety percent of all gas emitted by volcanoes is water vapor (steam), most of which is heated ground water (underground water from rain fall and streams). Other common volcanic gases are carbon dioxide, sulfur dioxide, hydrogen sulfide, hydrogen, and fluorine. Sulfur dioxide gas can react with water droplets in the atmosphere to create acid rain, which causes corrosion and harms vegetation. Carbon dioxide is heavier than air and can be trapped in low areas in concentrations that are deadly to people and animals. Fluorine, which in high concentrations is toxic, can be adsorbed onto volcanic ash particles that later fall to the ground. The

[43] Dzurisim, Dan, et al. "Living with Volcanic Risk in the Cascades." U.S. Geological Survey – Reducing the Risk from Volcano Hazards. USGS. Vancouver, Washington. 1997.

fluorine on the particles can poison livestock grazing on ash-coated grass and also contaminate domestic water supplies.[44]

Volcanoes of the Cascades[45]

The volcanoes of the Cascade Range, which stretches from northern California into British Columbia, have produced more than 100 eruptions, most of them explosive, in just the past few thousand years. However, individual Cascade volcanoes can lie dormant for many centuries between eruptions, and the great risk posed by volcanic activity in the region is therefore not always apparent.

When Cascade volcanoes do erupt, high-speed avalanches of hot ash and rock (pyroclastic flows), lava flows, and landslides can devastate areas 10 or more miles away; and huge mudflows of volcanic ash and debris, called lahars, can inundate valleys more than 50 miles downstream. Falling ash from explosive eruptions can disrupt human activities hundreds of miles downwind, and drifting clouds of fine ash can cause severe damage to jet aircraft even thousands of miles away. Erupting Cascade volcanoes are more prone than other U.S. volcanoes to explosive volcanic activity, resulting in pyroclastic flows. These are hot, often incandescent mixtures of volcanic fragments and gases that sweep along close to the ground at speeds up to 450 mph.

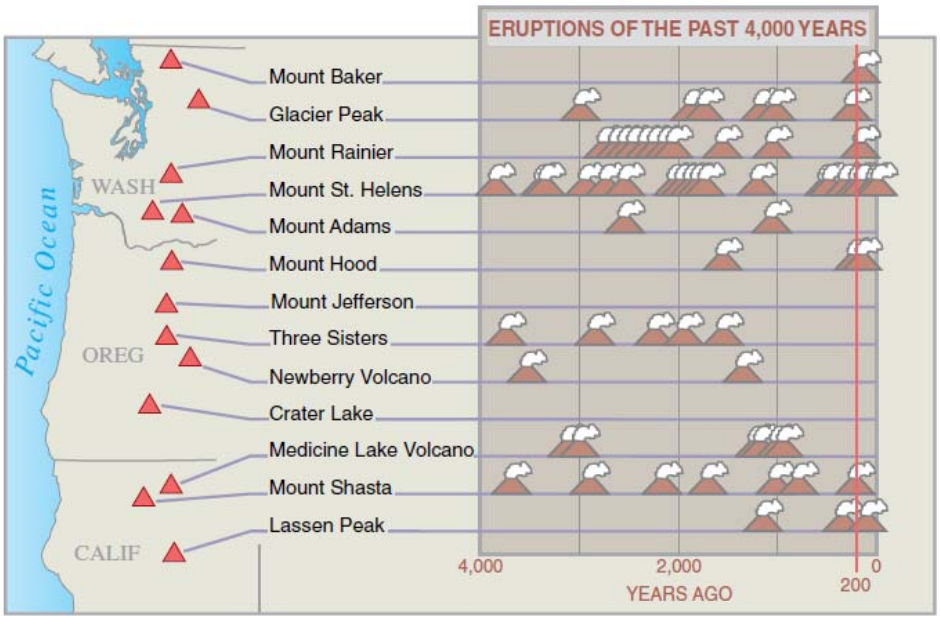
Because the population of the Pacific Northwest is rapidly expanding, the volcanoes of the Cascade Range in Washington, Oregon, and northern California are some of the most dangerous in the United States. Although Cascade volcanoes do not often erupt (on average, about two erupt each century), they can be dangerous because of their violently explosive behavior, their permanent snow and ice cover that can fuel large volcanic debris flows (lahars), and their proximity to various critical infrastructure, air routes, and populated areas in Washington, Oregon, and California.

---

[44] Myers, Bobbie, et al. "What are Volcano Hazards?" U.S. Geological Survey. Vancouver, Washington. July 2004.

[45] Dzurisim, Dan, et al. "Living with Volcanic Risk in the Cascades." U.S. Geological Survey – Reducing the Risk from Volcano Hazards. USGS. Vancouver, Washington. 1997.

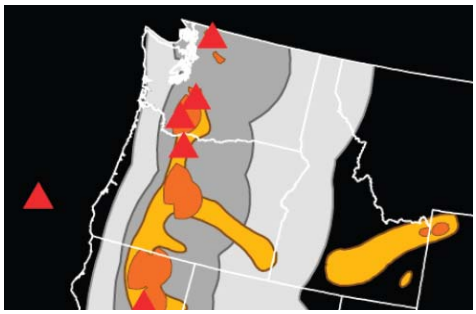
Figure 4.9. Record of Cascade Range Volcanic Eruptions.



Of the 13 potentially active volcanoes in the Cascade Range, 11 have erupted in the past 4,000 years. More than 100 eruptions have occurred during that period, making the volcanoes of the Cascade Range some of the most hazardous in the U.S. Each eruption symbol in the diagram represents from one to several eruptions closely spaced in time at or near the named volcano.

Washington

Mount Baker erupted in the mid-1800s for the first time in several thousand years. Activity at steam vents (fumaroles) in Sherman Crater, near the volcano's summit, increased in 1975 and is still vigorous, but there is no evidence that an eruption is imminent. **Glacier Peak** has erupted at least six times in the past 4,000 years. About 13,000 years ago, an especially powerful series of eruptions deposited volcanic ash at least as far away as Wyoming. **Mount Rainier** has produced at least ten eruptions and numerous lahars in the past 4,000 years. It is capped by more glacier ice than the rest of the Cascade volcanoes combined, and parts of Rainier's steep slopes have been weakened by hot, acidic volcanic gases and water. These factors make this volcano especially prone to landslides and lahars. **Mount St. Helens** is the most frequently active volcano in the Cascades. During the past 4,000 years, it has produced many lahars and a wide variety of eruptive activity, from relatively quiet outflows of lava to explosive eruptions much larger than that of May 18, 1980. **Mount Adams** has produced few eruptions during the past several thousand years. This volcano's most recent activity was a series of small eruptions about 1,000 years ago.



The red triangles are volcano locations. Dark orange areas have a higher volcanic hazard; light orange areas have a lower volcanic hazard. Dark gray areas have a higher ash fall hazard; light-gray areas have a lower ash fall hazard.[1]

Oregon

Mount Hood last erupted about 200 years ago, producing pyroclastic flows, lahars, and a prominent lava dome (Crater Rock) near the volcano's summit. Most recently, a series of steam blasts occurred between 1856 and 1865. **Mount Jefferson** last erupted more than 20,000 years ago. However, eruptions nearby have produced several lava flows and small volcanic cones in the past 10,000 years. Three Sisters Volcanic Center in central Oregon includes five large volcanoes—**North Sister, Middle Sister, South Sister, Broken Top**, and **Mount Bachelor**. About 2,000 years ago, eruptions occurred on South Sister, as well as from several small volcanoes north of North Sister. Since 1997, a broad area centered 3 miles west of South Sister has domed upward by more than 8 inches. Scientists think that this doming reflects the ongoing accumulation of magma at a depth of 3 to 4 miles. The outcome of this activity is uncertain, but there is no evidence that an eruption is imminent. The USGS and its partners have increased monitoring efforts in the area to detect any changes that might warrant more concern. **Newberry Volcano**, a broad shield covering more than 500 square miles, is capped by Newberry Crater, a large volcanic depression (caldera) 5 miles across. Its most recent eruption was about 1,300 years ago. **Crater Lake** occupies a 6-mile-wide caldera formed 7,700 years ago when the summit of an ancient volcano (referred to as Mount Mazama) collapsed during a huge explosive eruption. More than 10 cubic miles of magma was erupted, 10 times as much as in any other eruption in the Cascades during the past 10,000 years. Smaller eruptions ending about 5,000 years ago formed Wizard Island and several submerged cones and lava domes on the lake floor.

Reducing the Risk

After the 1980 eruption of Mount St. Helens, Congress provided increased funding that enabled the USGS to establish a volcano observatory for the Cascade Range. Located in Vancouver, Washington, the David A. Johnston Cascades Volcano Observatory (CVO) was named for a USGS scientist killed at a forward observation post by the May 18, 1980 eruption.

Scientists at CVO quickly recognized that it was not economically feasible to fully monitor all potentially active Cascade volcanoes. To address this and similar problems elsewhere in the United States and abroad, the USGS developed a suite of portable volcano-monitoring instruments—essentially, a portable volcano observatory. In the Pacific Northwest, when regional networks of earthquake sensors, operated in cooperation with the University of Washington's Pacific Northwest Seismic Network, detect unusual seismic activity at a volcano, CVO staff will rapidly deploy this portable equipment to evaluate the hazard and, if needed, provide timely warnings to local officials and the public.

CVO also uses remote sensing as an early-detection tool. A technique called interferometric synthetic-aperture radar (InSAR) allows scientists to measure subtle movements of the ground surface, using radar images obtained by Earth-orbiting satellites. The current ground doming at Three Sisters was first detected using this technique.

Drought

Drought is defined as a prolonged period of dryness severe enough to reduce soil moisture, water levels, and snow levels below the minimum necessary for sustaining plant, animal and economic systems. In the past century, Washington State has experienced a number of drought cycles including several that lasted for more than a single season (1928-32, 1992-94, and 1996-97). The most severe droughts occurred in 1977 and 2001. The most recent drought affecting eastern Washington counties occurred in 2005, but was less severe than the 2001 cycle. Drought can have a widespread impact on the environment and the economy, depending on its severity, although it typically does not result in loss of life or damage to property.

Unlike most states, Washington has a statutory definition of drought, consisting of two parts:

1. An area has to be experiencing or projected to experience a water supply that is below 75 percent of normal.
2. Water users within those areas will likely incur undue hardships as a result of the shortage.

On average, the nationwide annual economic impacts of drought – between $6 billion and $8 billion annually in the United States – are greater than the impacts of any other natural hazard. They occur primarily in the agriculture, transportation, recreation and tourism, forestry, and energy sectors. Social and environmental impacts are also significant, although it is difficult to put a precise cost on these impacts. A drought directly or indirectly affects all of the residents of Lincoln County. The National Drought Mitigation Center uses three categories to describe likely drought impacts:

- Agriculture – drought threatens crops that rely on natural precipitation
- Water Supply – drought threatens supplies of water for irrigated crops and for communities
- Fire Hazard – drought increases the threat of wildfire from dry conditions in forest and rangelands

Additionally, drought threatens the supply of electricity in Washington. Hydroelectric power plants generate approximately three quarters of the electricity produced in Washington State. When supplies of locally generated hydropower shrink because of drought, utilities seek other sources of electricity, which can drive up prices as well as reduce supply. Snowpack and water supply effects on Washington power supplies generally occur in the winter. Snow melt is captured throughout the spring and summer behind hydroelectric dams for release and generation during the peak demand winter period. Energy demand in the Pacific Northwest has decreased significantly since 2001, due in part to the closure of aluminum plants, and that load has not returned. Also, between 2001 and 2005, the region added significant amounts of non-hydropower generation. The decrease in demand, the increase in generating capacity, and the larger river flow reduces the potential impacts droughts will have on Washington's energy supply.

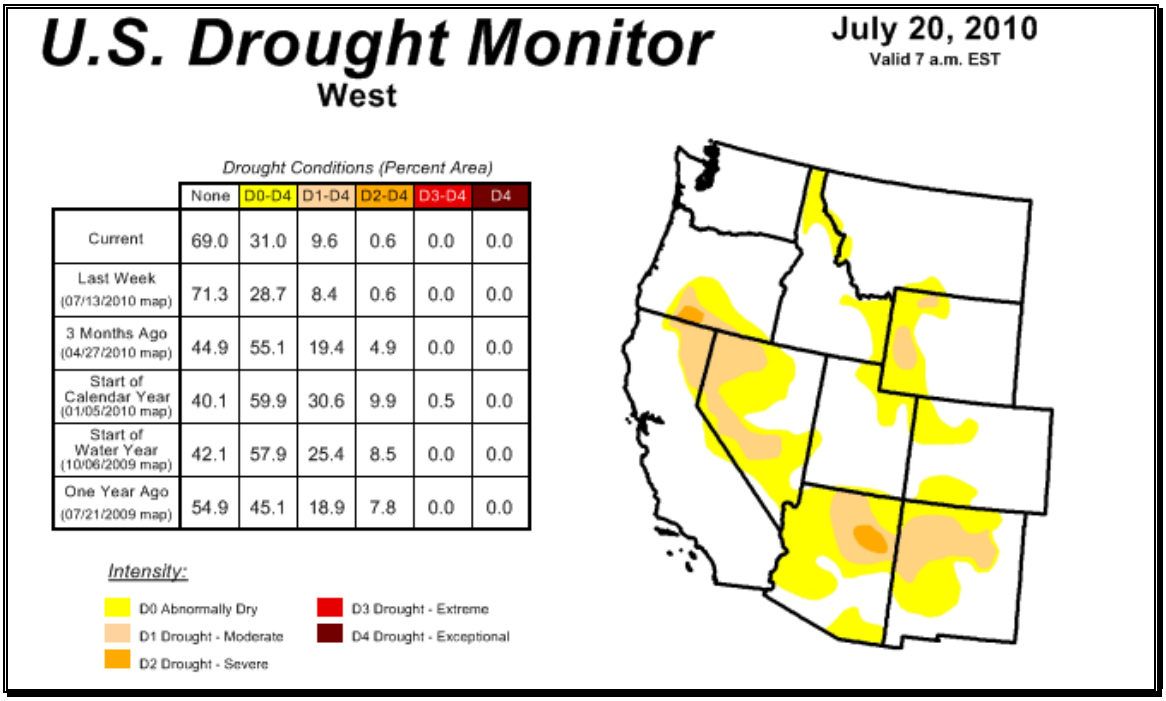
Drought can also effect groundwater sources, but generally not as quickly as surface water supplies. However, groundwater supplies usually take longer to recover. Reduced precipitation during a drought means that groundwater supplies are not replenished at the normal rate. This can lead to a reduction in groundwater levels and problems such as reduced pumping capacity or wells going dry. Shallow wells are

more susceptible than deep wells. Low ground and surface water supplies directly impact eastern Washington fisheries by reducing river and stream levels and thereby reducing potential habitat.

Agriculture is the industry most heavily affected by drought. Low water flow in the Columbia River can present problems for wheat growers in eastern Washington since a majority of their crop is transported by barge. Lack of dredging combined with low river levels reduces the capacity for barge transportation down river, forcing eastern Washington growers to use higher cost alternatives such as trucking and rail.

Drought indices assimilate thousands of bits of data on rainfall, snowpack, streamflow, and other water supply indicators into a comprehensible big picture. A drought index value is typically a single number, far more useful than raw data for decision making. The U.S. Drought Monitor is a synthesis of multiple indices and impacts that represents a consensus of federal and academic scientists.[46]

Figure 4.10. U.S. Drought Monitor Map of Western Region.

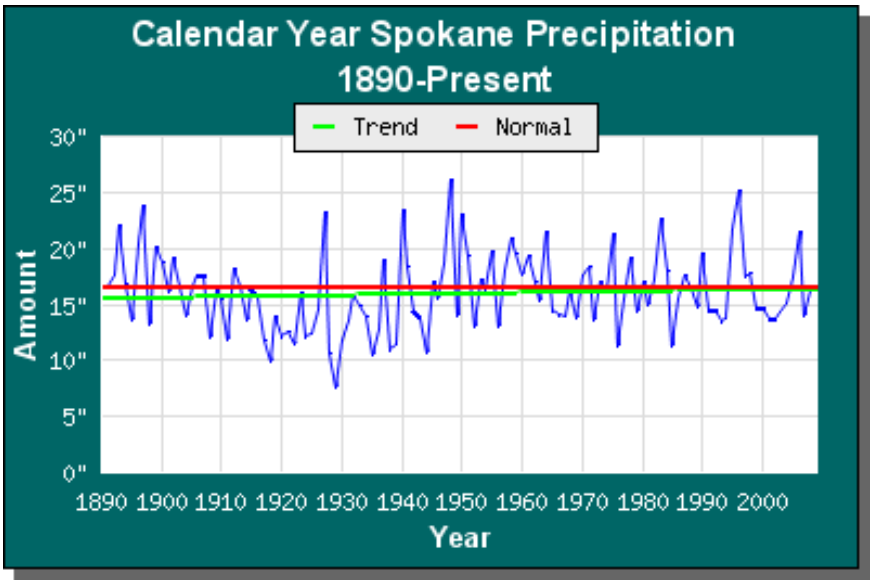


	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	69.0	31.0	9.6	0.6	0.0	0.0
Last Week (07/13/2010 map)	71.3	28.7	8.4	0.6	0.0	0.0
3 Months Ago (04/27/2010 map)	44.9	55.1	19.4	4.9	0.0	0.0
Start of Calendar Year (01/05/2010 map)	40.1	59.9	30.6	9.9	0.5	0.0
Start of Water Year (10/06/2009 map)	42.1	57.9	25.4	8.5	0.0	0.0
One Year Ago (07/21/2009 map)	54.9	45.1	18.9	7.8	0.0	0.0

The major causes of droughts in Washington are either low snow accumulations from either low precipitation or warm winter temperatures; or by warm weather in the late winter-early spring that causes early melt of the snowpack. Most of the state's annual precipitation occurs during the winter. Precipitation in northeaster Washington is normally stored as snow that slowly melts during the spring and summer, maintaining stream and river flows. This is the primary source of water for irrigation and municipal use.

[46] National Drought Mitigation Center. "U.S. Drought Monitor". Available online at http://drought.unl.edu/dm/monitor.html. February 2010.

Figure 4.11. Precipitation Record 1890 – Present.

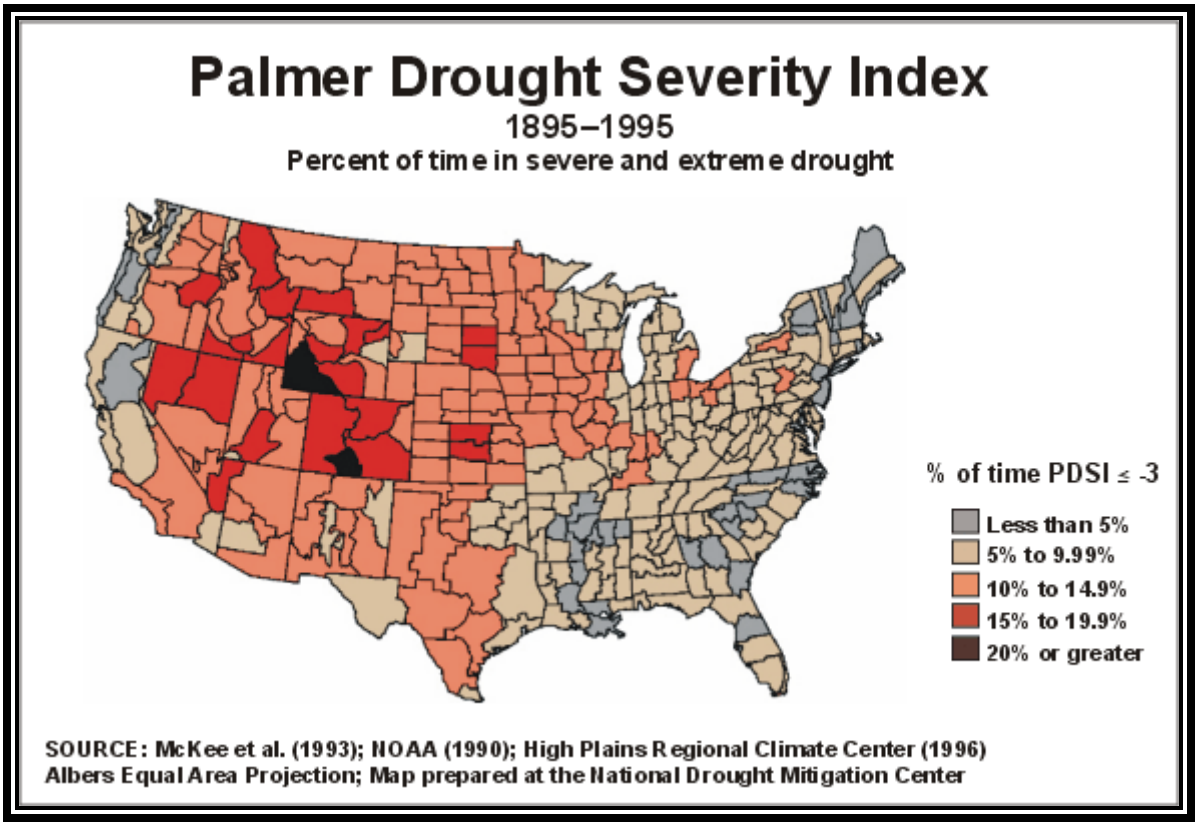


In 1965, W.C. Palmer developed an index to measure the departure of the moisture supply. Palmer based his index on the supply-and-demand concept of the water balance equation, taking into account more than just the precipitation deficit at specific locations. The objective of the Palmer Drought Severity Index (PDSI), as this index is now called, was to provide measurements of moisture conditions that were standardized so that comparisons using the index could be made between locations and between months. It is most effective measuring impacts sensitive to soil moisture conditions, such as agriculture.[47]

At this time, reliable forecasts of drought are not attainable for temperate regions of the world more than a season in advance. However, based on a 100-year history with drought, the state as a whole can expect severe or extreme drought at least 5 percent of the time in the future. As the historical Palmer Drought Severity Index below indicates, between 1895-1995, Lincoln County was in severe or extreme drought conditions 10-14.9% of the time. In 1985-95, the County was in severe or extreme drought conditions 20-30% of the time and in 1976-77, Lincoln County was in severe or extreme drought conditions 30-40% of the time.

[47] Hayes, Michael J. "Drought Indices." National Drought Mitigation Center. Available online at http://drought.unl.edu/whatis/indices.htm#pdsi. 2006.

Figure 4.12. Palmer Drought Severity Index Map.



Chapter 5

Jurisdictional Vulnerability Assessment

IN THIS SECTION:

- Lincoln County Annex
  - City of Davenport Annex
  - City of Sprague Annex
  - Town of Almira
  - Town of Creston
  - Town of Harrington
  - Town of Odessa
  - Town of Reardan
  - Town of Wilbur
  - Lincoln Hospital District
  - Odessa Memorial Healthcare Center

Chapter 5 – Jurisdictional Vulnerability Assessment

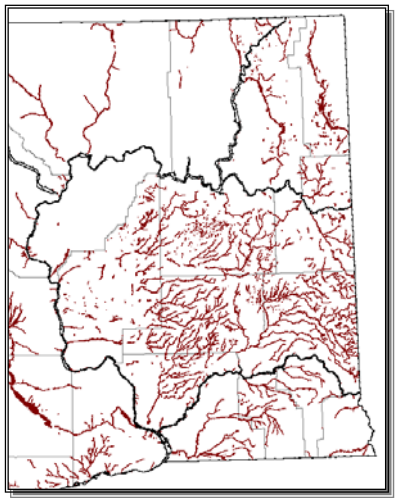
Lincoln County Annex

The Flood Mitigation Plan contained within this Multi – Hazard Mitigation Plan fulfills the requirements of a Flood Mitigation Plan as specified in 44 CFR 78.5 of the Federal Register describing the Flood Mitigation Assistance program. The purpose of this section is to prescribe actions, procedures, and requirements for administration of the Flood Mitigation Assistance (FMA) program, authorized by Sections 1366 and 1367 of the National Flood Insurance Act of 1968, 42 U.S.C. 4104c and 4104d. The goal of FMA is to assist state and local governments in funding cost-effective actions that reduce or eliminate the long term risk of flood damage to buildings, manufactured homes, and other insurable structures.

Flood

The flood history record in Lincoln County is limited to flash floods and relatively small riverine flooding along minor drainages. Although many areas of the county flood on a regular basis, no damages have occurred due to naturally functioning floodplains. Nearly all flood damages within Lincoln County have occurred within the incorporated communities. High intensity rainfall, rain-on-snow and rain-on-frozen soil events have been prominent causes for flooding through the hydrologic record. Floods in Lincoln County may occur at any time between November and June with flash floods from thunderstorms occurring during the summer months.

Figure 5.1. FEMA 100 Year Riverine Flood Hazard Areas in Eastern Washington.



February 1996 Flood - One of the top 10 weather events in Washington during the 20th Century, according to National Weather Service, Seattle Forecast Office. Heavy rainfall, mild temperatures and low-elevation snowmelt caused flooding in Adams, Asotin, Benton, Clark, Columbia, Cowlitz, Garfield, Grays Harbor, King, Kitsap, Kittitas, Klickitat, Lewis, Lincoln, Pierce, Skagit, Skamania, Snohomish, Spokane, Thurston, Wahkiakum, Walla Walla, Whitman and Yakima counties, and the Yakima Indian Reservation. Mudslides occurred throughout the State. Traffic was shut down for several days in most directions. Damage throughout the Pacific Northwest was estimated at $800 million.

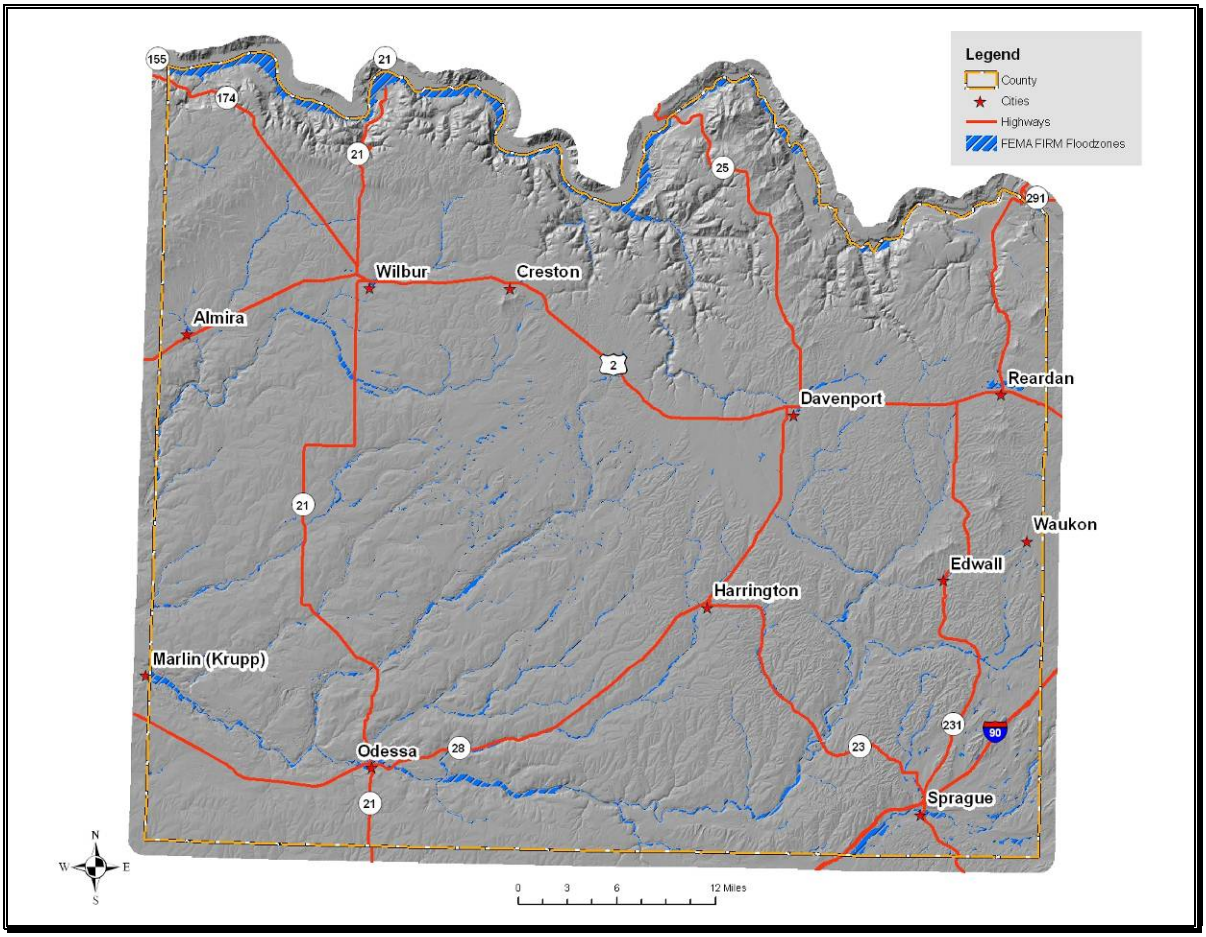
December 1996 –January 1997 Flood – Saturated ground combined with snow, freezing rain, rain, rapid warming, and high winds within a five day period caused heavy flooding. Lincoln County was one of many areas impacted across the State. There were 24 deaths statewide, an estimated $140 million in insured losses, and 250,000 people lost power.

March 1997 Flooding – Heavy rainfall and low-elevation mountain snowmelt caused significant flooding in the counties of Grays Harbor, Jefferson, King, Kitsap, Lincoln, Mason, Pacific, Pierce, Pend Oreille,and Stevens

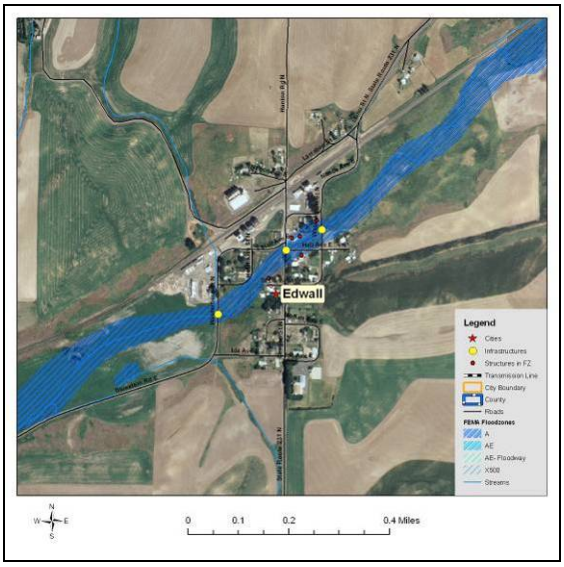
January 2006 Flood - Declared by Governor Gregoire on 12 January 2006, this event was the climax of a month of steady rainfall beginning in mid-December. Initially involving counties in the Puget Sound Basin and Spokane, the declaration eventually was extended to all 39 counties. Flooding, landslides and mudflows seriously impacted state and local transportation infrastructure across the state as well as damaging homes and businesses.

July 2010 Flash Flood – Officials reported flash flooding on Highway 23 between Harrington and Sprague from a thunderstorm predicted to produce ½ inch of rain.

Figure 5.2. FEMA Floodplains in Lincoln County, Washington.



Lincoln County is not considered to be one of the counties most at risk and vulnerable to flood in Washington according to the State of Washington Hazard Mitigation Plan. It is also not in the top percentage of Washington counties having a high frequency of floods causing damage. The Washington



Structures and critical infrastructure in the community of Edwall in unincorporated Lincoln County.

State Hazard Mitigation Plan also reports that Lincoln County has 0 repetitive loss properties.[48] Properties receiving two or more claim payments of more than $1,000 from the National Flood Insurance Program within any rolling 10-year period are considered repetitive loss properties by FEMA.[49]

The only major watershed in Lincoln County is the Columbia River which delineates the northern border of the County. There is very little risk of flooding along the Columbia River as this area is part of the Lake Roosevelt Reservoir. The water level of Lake Roosevelt is monitored and highly regulated for the purposes of providing not only irrigation water to the surrounding agricultural developments and hydroelectric power, but also to provide flood control for communities along this major drainage.

Lincoln County does; however, contain multitudes of small tributaries that meander through mostly large, flat floodplains. These drainages are highly susceptible to flash flood events resulting from thunderstorms, rain-on-snow events, or rapid snowmelt. Riverine flooding is also a common occurrence. Because most of these waterways are shallow, channels are often breached with floodwaters occupying wide floodplains for days at a time. Some of the more significant of these drainages include Lake Creek, Crab Creek, Sinking Creek, Wilson Creek, Hawk Creek, Duck Creek, Rock Creek, and Bluestem Creek. Most of these watersheds originate in Lincoln County and eventually drain into the Columbia River (either on the north end of the County or to the west in Grant County) or Moses Lake. Hundreds of secondary tributaries drain into these waterways.

Sediment has built up in many of the stream channels in Lincoln County. This buildup and subsequent vegetative growth has narrowed channels and restricted the capacity of the stream. These channel restrictions can prevent the stream from following its natural meandering course, which can contribute to changes in the floodplain.

The floodplain in Edwall is caused by a small tributary of Crab Creek. The stream flows in a southwesterly direction through the middle of the community. This stream has caused minor flood damages in the past.

---

[48] Washington Military Department Emergency Management Division. Washington State Hazard Mitigation Plan. Available online at http://www.emd.wa.gov/plans/washington_state_hazard_mitigation_plan.shtml. January 2008.

[49] Washington Military Department Emergency Management Division. Washington State Enhanced Hazard Mitigation Plan. Available online at http://www.emd.wa.gov/plans/washington_state_hazard_mitigation_plan.shtml. January 2008.

Value of Resources at Risk

There are approximately 305 parcels within the FEMA-identified floodplains (100- and 500-year) in unincorporated areas of Lincoln County, yielding a total structure value of $8.5 million. According to Lincoln County Emergency Management and the State Hazard Mitigation Plan, there are currently no repetitive loss properties within Lincoln County. The average damage to structures was estimated based on the parcel's location as either completely within or out of the flood zone. The estimated value of contents is ½ the value of the improvements equating to an additional $4.2 million in potential losses. In reality, the damages will most likely not be equally distributed between buildings based on building materials, building location, and flood location. However, these estimates provide a basic approximation.

Critical infrastructure located within the identified floodplain for unincorporated areas includes 3 bridges near Edwall, the Lincoln Hill boat launch, the Seven Bays boat launch and marina, the Fort Spokane boat launch, the Detillion boat launch, and the Keller Ferry.

Participation in the National Flood Insurance Program (NFIP) and subsequent adoption of the Uniform Building Codes, or more stringent local building codes, provide basic guidelines to communities on how to regulate development. When a county participates in the NFIP it enables property owners in the county to insure against flood losses. By employing wise floodplain management, a participating county can protect its citizens against much of the devastating financial loss resulting from flood disasters. Careful local management of development in the floodplains results in construction practices that can reduce flood losses and the high costs associated with flood disasters to all levels of government.

Table 5.1. NFIP Policy Statistics as of 7/31/2010 in Lincoln County.

Community Name	Policies In-Force	Insurance In-Force	Written Premium In-Force	FIRM Effective Date	Floodplain Ordinance/ Manager	CRS Ranking
Lincoln County (unincorporated	14	$1,740,600	7,458	9/30/1988	Yes/Yes	-
Almira	-	-	-	9/30/1988	No/No	-
Creston	-	-	-	9/30/1988	Yes/Yes	-
Harrington	2	$490,000	629	9/30/1988	Yes/Yes	-
Odessa	33	$3,563,500	24,918	9/30/1988	Yes/Yes	-
Sprague	12	$1,482,900	12,509	9/30/1988	Yes/Yes	-
Wilbur	27	$3,095,700	19,688	9/30/1988	Yes/Yes	-
Reardan	-	-	-	-	No/No	-
Davenport	-	-	-	-	No/No	-

An important part of being an NFIP community is the availability of low cost flood insurance for those homes and businesses within designated flood plains, or in areas that are subject to flooding, but that are not designated as Special Flood Hazard Areas.

Overall participation by individuals and business in the NFIP appears to be low relative to the number of structures within the floodplain. Potential reasons are:

- A lack of knowledge about the existence of the availability of low cost flood insurance.
- Home and business owners unaware of their vulnerability to flood events.

- Current cost of insurance is prohibitive.

The first two reasons can be addressed through public education. The third could be addressed by all communities in the county taking advantage of the Community Rating System (CRS). To encourage communities to go beyond the minimum requirements and further prevent and protect against flood damage, the NFIP established the Community Rating System (CRS). To qualify for CRS, communities can do things like make building codes more rigorous, maintain drainage systems, and inform residents of flood risk. In exchange for becoming more flood-ready, the CRS community's residents are offered discounted premium rates. Based on your community's CRS ratings, you can qualify for up to a 45% discount of your annual flood insurance premium.

Earthquake

Based on historical records, Lincoln County has not experienced any seriously damaging earthquakes in recorded history. Several distant earthquakes produced intensities strong enough to be felt in eastern Washington, but no earthquake epicenters were recorded for the region. [50] All earthquakes in eastern Washington have been shallow and most are at depths less than 6 kilometers. The largest earthquake in eastern Washington since 1969 was a shallow, magnitude 4.4 event northwest of Othello on December 20, 1973. Some of the most active earthquake areas in eastern Washington are near Entiat, south of Lake Chelan, and in the Saddle Mountains, south of Vantage. Many of the earthquakes in eastern Washington occur in clusters near the Saddle Mountains in folded volcanic rocks, which were extruded in southeastern Washington from 16.5 to 6 million years ago.[51]

Communities in Lincoln County can expect some structural failure of older multistory unreinforced masonry buildings as a result of even lower intensity earthquakes. Cornices, frieze, and other heavy decorative portions of these types of structures may fail. The potential impacts of a substantial earthquake event are highly variable. Many of the structures and infrastructure throughout the county may not incur any damages at all; however, damage to roads, bridges, unreinforced masonry, chimneys, foundations, water lines, and many other components are at risk. Fires can also be a secondary hazard to structures sustaining earthquake damage.

Because structural damage by earthquakes is typically not complete destruction, but rather tends to be subtle cracking or settling that undermines the stability of the structure. These types of repairs can be very costly. Additionally, changes to the water table or even the topography can significantly impact local municipal and private wells and could result in the loss of traditional land uses.

There are at least seven known geologic folds in the western part of Lincoln County. These folds reach into the County from the west and dead-end. Peak ground acceleration (pga) in percent g is a measure of the ground motion, which decreases, the further you are from the earthquake. The USGS Shaking Hazard maps

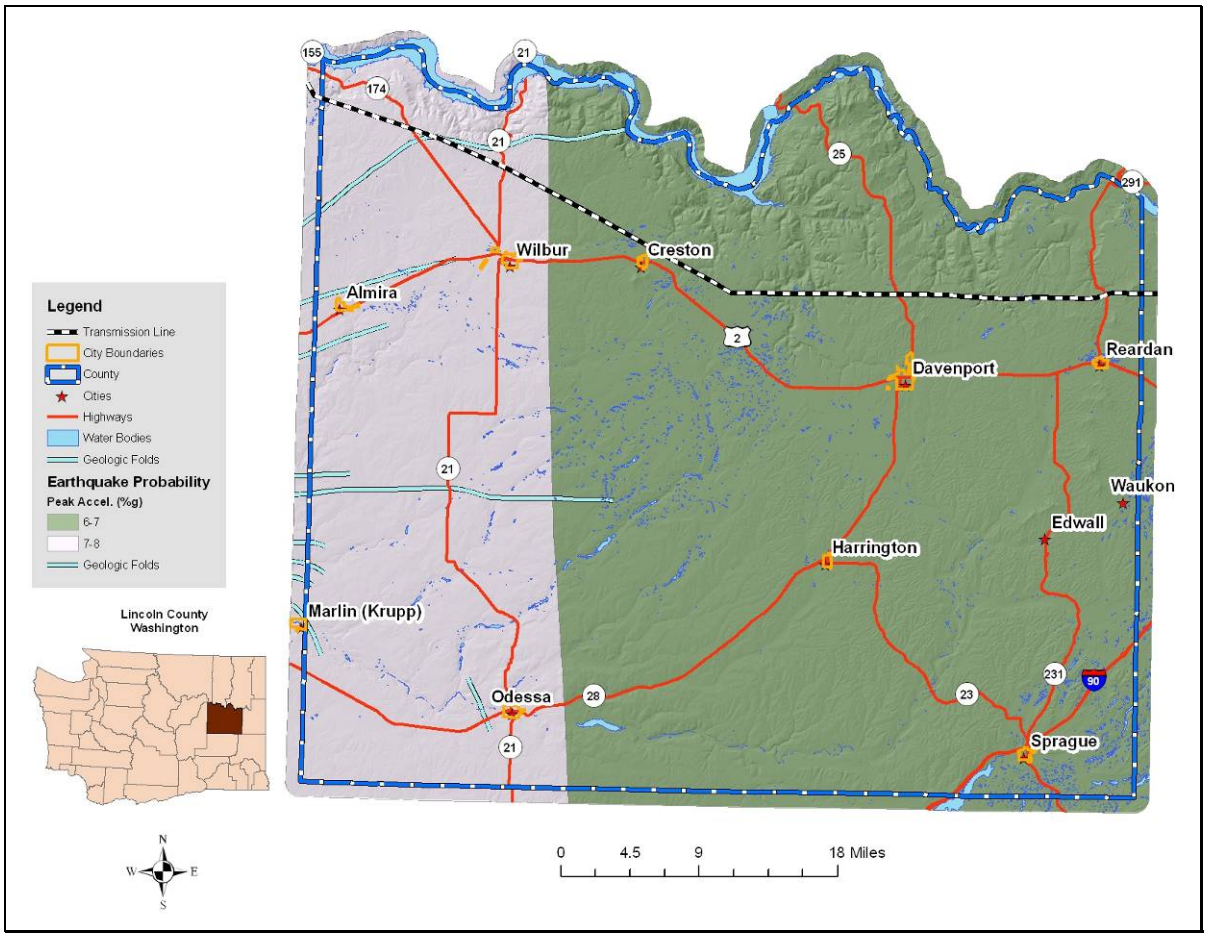
---

[50] Noson, Linda Lawrance, et al. Washington State Earthquake Hazards. Washington Division of Geology and Earth Resources Information Circular 85. Olympia, Washington. 1988.

[51] Noson, Linda, et al. 1988. "Washington State Earthquake Hazards". Washington Division of Geology and Earth Resources. Olympia, Washington. Information Circular 85.

for the United States are based on current information about the rate at which earthquakes occur in different areas and on how far strong shaking extends from quake sources. Colors on the map show the levels of horizontal shaking that have a 1 in 10 chance of being exceeded in a 50-year period. Shaking is expressed as a percentage of "g" (g is the acceleration of a falling object due to gravity). This map is based on seismic activity and fault-slip rates and takes into account the frequency of occurrence of earthquakes of various magnitudes. Locally, this hazard may be greater than that shown, because site geology may amplify ground motions. As seen in Figure 5.3, much of the western third of Lincoln County has 10% chance of exceeding a 7-8% pga in the next 50 years. This probability trends downwards to a 6-7% pga on the eastern two-thirds of the County.[52] No specific jurisdictions or special districts were identified as having differing issues or levels of risk associated with this hazard.

Figure 5.3. Regional Earthquake Probability Map.



Past events suggest that an earthquake in the Lincoln County area would cause little to no damage. Nonetheless, severity can increase in areas that have softer soils, such as unconsolidated sediments. Damage would be negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; and considerable in poorly built, old, or badly designed structures.

[52] USGS. 2008 United States National Seismic Hazard Maps. U.S. Geological Survey. U.S. Department of Interior. Available online at http://earthquake.usgs.gov/hazards/products/conterminous/2008/. October 2009.

Value of Resources at Risk

Unreinforced masonry (URM) structures and unreinforced chimneys of homes will likely be damaged in the event of an earthquake. Damaged or collapsed chimneys could result in the secondary hazard of fire. Nonstructural damage caused by falling and swinging objects may be considerable after any magnitude earthquake. Damage to some older, more fragile bridges and land failure causing minor slides along roadways may isolate some residents.

The only known publicly accessible unreinforced masonry structure in unincorporated Lincoln County is the Guardhouse at Fort Spokane. This building is a historical structure built in the late 1800s by the Army and is currently used as a Visitor's Center from May to September. The value of this structure is not determinable.

Landslide

To date, there is no recorded history of major landslides occurring in Lincoln County; however, there is evidence of past landslides along the Columbia River on the northern edge of Lincoln County. The probability of a major landslide event in Lincoln County is moderate to low. Nevertheless, there are some areas in Lincoln County that have specific landslide concerns. Areas that are generally prone to landslides are:

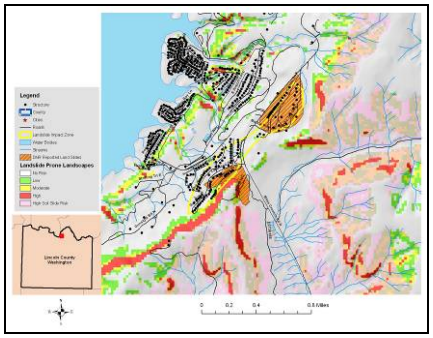
- On existing landslides, old or recent
- On or at the base or top of slopes
- In or at the base of minor drainage hollows
- At the base or top of an old fill slope
- At the base or top of a steep cut slope

The only major landslide potential in Lincoln County occurs along the Columbia River drainage. While ancient alluvial fans provide evidence of historic landslides, the occurrence of new landslides and the reactivation of old landslides increased dramatically with the filling of reservoirs behind the Grand Coulee and Chief Joseph dams. Drawdowns for flood control and power generation also trigger new landslides and/or reactivate and extend old ones. Some of the landslide complexes extend for thousands of feet along the lakeshore, have head scarps in terraces 300 feet or more above reservoir level and extend well below its surface. With landslide activity common along hundreds of miles of shoreline, one hazard in such a setting is waves generated by fast-moving landslide masses. In Lincoln County, not all of the Lake Roosevelt shoreline is at risk to landslides and development has only occurred in specific areas rather than along the entire extent of the shore. The probability of occurrence of major, high velocity landslide events in this area, including those caused by severe local storms, is moderate.

Landslide near Mill Canyon 2009

July 1949 Landslide – A two to three million cubic yard landslide near the mouth of Hawk Creek created a 65-foot wave that crossed the lake about 35 miles above Grand Coulee Dam.

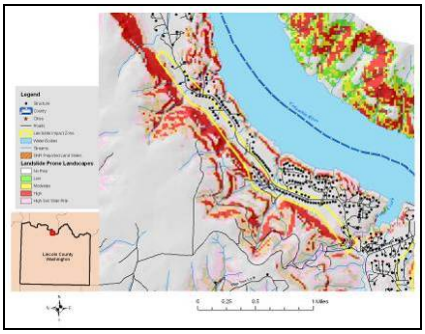
January 2009 Landslide – Property owners in the Spokane Arm of Lake Roosevelt were swamped by a huge wave caused by a 17 acre landslide near Mill Canyon northeast of Davenport. The resulting wave reached 30 feet above the full pool mark across the lake at Breezy Bay. Private docs and vessels were destroyed or damaged up to 1.5 miles downstream. The water reached one residence before receding and came up to the foundations of several others.



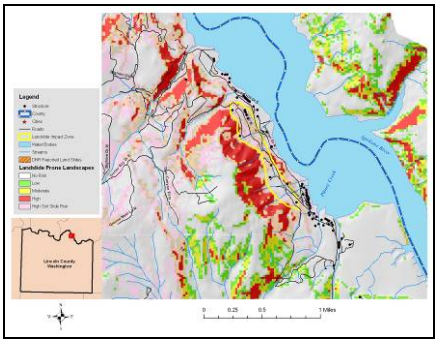
Seven Bays Landslide Impact Zone

The majority of the population in Lincoln County has a low risk of landslides; however, homes and infrastructure located in or at the mouth of drainages have an elevated risk. Additionally, sections of some primary access routes are in low to moderate landslide prone areas. There is a moderate probability of small slides occurring on slopes ranging from 5-35%. This type of slide is common on the eyebrows of hills, especially where there has been soil disturbance. Generally, these low angle slides will have a low velocity and will not impact structures or infrastructure.

Soil factors that increase the potential for landslide are soils developed from parent materials high in schist and granite, and soils that are less permeable containing a resistive or hardpan layer. These soils tend to exhibit higher landslide potential under saturated conditions than do well-drained soils. To identify the high-risk soils in Clearwater County, the NRCS State Soils Geographic Database (STATSGO) layer was used to identify the location and characteristics of all soils in the County. The specific characteristics of each major soil type within the County were reviewed. Soils information that suggested characteristics pertaining to very low permeability and/or developed a hardpan layer and soils developed from schist and granite parent material were selected as soils with potential high landslide risk. High-risk soils magnify the effect slope has on landslide potential. Soils identified as having high potential landslide risk are further identified only in areas with slopes between 14° and 30° (25-60%). It is these areas that traditionally exhibit the highest landslide risk due to soil characteristics within a given landscape.



Sterling Valley Landslide Impact Zone



Porcupine Bay Landslide Impact Zone

To portray areas of probable landslide risk due to slope related factors, slope models were used to identify areas of low, moderate and high risk. This analysis identified the low risk areas as slopes in the range of 20°-25° (36-46%), moderate as 26°-30° (48-60%) and high risk as slopes in the range of 31°-60° (60-173%). Slopes that exceeded 60° (173%) were considered low risk due to the fact that sliding most likely had already occurred relieving the area of the potential energy needed for a landslide. From the coverage created by these two methods, it is possible to depict areas of assumed risk and their proximity to

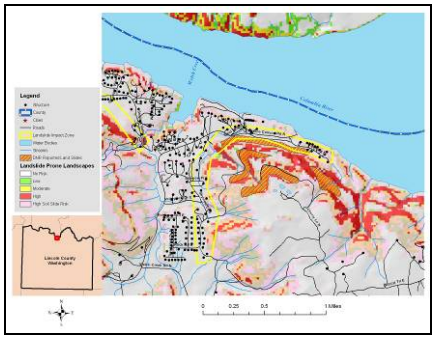
development and human activity. With additional field reconnaissance the areas of high risk can be further defined by overlaying additional data points identifying actual slide locations, thus improving the resolution by specifically identifying the highest risk areas. This method of analysis is similar to a method developed by the Clearwater National Forest in north central Idaho.[53]

The majority of the landslide potential in Lincoln County occurs in the steep canyons along the Columbia River. The canyons associated with Columbia River and Lake Roosevelt have a high propensity for slides based on the steeper slopes, unstable soils, and history of occurrence. Wildfires and/or severe storms that saturate the soils could lead to major slide events in these areas.

The Seven Bays, Porcupine Bay, Sterling Valley, and Redwine Canyon Landslide Impact Zones encompass relatively large population clusters along the Lake Roosevelt shoreline. In addition to the residences, landslides in these Impact Zones may affect several of county access roads. In many cases, there is only one well-maintained access route into the residential areas; thus, a closure or temporary delay could cause serious traffic concerns and possibly isolated some residents for an extended period of time.

Many of the slopes and hillsides in these impact zones are comprised by material deposited by past landslides. In fact, much of the lower slopes near the valley floors are alluvial fans created by sediment being carried downstream and deposited at the mouths of the numerous small drainages. The Washington Department of Natural Resources has mapped areas of past landslide events in the Seven Bays and Redwine Canyon Impact Zones. The presence of deposited material indicates the historic occurrence of high-energy, short duration floods and debris flows in these chutes in response to severe climatic conditions, such as thunderstorms and rain-on-snow events. These events are historically infrequent, with recurrence cycles on the order of years to decades. However, they can result in significant damage to buildings and infrastructure, disrupt travel, reduce water quality, and jeopardize safety.

The largest landslides typically occur where human development or disturbance has exposed landslide-prone sediments to steep topography. The abundance of development within the Landslide Impact Zones, both residential and roadway, is likely further undermining the stability of the slope. Today, initiation and reactivation of landslides is closely tied to unusual climatic events and land-use changes. Even small landslide activity on the upper slopes can transform into high-energy debris flows that endanger roads, buildings, and people below. Landslide debris is highly unstable when modified through natural variations in precipitation, artificial cuts, fills, and changes to surface drainage and ground water.[54]



Redwine Canyon Landslide Impact Zone

[53] McClelland, D.E., et al. 1977. Assessment of the 1995 and 1996 floods and landslides on the Clearwater National Forest Part 1: Landslide Assessment. Northern Region U.S. Forest Service. December 1977.

[54] Weisz, D.W., et al. 2003. Surficial Geological Map of the Payette Quadrangle. Idaho and Lewis Counties, Idaho. Idaho Geological Survey.

Wildfires in theses impact zones could cause a domino effect of multiple hazards. Higher intensity fires not only remove most of the vegetation, but they also cause soils to become hydrophobic or water repellent for a period of time after the fire. This combination leads to unusually high runoff after rain showers or during the spring runoff season. As streams and rivers begin to reach and exceed flood stage, bank failures and channel migration are common. Road building and other soil disturbances tend to exacerbate this effect leading to even more severe land and soil slides.

Value of Resources at Risk

The cost of cleanup and repairs of roadways is difficult to estimate due to the variable circumstances with each incident including size of the slide, proximity to a State or County shop, and whether the slide occurred on the cut slope or the fill slope. Other factors that could affect the cost of the damage may include culverts, streams, and removal of debris. This type of information is impossible to anticipate; thus, no repair costs for damaged roadways have been estimated.

Table 5.2. Landslide Impact Zones in Lincoln County.

Landslide Impact Zone	Number of Structures	Value of Structures at Risk
Seven Bays	90	$6,686,612
Porcupine Bay	10	$742,956
Sterling Valley	52	$3,863,375
Redwine Canyon	44	$3,269,010
Total	**196**	**$14,561,955**

Slides in the identified Impact Zones are more likely to be larger and more damaging as weaknesses in the underlying rock formations give way. Although infrequent, this type of slide has the potential to not only block, but destroy road corridors, dam waterways, and demolish structures. The highest risk areas in these impact zones are typically at the higher elevations where slopes exceed 25% grade. There are numerous homes in each of these impact zones. Single slide events will not likely impact the entire population, but rather individual structures. Many of the main access and secondary roads could also be at risk from slides initiating in these impact zones.

Severe Weather

Severe weather in Lincoln County ranges from the commonly occurring thunderstorms to hail, high winds, tornadoes, drought, dense fog, lightning, and snow storms.

All of Lincoln County is at risk to severe winter weather events and there is a high probability of their continued occurrence in this area. Due to topography and climatologic conditions, the higher elevations are often the most exposed to the effects of these storms. Commonly, higher elevations in the County will receive snowfall, while areas along the Lake Roosevelt shoreline may not. Periodically though, individual storms can generate enough force to impact the entire County at one time. From high winds to ice storms to freezing temperatures, there are all types of winter storms that take place during the course of any given year. Winter conditions can change very rapidly. It is not uncommon to have a snowstorm at night with sunshine the next day. Winter storms with heavy snow, high winds, and/or extreme cold can have a considerable impact on Lincoln County; however, most residents are well accustomed to the severe winter

conditions in this part of Washington. Power outages and unplowed roads are a frequent occurrence throughout many parts of the County, but most residents are prepared to handle the temporary inconvenience.

Wind usually accompanies snow storms in Lincoln County; thus, large accumulations are not common as most of the snow is blown away. Commonly, heavy drifting is the cause of disruptions to normal commuting activities (delays and inability to plow roads and driveways). When coupled with extreme cold weather, severe winter storms have a detrimental impact on residents in Lincoln County, particularly the senior population. Severe winter storms also have the potential to cause large losses among livestock and wildlife. Animal losses are usually the result of dehydration rather than cold or suffocation.

Snow loads on roofs, ice-slides off of roofs onto vehicles or other buildings, and damaged frozen pipes are also potential hazards associated with winter weather. These events represent a significant hazard to public health and safety, a substantial disruption of economic activity, and a constant threat to structures during the winter months. An average of at least two severe storms is anticipated each winter in Lincoln County. Lincoln County is not considered to be one of the counties most vulnerable to winter storms and blizzards in Washington according to the Washington State Hazard Mitigation Plan.[55]

January 1950 "The January 1950 Blizzard" - On this date, 21.4 inches of snow fell in Seattle, the second greatest 24-hour snowfall recorded. The snowfall was accompanied by 25-40 mph winds. The storm claimed 13 lives in the Puget Sound area. January had 18 days with high temperatures of 32 degrees or lower. The winter of 1949-50 was the coldest winter on record in Seattle, with an average temperature of 34.4 degrees. Eastern Washington, North Idaho, and parts of Oregon also were paralyzed by the snow – some lower-elevation snow depths reached nearly 50 inches and temperatures plunged into minus teens and twenties. Several dozen fatalities occurred.

1962 Columbus Day Wind Storm - The top weather event in Washington during the 20th Century, according to the National Weather Service, Seattle Forecast Office. This storm is the greatest windstorm to hit the Northwest since weather recordkeeping began in the 19th century, and called the "mother of all wind storms" in the 1900s. The Columbus Day Storm was the strongest widespread non-tropical windstorm to strike the continental U.S. during the 20th century, affecting an area from northern California to British Columbia. The storm claimed seven lives in Washington State; 46 died throughout the impacted region. One million homes lost power. More than 50,000 homes were damaged. Total property damage in the region was estimated at $235 million (1962 dollars). The storm blew down 15 billion board feet of timber worth $750 million (1962 dollars); this is more than three times the timber blown down by the May 1980 eruption of Mount St. Helens, and enough wood to replace every home in the state. Gusts of 88 miles per hour were recorded at Tacoma before power was lost to the recording stations.

February 1996 Severe Storm – Federal Disaster #1100. Stafford Act disaster assistance provided was $113 million. Small Business Administration disaster loans approved totaled $61.2 million. Heavy rainfall, mild temperatures and snowmelt caused flooding and mudslides in Adams, Asotin, Benton, Clark, Columbia,

---

[55] Washington Military Department Emergency Management Division. Washington State Hazard Mitigation Plan. Available online at http://www.emd.wa.gov/plans/washington_state_hazard_mitigation_plan.shtml. January 2008.

Cowlitz, Garfield, Grays Harbor, King, Kitsap, Kittitas, Klickitat, Lewis, Lincoln, Pierce, Skagit, Skamania, Snohomish, Spokane, Thurston, Wahkiakum, Walla Walla, Whitman and Yakima counties, and the Yakama Indian Reservation. This storm caused major flooding on rivers of western and southeast Washington. Mudslides occurred throughout the state. There were three deaths recorded and 10 people injured. Nearly 8,000 homes damaged or destroyed. Traffic flow both east and west, and north and south along major highways was shut down for several days. Damage throughout the Pacific Northwest estimated at $800 million.

December 1996 - January 1997 Severe Storm – Federal Disaster #1159. Stafford Act disaster assistance provided was $83 million. Small Business Administration loans approved totaled 31.7 million. Saturated ground combined with snow, freezing rain, rain, rapid warming and high winds within a five-day period produced flooding and landslides. Impacted counties – Adams, Asotin, Benton, Chelan, Clallam, Clark, Columbia, Cowlitz, Douglas, Ferry, Franklin, Garfield, Grant, Grays Harbor, Island, Jefferson, King, Kitsap, Kittitas, Klickitat, Lewis, Lincoln, Mason, Okanogan, Pacific, Pend Oreille, Pierce, San Juan, Skagit, Skamania, Snohomish, Spokane, Stevens, Thurston, Walla Walla, Whatcom, and Yakima. There was twenty-four deaths; $140 million (est.) in insured losses; and 250,000 people lost power.

June 2009 Tornadoes near Creston

June 2009 Tornadoes – The tornadoes in grain fields south or U.S. Highway 2 between Creston and Wilbur caused limited damage and were classified at the lowest level, zero, on the Enhanced Fujita Scale (EF0). Under the scale, wind gusts could reach 65 to 85 mph. The thunderstorm was centered northwest of Sprague in Lincoln County. It dropped hail of one inch in diameter at the west side of Sprague Lake and caused flooding across a rural highway northwest of Sprague.

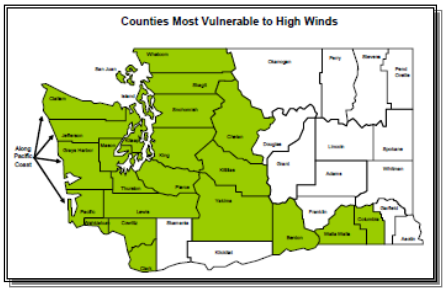
January 2009 Ice Storm – Freezing fog caused power lines and tree limbs to snap throughout Lincoln County. More than 1,600 electrical customers were without power. The Sheriff's dispatch center had to switch to generators for power. Early estimates indicated that the recent ice damage, snow storms, and flooding in the Spokane area left $100 million in damages.

March 2009 Winter Storm - President Obama declared that a major disaster exists in the State of Washington. This declaration made Public Assistance requested by the Governor available to State and eligible local governments and certain private nonprofit organizations on a cost-sharing basis for emergency work and the repair or replacement of facilities damaged by the severe winter storm and record and near record snow in Clallam, Clark, Columbia, Cowlitz, Garfield, Grays Harbor, Island, Jefferson, King, Klickitat, Lewis, Lincoln, Mason, Pacific, Pend Oreille, Skagit, Skamania, Snohomish, Spokane, Stevens, Thurston, Wahkiakum, Walla Walla, and Whatcom Counties.[56]

[56] FEMA. 2009. *Severe Winter Storm and Record and near Record Snow*. FEMA 1825-DR. Available online at http://www.fema.gov/pdf/news/pda/1825.pdf.

Due to their relative frequency and minimal severity, severe thunderstorms are not well documented in Lincoln County. Their impacts are fairly limited and do not significantly affect the communities enough to declare a disaster. The secondary impacts of thunderstorms, floods, are emphasized within the flood chapter of this document. Areas most vulnerable to this type of storm are those subject to a strong southwesterly flow of moist, unstable air that generates strong, sometimes violent thunderstorms with one or more of the following characteristics: strong damaging winds, large hail, waterspouts, or tornados.

Hail can occur in any strong thunderstorm, which means hail is a threat everywhere. Hail is precipitation that is formed when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere. Large hail stones can fall at speeds faster than 100 miles per hour. Hail damage in Washington is very small in comparison with damage in areas of the central part of the United States. Often the hail that occurs does not grow to a size larger than one-half inch in diameter, and the areas affected are usually small. Quite often hail comes during early spring storms, when it is mostly of the small, soft variety with a limited damaging effect. Later, when crops are more mature and more susceptible to serious damage, hail occurs in widely scattered spots in connection with summer thunderstorms. The potential impacts of a severe hail storm in Lincoln County include crop damage, downed power lines, downed or damaged trees, broken windows, roof damage, and vehicle damage. Hail storms can, in extreme cases, cause death by exposure. The most common direct impact from ice storms to people is traffic accidents. Over 85% of ice storm deaths nationwide are caused by traffic accidents. Hail storms also have the potential to cause losses among livestock. The highest potential damage from hail storms in Lincoln County is the economic loss from crop damage. Even small hail can cause significant damage to young and tender plants and fruit. Trees can also be severely damaged by hail as was seen in the 1996 ice storm near Spokane, Washington.



Windstorms are frequent in Lincoln County and they have been known to cause substantial damage. Under most conditions, the County's highest winds come from the south or southwest. Due to the abundance of agricultural development in Lincoln County, crop damage due to high winds can have disastrous effects on the local economy. In the case of extremely high winds, some buildings may be damaged or destroyed. Wind damages will generally be categorized into four groups: 1) structure damage to roofs, 2) structure damage from falling trees, 3) damage from wind blown dust on sensitive receptors, or 4) wind driven wildfires. Structural injury from damaged roofs is not uncommon in Lincoln County. Structural damage from falling trees is also relatively common. Many homeowners have planted ornamental trees for shade and windbreak protections. However, many of these trees are located near, and upwind of homes putting them at risk to falling trees which could cause substantial structural damage and potentially put lives at risk. Airborne particulate matter increases during high wind events. When this occurs, sensitive receptors including the elderly and those with asthma are at increased risk to complications. The National Weather Service defines high winds as sustained winds of 40 mph or gusts of 58 mph or greater, not caused by thunderstorms, expected to last for an hour or more. Areas most vulnerable to high winds are those affected by a strong pressure difference from deep storms originating over the Pacific Ocean; an outbreak of very cold, Arctic air originating over Canada; or air pressure

differences between western and eastern Washington that primarily affect the Columbia River Gorge, Cascade Mountain passes, ridges and east slopes, and portions of the Columbia Basin. Lincoln County is not considered to be one of the most vulnerable to high winds in Washington State according to the Washington State Hazard Mitigation Plan.[57]

Lincoln County and the entire region are at increased risk to wildfires during high wind events. Ignitions can occur from a variety of sources including downed power lines, lightning, or arson. Once ignited, only wildfire mitigation efforts around the community and scattered homes will assist firefighters in controlling a blaze. Details about wildfire mitigation are discussed in the wildland fire annexes of this Multi - Hazard Mitigation Plan.

A tornado is formed by the turbulent mixing of layers of air with contrasting temperature, moisture, density, and wind flow. This mixing accounts for most of the tornadoes occurring in April and May, when cold, dry air from the north or northwest meets warm, moister air moving up from the south. If this scenario was to occur and a major tornado was to strike a populated area in Lincoln County, damage could be widespread. Businesses could be forced to close for an extended period, and routine services such as telephone or power could be disrupted. The National Weather Service defines a tornado as a violently rotating column of air that contacts the ground; tornados usually develop from severe thunderstorms. Areas most vulnerable to tornado are those subject to severe thunderstorms or those with a recurrence rate of 5 percent or greater, meaning the County experiences one damaging severe thunderstorm event at least once every 20 years.

According to the Tornado Project[58] and the National Climatic Data Center[59], there were 6 reports of tornadoes in Lincoln County between 1880 and 2000. They occurred in May 1957 (F0), April 1972 (F3), August 1978 (F1), May 1979 (F1), May 1997 (F1), and June 2009 (F0-1). There were 5 separate funnel clouds in the Davenport and Creston areas associated with the June 2009 event. The 1972 tornado was recorded as an F3 on the Fujita Tornado Scale, which correlates to approximately 158 to 206 mile per hour winds. This storm caused 1 injury.

Lincoln County Road in Winter 2009

[57] Washington Military Department Emergency Management Division. Washington State Hazard Mitigation Plan. Available online at http://www.emd.wa.gov/plans/washington_state_hazard_mitigation_plan.shtml. January 2008.

[58] Tornado Project. 1999. St. Johnsbury, Vermont. Available online at http://www.tornadoproject.com/alltorns/watorn.htm#Columbia.

[59] National Climatic Data Center. 2010. *Storm Events Database*. NOAA Satellite and Information Service. U.S. Department of Commerce. Available online at http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms.

Value of Resources at Risk

It is difficult to estimate the cost of potential winter storm damages to structures and the economy in Lincoln County. Damage to roofs by heavy snow accumulations depends on the moisture content of the snow and the structural characteristics of the buildings. In general, snow in this region tends to have low moisture content because of the low temperatures and arid environment. Additionally, due to the lack of significant topographic features, the wind tends to blow much of the snow accumulation away. Frozen water pipes are the most common damage to residential and business structures. Older homes tend to be at a higher risk to frozen water pipes than newer ones. Snow plowing in Lincoln County occurs from a variety of departments and agencies. The state highways are maintained by the State of Washington. Plowing of county roads is done by the County Road Department and the road departments of the individual cities. Private landowners are responsible for maintaining their own driveways or other private roads. Utility supplies are impacted during severe winter storms as power is lost on a regional basis. This has a two-fold impact on Lincoln County residents as not only is power cut to homes and businesses, but primary heating is lost for many residents. Gas furnaces and wood stoves supplement electrical heating, but with wood heating the senior population is at a disadvantage. Emergency response to severe winter storms includes site visits by police or fire department personnel, opening of shelters, or assistance with shopping, medical attention, and communications. The economic losses caused by severe winter storms may frequently be greater than structural damages. Employees may not be able to travel to work for several days and businesses may not open. Damages are seen in the form of structural repair and loss of economic activity. Lincoln County schools are occasionally closed during and right after a severe winter storm because of cold temperatures and snow covered roads.

Thunderstorms do occur within Washington affecting all counties, but usually are localized events. Their impacts are fairly limited and do not significantly affect the communities enough to declare a disaster. The loss potential from flooding that results from severe thunderstorms can be significant in Lincoln County.

Although the financial impacts of hail can be substantial and extended, accurately quantifying these impacts is problematic. Hail typically causes direct losses to structures and other personal property as well as to the extensive agricultural development in Lincoln County. Potential losses to agriculture can be disastrous. They can also be very localized; thus, individual farmers can have significant losses, but the event may not drastically affect the economy of the County. Furthermore, crop damage from hail will also be different depending on the time of year and the type of crop. Most farmers carry insurance on their crops to help mitigate the potential financial loss resulting from a localized hail storm. Federal and state aid is available for County's with declared hail disasters resulting in significant loss to local farmers as well as the regional economy. Homeowners in Lincoln County rarely incur severe damage to structures (roofs); however, hail damage to vehicles is not uncommon. The damage to vehicles is difficult to estimate because the number of vehicles impacted by a specific ice storm is unknown. Additionally, most hail damage records are kept by various insurance agencies.

It is difficult to estimate potential losses in Lincoln County due to windstorms and tornadoes. Construction throughout the County has been implemented in the presence of high wind events, and therefore, the community is at a higher level of preparedness to high wind events than many other areas experiencing lower average wind speeds.

We have estimated losses based on wind and tornado damage as follows:

- 3% of the buildings damaged causing 50% of value loss (loss could be from downed or damaged trees, damaged outbuildings, damaged fences/poles, damage to siding, damaged landscaping etc.)
- 5% of the buildings received damage to roof (requiring replacement of roof equaling $3,000)

Damages associated with sensitive receptor irritation have not been estimated. We have also not estimated the potential for a large scale wildfire event associated with high winds. Based on the data provided by the County, there are 4,861 total structures in unincorporated Lincoln County with a total value of approximately $361.2 million. Using the criteria outlined above an estimate of the impact of high winds on the County has been made. The potential wind and tornado damage to all buildings is estimated at approximately $5.4 million. The estimated damage to roofs is approximately $729,000.

Power failure often accompanies severe storms. More rural parts of the County are sometimes better prepared to deal with power outages for a few days due to the frequent occurrence of such events; however, prolonged failure, especially during cold winter temperatures can have disastrous effects. All communities should be prepared to deal with power failures. Community shelters equipped with alternative power sources will help local residents stay warm and prepare food. A community-based system for monitoring and assisting elderly or disabled residents should also be developed. All households should maintain survival kits that include warm blankets, flashlights, extra batteries, nonperishable food items, and clean drinking water.

Wildland Fire

The Lincoln County Community Wildfire Protection Plan[60] provides a comprehensive analysis of the wildland fire risks and recommended protection and mitigation measures for all jurisdictions in Lincoln County. The information in the "Wildland Fire" sections of this Lincoln County Annex is excerpted from that more detailed document.

Lincoln County is located in northeast Washington. The county encompasses approximately 2,311 square miles and has an elevation range of 980 to 3,500 feet above sea level. Land is owned by private individuals, corporations, the state of Washington, and the federal government. Federal lands are managed by the Bureau of Land Management, National Park Service, and the Bureau of Reclamation. State lands include parcels managed by the Washington Department of Natural Resources and Washington Department of Fish and Wildlife. Lincoln, the seventh largest county in the state, is bordered on the west by Grant County, to the south by Adams and Whitman County, to the east by Spokane County, and to the north by Stevens County, Ferry County, and a small part of Okanogan County. Lincoln County lies within the channeled scablands of the Columbia Basin, a region formed by ice age flooding and wind blown volcanic ash. Many small pothole lakes are scattered throughout the scoured basalt scablands connected by Lake Creek and Crab Creek on the southern and eastern side of the county. The terrain is predominantly flat with alternating rolling hills and shallow canyons or coulees. Along the northern boundary the topography

[60] King, Tera and V. Bloch. 2008. Lincoln County Community Wildfire Protection Plan. Northwest Management, Inc.. Moscow, Idaho.

becomes steep as it plunges into wide valleys formed by the Spokane and Columbia Rivers. The mild climate, abundance of sunshine and low annual precipitation results in an environment that is potentially very prone to wildland fire. Although much of the native grasslands have been converted for agricultural purposes, there are many areas of native vegetation and fallow farm land that cures early in the summer and remains combustible until winter. If ignited, theses areas burn rapidly, potentially threatening people, homes, and other valued resources.

Cover vegetation and wildland fuels exhibited across the county have been influenced by massive geologic events during the Pleistocene era that scoured and shifted the earths surface leaving areas of deep rich soil interspersed with rocky canyons and deep valleys. In addition to the geological transformation of the land, wildland fuels vary within a localized area based on slope, aspect, elevation, management practices, and past disturbances. Geological events and other factors have created distinct landscapes that exhibit different fuel characteristics and wildfire concerns.

In order to facilitate a mutual understanding of wildfire risks specific to commonly known areas in the county, the landscape-level wildfire risk assessments in the following sections are based on four predominant landscapes types that exhibit distinct terrain and wildland fuels. The four landscapes identified for the assessments are: agricultural lands, channeled scablands, western river breaks and eastern river breaks. These landscapes, although intermixed in some areas, exhibit specific fire behavior, fuel types, suppression challenges, and mitigation recommendations that make them unique from a planning perspective.

The gentle terrain that dominates Lincoln County facilitates extensive farming and ranching operations. Agricultural fields occasionally serve to fuel a fire after curing; burning in much the same manner as low grassy fuels. Fires in grass and rangeland fuel types tend to burn at relatively low intensities with moderate flame lengths and only short-range spotting. Common suppression techniques and resources are generally quite effective in this fuel type. Homes and other improvements can be easily protected from direct flame contact and radiant heat through adoption of precautionary measures around structures. Rangelands with a significant shrub component will have much higher fuel loads with greater spotting potential than grass and agricultural fuels. Although fires in agricultural and rangeland fuels may not present the same control problems as those associated with large, high intensity fires in timber, they can cause significant damage if precautionary measures have not been taken prior to a fire event. Wind driven fires in these fuel types spread rapidly and can be difficult to control. During extreme drought and when pushed by high winds, fires in agricultural and rangeland fuels can exhibit extreme rates of spread, which complicates suppression efforts.

Forest and woodland fuels are mostly present in the canyons and river breaks on sloping terrain less favorable to clearing for agricultural development. A patchwork of ponderosa pine and Douglas-fir stands occupy sheltered areas on favorable soil where moisture is not a limiting factor. Wooded areas tend to be on steep terrain intermingled with grass and shrubland providing an abundance of ladder fuels which lead to horizontal and vertical fuel continuity. These factors, combined with arid and windy conditions characteristic of the river valleys in the region, can result in high intensity fires with large flame length and fire brands that may spot long distances. Such fires present significant control problems for suppression resources and often results in large wildland fires.

Development is rapidly occurring along the Spokane and Columbia River breaks on the north side of the county. Many people have purchased small tracts of land in this location and built dwellings amongst the trees and shrubland. Scenic vistas and rolling topography with close proximity to Lake Roosevelt National Recreation Area make this area desirable. However, the risk of catastrophic loss from wildfires in this area is significant. Fires igniting along the bottom of the canyon have the potential to grow at a greater rate of speed on the steeper slopes and rapidly advance to higher elevations. Within the forest and woodland areas, large fires may easily produce spot fires up to 2 miles away from the main fire, compounding the problem and creating fires on many fronts. Fire suppression efforts that minimize loss of life and structures in this area are largely dependent upon access, availability and timing of equipment, prior fuels mitigation activities, and public awareness.

Fire was once an integral function of the majority of ecosystems in northeastern Washington. The seasonal cycling of fire across the landscape was as regular as the July, August and September lightning storms plying across the canyons and mountains. Depending on the plant community composition, structural configuration, and buildup of plant biomass, fire resulted from ignitions with varying intensities and extent across the landscape. Shorter return intervals between fire events often resulted in less dramatic changes in plant composition.[61] The fires burned from 1 to 47 years apart, with most at 5- to 20-year intervals.[62] With infrequent return intervals, plant communities tended to burn more severely and be replaced by vegetation different in composition, structure, and age.[63] Native plant communities in this region developed under the influence of fire, and adaptations to fire are evident at the species, community, and ecosystem levels. Fire history data (from fire scars and charcoal deposits) suggest fire has played an important role in shaping the vegetation in the Columbia Basin for thousands of years.

Detailed records of fire ignitions and extents have been compiled by the Washington Department of Natural Resources and the Lincoln County Fire Districts. Using the data on past fire extents and ignition, the occurrence of wildland fires in the region of Lincoln County has been evaluated.

The Washington Department of Natural Resources database used in this analysis includes ignition and extent data from 2004 through 2008 for wildfires occurring on DNR protected lands, which are located primarily north of Highway 2 in Lincoln County. An analysis of the DNR reported wildfire ignitions in Lincoln County reveals that during this period over 25,000 DNR-protected acres burned as a result of 36 wildfire ignitions. The Miscellaneous ignition source category resulted in both the most number of ignitions and by far the most acres burned. However, the majority of the acres burned in this category occurred in 2008 as a result the Swanson Lake Fire (19,096 acres). Fires ignited by lightning and equipment contributed to a

---

[61] Johnson, C. G. 1998. Vegetation Response after Wildfires in National Forest of Northeastern Oregon. 128 pp.

[62] Barrett, J. W. 1979. *Silviculture of ponderosa pine in the Pacific Northwest: The state of our knowledge. USDA Forest Service*. General Technical Report PNW-97. Pacific Northwest Forest and Range Experiment Station. Portland, Oregon. 106pp.

[63] Johnson, C.G.; et al. 1994. *Biotic and Abiotic Processes of Eastside Ecosystems: the Effects of Management on Plant and Community Ecology, and on Stand and Landscape Vegetation Dynamics*. Gen. Tech. Report PNW-GTR-322. USDA-Forest Service. PNW Research Station. Portland, Oregon. 722pp.

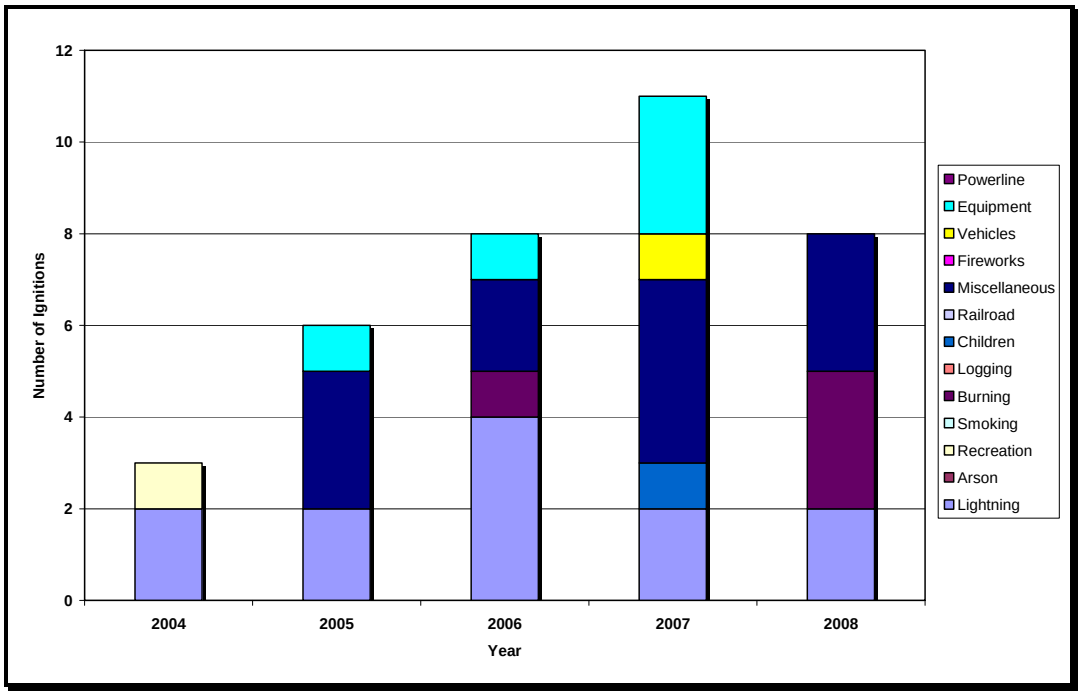
significant amount of ignitions and total acres burned. An average of 7 fires and 5,100 acres burned per year was recorded during this period.

Table 5.3. Summary of ignitions in Lincoln County from Washington DNR database 2004-2008.

Cause	Acres Burned	Percent	Number of Ignitions	Percent
Lightning	29	0%	12	33%
Arson	-	0%	0	0%
Recreation	150	1%	1	3%
Smoking	-	0%	0	0%
Burning	39	0%	4	11%
Logging	-	0%	0	0%
Children	3	0%	1	3%
Railroad	-	0%	0	0%
Miscellaneous	22,847	89%	12	33%
Fireworks	-	0%	0	0%
Vehicles	1	0%	1	3%
Equipment	2,661	10%	5	14%
Powerline	-	0%	0	0%
Total	**25,729**	**100%**	**36**	**100%**

The "Miscellaneous" category includes ignitions originating from burning material from aircraft, electric fence, hot ashes, spontaneous combustion (other than sawdust piles), use of fire (other than logging), woodcutting, and an "other" category.

Figure 5.1. Washington DNR Recorded Ignitions 2004-2008.



In order to capture the full breadth of the wildfire ignitions in Lincoln County, ignition and extent data was compiled from most of the local fire district's records. This database includes ignition and extent data from

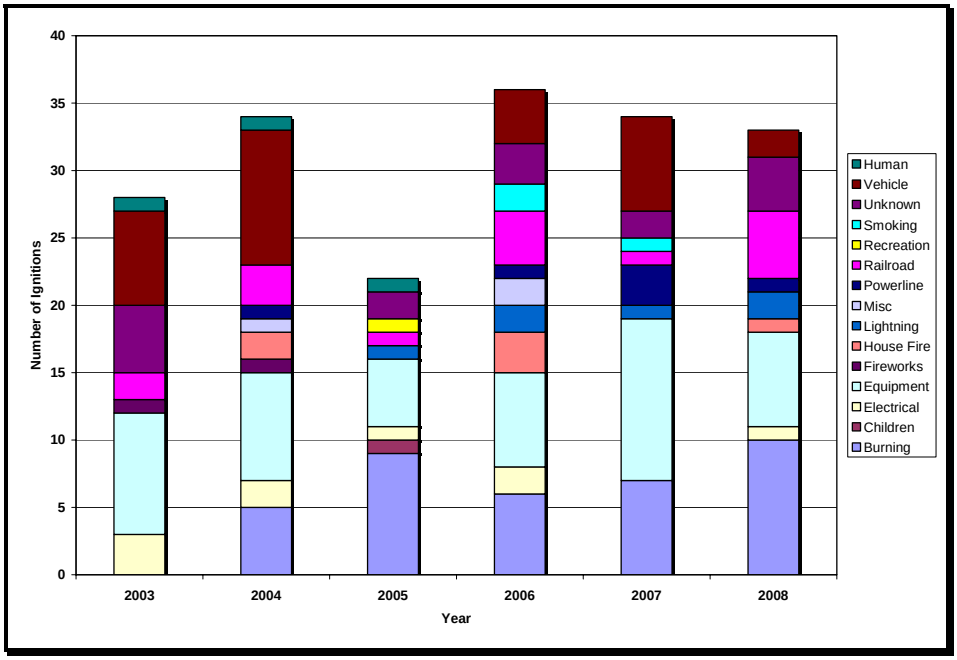
Lincoln County Fire District #1, #6, #7, #8, and #9 from 2003 through 2008. Although this data helps to more accurately describe the wildland fire potential in the County, many of the fires may have been reported by more than one district resulting in duplicated entries. Additionally, many of these fires are also included in the Washington DNR database.

Table 5.4. Summary of Ignitions in Lincoln County Reported by Local Fire Districts 2003-2008.

Cause	Acres Burned	Percent	Number of Ignitions	Percent
Burning	294	1%	37	20%
Children	1	0%	1	1%
Electrical	14	0%	9	5%
Equipment	9,170	18%	48	26%
Fireworks	9	0%	2	1%
House Fire	130	0%	6	3%
Lightning	19,205	37%	6	3%
Miscellaneous	2	0%	3	2%
Powerline	46	0%	6	3%
Railroad	50	0%	16	9%
Recreation	1,000	2%	1	1%
Smoking	3	0%	3	2%
Unknown	2,642	5%	16	9%
Vehicle	7,376	14%	30	16%
Human	12,051	23%	3	2%
Total	**51,992**	**100%**	**187**	**100%**

This database augments the DNR's data by showing that lightning, equipment, and vehicle fires are significantly contributing to the number of acres burned each year while burning, equipment, and vehicles are accountable for the most number of ignitions.

Figure 5.2. Ignition Data Recorded by Local Fire Districts 2003-2008.



Ideally, historical fire data would be used to estimate the annual probability for fires in Lincoln County. However, current data are not adequate to make credible calculations because the data for local, state, and federal responsibility areas are not reported by the same criteria. Nevertheless, the data reviewed above provide a general picture of the level of wildland-urban interface fire risk for Lincoln County overall.

Value of Resources at Risk

It is difficult to estimate potential losses in Lincoln County due to wildland fire due to the unpredictability of wildfire behavior and the nature of ignition sources. It is impossible to forecast the path a wildfire will take and what type of assets and resources, manmade and ecological, will be at risk. Thus, no value estimates were made for this hazard.

Typically, structures located in forested areas without an adequate defensible space or fire resistant landscaping have the highest risk of loss. Nevertheless, homes and other structures located in the grasslands or agricultural regions are not without wildfire risk. Grass fires are often the most dangerous due to high rates of spread. Fires in this fuel type are considered somewhat easier to suppress given the appropriate resources, but they can also be the most destructive.

Ignition potential is high throughout the County. Recreational areas, major roadways, debris burning, and agricultural equipment are typically the most likely human ignition sources. Lightning is also a common source of wildfires in Lincoln County.

Lincoln County is actively pursuing funds to help with wildland fire mitigation projects and public education programs. While mitigation efforts will significantly improve the probability of a structure's survivability, no amount of mitigation will guarantee survival.

Avalanche

There have been no reported damages or lives lost due to an avalanche in Lincoln County. The northern border of the County along Lake Roosevelt has the highest propensity for avalanches due to the steeper terrain; however, this area rarely accumulates a significant amount of snow. There are currently no avalanche mitigation programs occurring in Lincoln County.

Value of Resources at Risk

Lincoln County has no assets at significant risk of avalanches due to the topography and low snow accumulations.

Tsunami

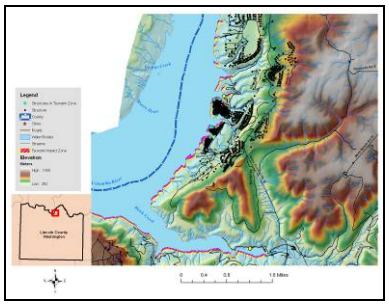
The northern border of Lincoln County is formed by the Columbia River. There is a moderate probability of landslides causing localized tsunamis in this vicinity. The shores of Roosevelt Lake have been subject to several hundred landslides since the reservoir began to be filled during construction of Grand Coulee Dam during the 1930's and early 1940's. The greatest percentage of landslide activity occurred during initial filling of the reservoir, but many slope failures also have been caused by intermittent drawdown of the reservoir level. In addition, occasional slope failures have occurred as natural phenomena, related more to wet winters than to fluctuation of the reservoir.

1944-1953 Inland Tsunamis – Massive landslides generated a number of inland tsunamis in Lake Roosevelt after Grand Coulee Dam created the lake on the Columbia River. Most tsunamis generated large waves (30 to 60 feet in height) that struck the opposite shore of the lake, with some waves observed miles from the source.

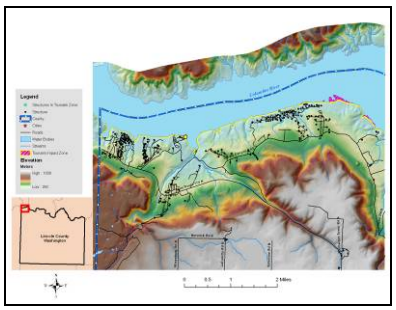
January 2009 Inland Tsunami - Property owners in the Spokane Arm of Lake Roosevelt were swamped by a huge wave caused by a 17 acre landslide near Mill Canyon northeast of Davenport. The resulting wave reached 30 feet above the full pool mark across the lake at Breezy Bay. Private docks and vessels were destroyed or damaged up to 1.5 miles downstream. The water reached one residence before receding and came up to the foundations of several others.

August 2009 Tsunami Damage

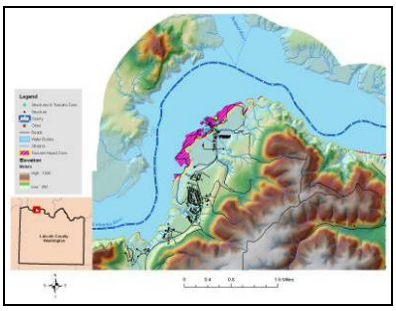
August 2009 Inland Tsunami – A large landslide occurred near the Blue Creek drainage on the Spokane Indian Reservation side of the Spokane Arm of Lake Roosevelt. This resulted in a 12 foot wave hitting Porcupine Campground on the southern shores less than a thousand yards across the Lake. Numerous people were in the water at Porcupine Bay during the event. Damage to National Park Service facilities including log booms, docks, and a swim platform was estimated at $250,000.



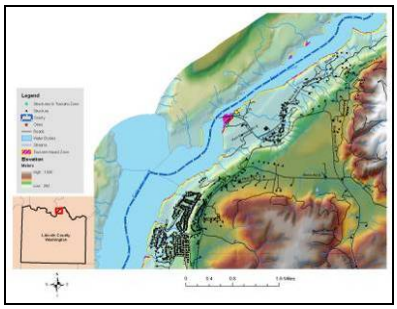
Seven Bays



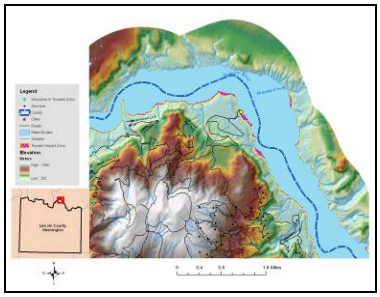
Spring Canyon



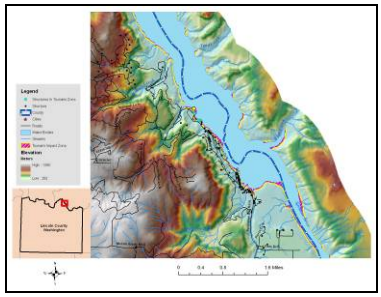
Keller



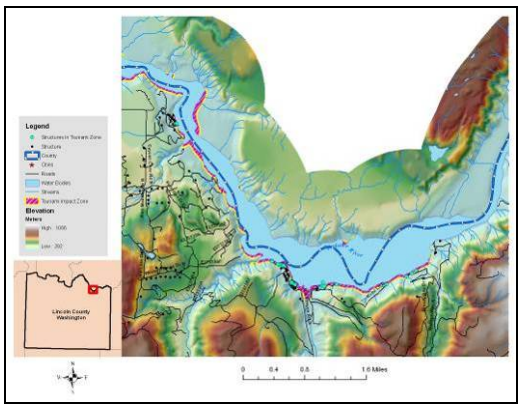
Fort Spokane



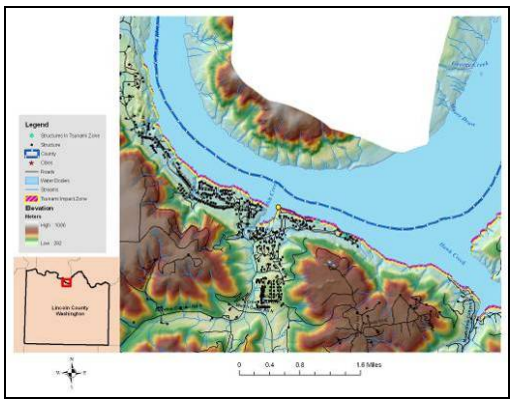
Detillion



Porcupine Bay



Arrowhead Bay



Hawk Creek

Based on past events, it was determined that most of the landslides along Lake Roosevelt had produced a 30 foot or less wave on the opposite shore For the purposes of this document, the Lincoln County shoreline was evaluated to determine where and what type of development or resources were in this potential Impact Zone. The Tsunami Impact Zone is based on a 32.8 foot (10 meter) “wave” hitting above the Lake Roosevelt full pool level. The maps above depict the Impact Zone in areas with significant development or infrastructure at risk.

Value of Resources at Risk

Due to the lower population density and the lack of infrastructure within approximately 30 feet of the Lake Roosevelt shoreline, it is unlikely that an inland tsunami would cause significant damages within the County. Currently, there are 55 structures with an approximate total value of $4.1 million based on the County Assessor’s data. Individual crops, structures, or docks may be damaged, but widespread losses are unlikely. Most of the infrastructure within the Impact Zone is recreational facilities including the National

Park Service's Spring Canyon facility, Lincoln Hill launch ramp, Hawk Creek launch ramp, Seven Bays launch ramp and marina, Fort Spokane launch ramp, Detillion launch ramp, and their Porcupine Bay launch ramp. The Keller Ferry facility is also at risk. All of these recreational sites are valued in the millions.

Volcano

Lincoln County is not directly at risk of experiencing a volcano; however, there is a high probability that ash and other particulates from an eruption in western Washington or Oregon would be carried to and deposited within the County. The Mount St. Helens eruption in 1980 deposited several inches of ash causing widespread damages to vehicles and other equipment in Lincoln County. The airborne particulates can also cause respiratory problems for both people and animals. These affects are particularly notable for populations already dealing with respiratory illnesses. Local accounts of the 1980 eruption did not indicate that the ash deposition adversely affected crops. In fact, some noted that the addition of volcanic ash increased the water retention properties of the soil.

Value of Resources at Risk

Lincoln County has no assets at direct risk of being impacted by a volcanic eruption. However, the secondary effects of ash and airborne particulates may have varying degrees of negative effects within the County. Damages to property will likely be limited to vehicles and cleanup costs. Additionally, residents of Lincoln County will be at risk to health problems associated with the respiratory effects of breathing airborne particulates.

Drought

Drought is a condition of climatic dryness that is severe enough to reduce soil moisture and water below the minimum necessary for sustaining plant, animal, and human life systems. The severity of drought is measured by the Palmer Index in a range of 4 (extremely wet) to -4 (extremely dry). The Palmer Index incorporates temperature, precipitation, evaporation and transpiration, runoff and soil moisture when designating the degree of drought. The Washington State Hazard Mitigation Plan does not consider Lincoln County to be one of the counties most vulnerable to drought in Washington.[64]

Lincoln County was in a severe drought condition 10-15% of the time between 1895 and 1995, 20-30% of the time between 1985 and 1995, and 30-40% of the time between 1976 and 1977.

2001 Drought – While November and December 2000 were unusually dry, most experts assumed the typical heavy snow and rainfall levels would begin again in January 2001. However, my mid-March, Lincoln County was in a water supply deficit. On March 14th, 2001, then Governor Gary Locke authorized a statewide drought emergency. The August 2001 Palmer Drought Index shows that northeastern Washington, including Lincoln County, was considered in an "extreme drought" condition.

[64] Washington Military Department. 2008. Washington State Enhanced Hazard Mitigation Plan. Washington Military Department, Emergency Management Division. Camp Murray, Washington. Available online at http://www.emd.wa.gov/plans/washington_state_hazard_mitigation_plan.shtml.

2005 Drought – The winter of 2004-05 were abnormally warm and a mid-January storm removed much of the remaining snowpack. On March 10, 2005, Governor Christine Gregoire authorized the Department of Ecology to declare a statewide drought emergency, which remained in effect until December 2005. The U.S. Drought Monitor showed Lincoln County as under a "severe drought" condition in May of 2005.

Drought affects water levels for use by industry, agriculture, and individual consumers. Water shortages affect fire fighting capabilities through reduced flows and pressures. Drought also affects power production. Much of Washington State's power is produced by hydro-electric dams. When water levels drop, electric companies cannot produce enough power to meet demand and are forced to buy electricity from other sources. It is often difficult to recognize a drought before being in the middle of it. Droughts do not occur spontaneously, they evolve over time as certain conditions are met. Therefore, it is difficult to measure the losses due to a drought.

Oftentimes, drought is accompanied by extreme heat. When temperatures reach 90 degrees and above, people are vulnerable to sunstroke, heat cramps, and heat exhaustion. Pets and livestock are also vulnerable to heat-related injuries. Crops can be vulnerable as well. In the past Washington State droughts, wheat has been scorched, apples have sunburned and peeled, and yields were significantly lessened.

The Washington State Legislature in 1989 gave permanent drought relief authority to the Department of Ecology and enabled them to issue orders declaring drought emergencies. Nearly all areas of the State are vulnerable to drought. In every drought, agriculture is adversely impacted, especially in non-irrigated areas such as dry land farms and rangelands. Droughts impact individuals (farm owners, tenants, and farm laborers), the agricultural industry, and other agriculture-related sectors.

Problems of domestic and municipal water supplies are historically corrected by building another reservoir, a larger pipeline, a new well, or some other facility. Short-term measures, such as using large capacity water tankers to supply domestic potable water, have also been used. As a result of droughts, agriculture uses new techniques. Federal and state governments play an active role in developing new water projects and soil conservation programs.

Drought increases the danger of forest and wildland fires. Millions of board feet of timber have been lost to wildland fires in northeast Washington. Loss of forests and trees increases erosion causing serious damage to aquatic life, irrigation, and power development by heavy silting of streams, reservoirs, and rivers. Low stream flows have created high temperatures, oxygen depletion, disease, and lack of spawning areas for fish resources.

High quality agricultural soils exist in much of Lincoln County. Many areas of the county sustain dry land crops such as wheat that are dependent upon moisture through the winter and spring and dry arid conditions in the summer. While Lincoln County does experience droughts, on the whole, they are mild and do not cause long term damage.

Value of Resources at Risk

The most direct impact of drought is economic rather than loss of life or immediate destruction of property. Droughts impact individuals, the agricultural industry, and other related sectors. Additionally, there is increased danger of wildland fires associated with most droughts. Millions of board feet of timber have

been lost, and in many cases, erosion occurred which caused serious damage to aquatic life, irrigation, and power production.

The 2001 and 2005 drought years in Washington caused only minor damages and crop losses. There were no threats to any critical facilities. Thus, a minor to moderate drought has a low probability of affecting the County's economy directly due to the availability of irrigation waters. An extreme and prolonged drought could result in limited availability of irrigation water; thus causing severe crop losses countywide.

In the event of an extended drought cycle, water shortages may lead to crop failures, or at the least, the necessity to plant lower value crops that are less water-dependent. The majority of the population is employed either directly by the agriculture industry or to a service industry dependent on agriculture. Crop losses resulting from extended droughts would likely be considered a disaster for Lincoln County. Lower water levels may also affect the County's ability to efficiently transport crops to available markets. Barging of goods on the Columbia River could be reduced due to lower water levels.

Domestic and municipal water shortages are also likely to occur during an extended drought. Efforts to conserve water resources, including public education on conservation techniques, are encouraged by Lincoln County during the summer months.

City of Davenport Annex

Flood

The main channel of Cottonwood Creek, a tributary to Hawk Creek, runs directly through the city of Davenport entering near State Highway 25 on the northeast corner of town and exiting along the western boundary. Within Davenport, flooding is generally limited to large rain-on-snow events such as occurred in 1996-1997 and most recently in 2009-10. Warm rains result in a significantly increased rate of snowmelt. Often this melting occurs while the ground is frozen and the water cannot be absorbed into the soil, resulting in increased overland flows. Flood waters recede slowly as rain-on-snow weather events tend to last for several days. Low velocity flooding occurs in several of the nearby tributaries almost annually during the spring runoff period. Flash floods are also a concern as numerous small tributaries feed Cottonwood Creek. These smaller streams typically have shallow channels with large floodplains draining hundreds of acres. Cottonwood Creek collects much of this runoff before entering the relatively narrow channel through downtown Davenport. Jams can also cause localized flooding as debris or ice get caught at bridge abutments and other obstructions causing the channel to become constricted and floodwaters to back up.

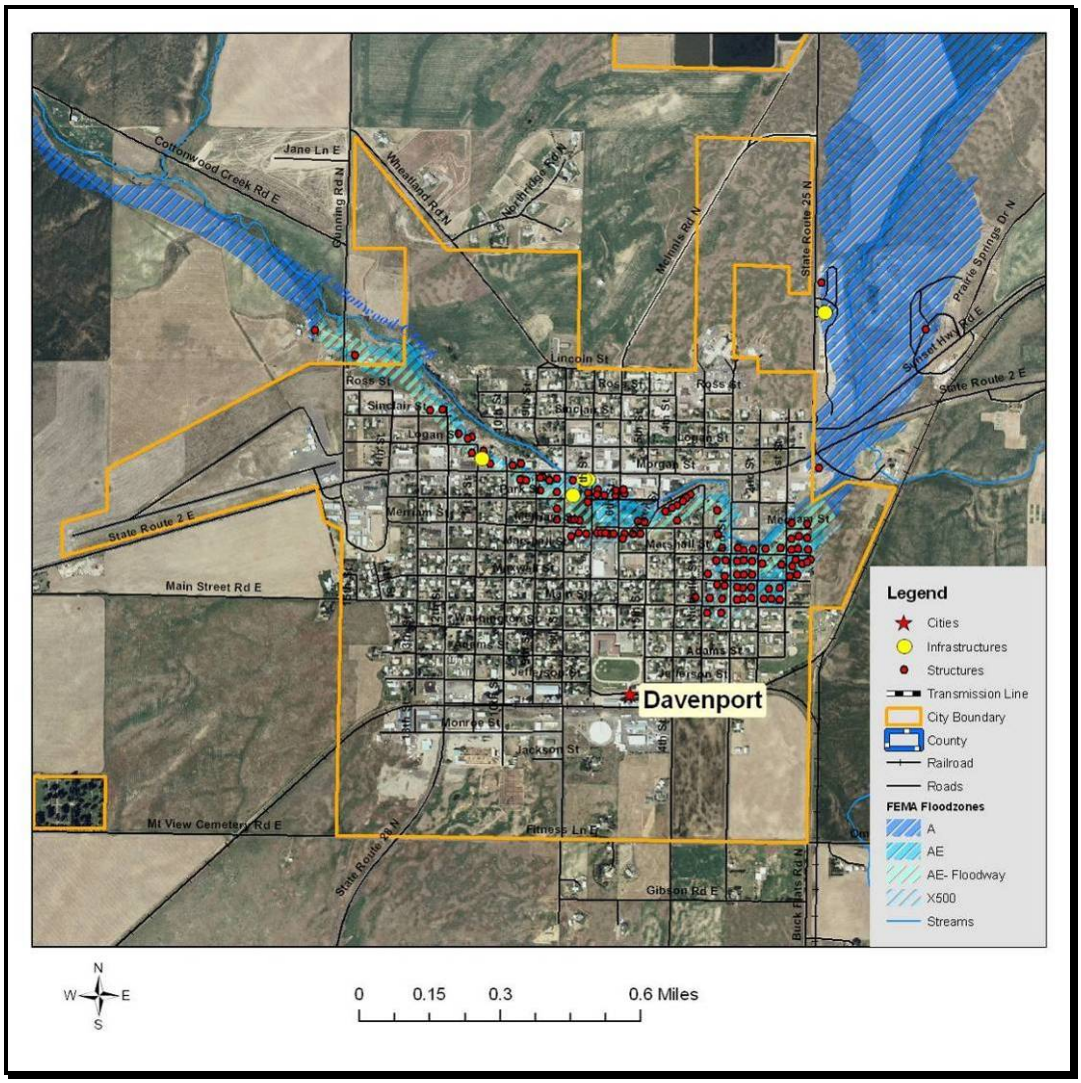
Davenport's municipal water system is supplied by several wells in the area. Flooding as well as several other hazards and numerous potential non-point sources could cause contamination of the water supply or affect the capacity of the system. All of the homes and businesses in Davenport are fed by the municipal system; thus, the impact of these events could affect the majority of the population including the hospital and schools.

Rural residences, ranches, farms, and roadways located near smaller waterways may be at significant flood risk. The onset of flooding in the smaller drainages can range from extremely slow to very fast. This variability depends on the cause of flooding and other factors such as rainfall intensity, the areas receiving the rain, temperature, and the condition of the soil. Floods that occur quickly are usually caused by thunderstorms, while floods that occur more slowly are often the result of moderate, but prolonged rainfall, snowmelt, or a combination of both. In the case of intense rainfall immediately above developed areas, the onset of flooding may occur in a matter of minutes.

The major impacts from flooding in Davenport are the restricted use of several streets, commercial, railroad spurs, and residential areas due to overburden of existing drainage facilities. There are numerous bridge and culvert crossings over Cottonwood Creek throughout its extent within the City and the surrounding area.

A high level of sediment is prevalent during periods of intense runoff. This sediment tends to cause a deteriorating condition in streambeds and channels through deposition. Natural obstructions to flood waters include trees, brush, and other vegetation along the stream banks in the floodplain area. Considerable debris has been allowed to accumulate in these channels, plugging culverts and bridges at several locations throughout the county.

Figure 5.3. City of Davenport FEMA Flood Insurance Rate Map.



Value of Resources at Risk

There are approximately 291 parcels and 108 structures within the FEMA-identified floodplains (100- and 500-year) in Davenport, yielding a total structure value of $8 million. The average damage to structures was estimated based on the parcel's location as either completely within or out of the flood zone. The estimated value of contents is ½ the value of the improvements equating to an additional $4 million in potential losses. In reality, the damages will most likely not be equally distributed between buildings based on building materials, building location, and flood location. However, these estimates provide a basic approximation.

Critical infrastructure located within the identified floodplain for Davenport includes the fire station, the police station, and the Inland Power and CenturyTel communication towers.

Earthquake

There are no recorded occurrences of earthquakes significantly impacting the city of Davenport; however, some minimal shaking has been felt as a result of larger earthquakes elsewhere. The City has 10% chance of exceeding a 6-7% pga in the next 50 years.[65] Davenport does not have any differing issues or levels of risk associated with this hazard than Lincoln County as a whole.

Value of Resources At Risk

Unreinforced masonry (URM) structures and unreinforced chimneys of homes will likely be damaged in the event of an earthquake. There are several publicly accessible unreinforced masonry structures in Davenport in addition to the numerous homes and other buildings throughout the City with unreinforced chimneys. Damaged or collapsed chimneys could result in the secondary hazard of fire. Nonstructural damage caused by falling and swinging objects may be considerable after any magnitude earthquake. Damage to some older, more fragile bridges and land failure causing minor slides along roadways may isolate some residents.

In Davenport, nearly all of the downtown structures are assumed to be unreinforced masonry including the police and fire station, city Library, city hall, and nearly all original buildings located on Morgan Street (SR2). These structures were built prior to the inclusion of articles for seismic stability in the Uniform Building Codes in 1972. The number and value of unreinforced masonry homes or homes with masonry chimneys in Davenport is unknown, but estimated to include at least 100 buildings.

Landslide

The city of Davenport has a very low probability of experiencing damaging landslides. The few slopes in and around the community are generally less than 20%. While small, low angle slumps may occur on eyebrows of the surrounding rolling hills, these will be infrequent and likely the result of water saturation or a major disturbance such as an earthquake or road construction.

Value of Resources at Risk

There are no structures or infrastructure directly at risk from landslides within the city of Davenport.

Severe Weather

The city of Davenport does not have any differing levels of risk associated with this hazard than Lincoln County as a whole.

Value of Resources at Risk

It is difficult to estimate the cost of potential winter storm damages to structures and the economy in Davenport. Damage to roofs by heavy snow accumulations depends on the moisture content of the snow and the structural characteristics of the buildings. In general, snow in this region tends to have low moisture content because of the low temperatures and arid environment. Additionally, snow rarely

---

[65] USGS. 2008 United States National Seismic Hazard Maps. U.S. Geological Survey. U.S. Department of Interior. Available online at http://earthquake.usgs.gov/hazards/products/conterminous/2008/. October 2009.

accumulates for long periods of time due to regular wind events. Frozen water pipes are the most common damage to residential and business structures. Older homes tend to be at a higher risk to frozen water pipes than newer ones. Snow plowing in within the city limits is accomplished by the city's public works department. Private landowners are responsible for maintaining their own driveways or other private roads. Utility supplies are impacted during severe winter storms as power is lost on a regional basis. This has a two-fold impact on residents as not only is power cut to homes and businesses, but primary heating is lost for many residents. Gas furnaces and wood stoves supplement electrical heating, but with wood heating the senior population is at a disadvantage. Emergency response to severe winter storms includes site visits by police or fire department personnel, opening of shelters, or assistance with shopping, medical attention, and communications. The economic losses caused by severe winter storms may frequently be greater than structural damages. Employees may not be able to travel to work for several days and businesses may not open. Damages are seen in the form of structural repair and loss of economic activity. Lincoln County schools are occasionally closed during and right after a severe winter storm because of cold temperatures and snow covered roads.

Thunderstorms are not likely to be severe enough in Davenport to cause significant damages. However, the loss potential from flooding that result from severe thunderstorms could be significant.

Although the financial impacts of hail can be substantial and extended, accurately quantifying these impacts is problematic. Hail typically causes direct losses to structures and other personal property within Davenport. The most significant losses are most clearly seen in the agriculture sectors of the economy. Potential losses to agriculture can be disastrous. Crop damage from hail will also be different depending on the time of year and the type of crop. Most farmers carry insurance on their crops to help mitigate the potential financial loss resulting from a localized hail storm. Homeowners in Davenport rarely incur severe damage to structures (roofs); however, hail damage to vehicles is not uncommon. The damage to vehicles is difficult to estimate because the number of vehicles impacted by a specific ice storm is unknown. Additionally, most hail damage records are kept by various insurance agencies.

It is difficult to estimate potential losses in Davenport due to windstorms and tornadoes. Construction throughout the County has been implemented in the presence of high wind events, and therefore, the community is at a higher level of preparedness to high wind events than many other areas experiencing lower average wind speeds.

We have estimated losses based on wind and tornado damage as follows:

- 3% of the buildings damaged causing 50% of value loss (loss could be from downed or damaged trees, damaged outbuildings, damaged fences/poles, damage to siding, damaged landscaping etc.)
- 5% of the buildings received damage to roof (requiring replacement of roof equaling $3,000)

Damages associated with sensitive receptor irritation have not been estimated. We have also not estimated the potential for a large scale wildfire event associated with high winds. Based on the data provided by the County, there are 802 total structures in Davenport with a total value of approximately $59.6 million. Using the criteria outlined above an estimate of the impact of high winds in Davenport has been made. The

potential wind and tornado damage to all buildings is estimated at approximately $2.1 million. The estimated damage to roofs is approximately $120,000.

Power failure often accompanies severe storms. Prolonged failure, especially during cold winter temperatures can have disastrous effects. All communities should be prepared to deal with power failures. Community shelters equipped with alternative power sources will help local residents stay warm and prepare food. A community-based system for monitoring and assisting elderly or disabled residents should also be developed. All households should maintain survival kits that include warm blankets, flashlights, extra batteries, nonperishable food items, and clean drinking water.

Wildland Fire

The agricultural landscape is widespread across Lincoln County and surrounds Davenport. Vast areas of deep, rich soil deposits provide for extensive agriculture development. Lincoln County is the second highest wheat and barley producing county in the state. Other crops include grass seed, oats, hay and potatoes as well as extensive areas of fallow land set aside in the CRP. Most of these crops are vulnerable to wildfire at certain times of the year. The agriculture landscape is the predominant cover vegetation and fuel type throughout the county dominating the south, northwest and east central portions of the county. Interspersed throughout this landscape are stream channels and rocky scabland areas. New development occurs primarily near the community and along major roads. Occasionally farmland is subdivided between family members for new home sites or for development of new farming facilities. Most of the pressure for multi-housing subdivisions occurs in close proximity to town. In nearly all developed areas, structures are in close proximity to vegetation that becomes a significant fire risk at certain times of the year.

Wildfire potential in the agricultural landscape is moderate in the rural farmland and moderate to high in the shrubby draws and waterways, pastures, and scattered patches of scabland. Virtually all of the populated areas within the agricultural landscape face similar challenges related to wildfire control and opportunities for fuels mitigation efforts. Farming and ranching activities have the potential to increase the risk of a human-caused ignition. Large expanses of crops, CRP, rangeland or pasture provide areas of continuous fuels that may threaten homes and farmsteads. Under extreme weather conditions, escaped fires in these fuels could threaten individual homes or a town site; however, this type of fire is usually quickly controlled. Clearings and fuel breaks disrupt a slow moving wildfire enabling suppression before a fire can ignite heavier fuels. High winds increase the rate of fire spread and intensity of crop and rangeland fires. It is imperative that homeowners implement fire mitigation measures to protect their structures and families prior to a wildfire event in these areas.

Wildfire risk in the agricultural landscape is at its highest during late summer and fall when crops are cured and daily temperatures are at their highest. A wind-driven fire in agricultural fuels or dry native fuel complexes would produce a rapidly advancing, but variable intensity fire. Fires burning in some types of unharvested fields would be expected to burn more intensely with larger flame lengths due to the greater availability of fuels resulting from the higher productivity of the vegetation. Fields enrolled in the CRP or set aside for wildlife habitat can burn very intensely due to an increased amount of fuel build-up from previous years' growth. Fires in these types of fuels are harder to extinguish completely due to the dense duff layer, often leading to hold over fires that may reemerge at a later date causing additional fire starts.

Residents living in Davenport have access to the municipal water supply system and public fire hydrants. Outside these areas, development relies on individual, co-op, or multiple-home well systems. Creeks, ponds, and developed drafting areas provide water sources for emergency fire suppression in the rural areas to a limited extent. Irrigation systems are capable of providing additional water supply for suppression equipment on a limited basis. Additional water resources distributed and documented throughout the agricultural landscape are needed to provide water for fire suppression.

Above ground, high voltage transmission lines cross the planning area in many directions in corridors cleared of most vegetation, which provides for a defensible space around the power line infrastructure and may provide a control point for fire suppression, if well maintained. Local public electrical utility lines are both above and below ground traveling through back yards and along roads and highways. Many of these lines are exposed to damage from falling trees and branches. Power and communications may be cut to some of these during a wildfire event.

Lincoln County Fire District #5 protects the community of Davenport. The fire district provides structural fire protection as well as wildland fire protection. Mutual aid agreements between fire districts supplement wildland fire protection when needed. Additional fire protection is provided by the Washington DNR, which provides wildfire protection and suppression on privately owned forestland and state-owned forestland north of Highway 2 in Lincoln County. The DNR does not provide structural fire suppression, but does provide wildfire protection on non-forested land that threatens DNR-protected lands. The BLM provides wildfire protection on their ownership within Lincoln County and has mutual aid agreements with the DNR for protection of forested land. BLM also does not provide structural fire suppression.

Value of Resources at Risk

It is difficult to estimate potential losses in Davenport from wildland fire due to the unpredictability of wildfire behavior and the nature of ignition sources. It is impossible to forecast the path a wildfire will take and what type of assets and resources, manmade and ecological, will be at risk. Thus, no value estimates were made for this hazard.

Typically, structures located in forested areas without an adequate defensible space or fire resistant landscaping have the highest risk of loss. Nevertheless, homes and other structures located in the grasslands or agricultural regions are not without wildfire risk. Grass fires are often the most dangerous due to high rates of spread. Fires in this fuel type are considered somewhat easier to suppress given the appropriate resources, but they can also be the most destructive. Homes along the perimeter of the community would have the highest risk due to their adjacency to flashy fuels.

Avalanche

The city of Davenport will not be directly impacted by this type of localized event due to the gentle topography and low snow accumulations.

Value of Resources at Risk

The city of Davenport has no assets at risk to avalanches.

Tsunami

Although Lincoln County's northern border has a moderate risk of being impact by an inland tsunami on Lake Roosevelt, the city of Davenport will not be directly impacted by this type of localized event.

Value of Resources at Risk

The city of Davenport has no assets at risk to inland tsunamis.

Volcano

The city of Davenport does not have any differing levels of risk associated with this hazard than Lincoln County as a whole.

Value of Resources at Risk

The city of Davenport has no assets at direct risk of being impacted by a volcanic eruption. However, the secondary effects of ash and airborne particulates may have varying degrees of negative effects. Damages to property will likely be limited to vehicles and cleanup costs. Additionally, residents of Davenport will be at risk to health problems associated with the respiratory effects of breathing airborne particulates.

Drought

The city of Davenport does not have any differing levels of risk associated with this hazard than Lincoln County as a whole. However, the city does have its own policies concerning water conservation practices during emergency drought conditions. Additionally, the city may further develop programs to deal with residents and businesses significantly impacted by drought if necessary. Year-round water conservation ideas are regularly being offered to citizens to reduce consumption.

Value of Resources at Risk

The city of Davenport has no assets directly at risk to drought; however, the economic impacts of a drought or a wildland fire caused by extended dry periods would have a great impact on the community. The majority of the population is employed either directly by the agriculture industry or to a service industry dependent on agriculture. Crop losses resulting from extended droughts would likely be considered a disaster for the community.

City of Sprague Annex

Flood

The city of Sprague is bisected by the main channel of Negro Creek, the feeder stream for Sprague Lake. Additionally, two small unnamed springs flow out of the north and drain into Negro Creek at Sprague. Much of Sprague's downtown area as well as several residential neighborhoods fall within the floodplain of this drainage.

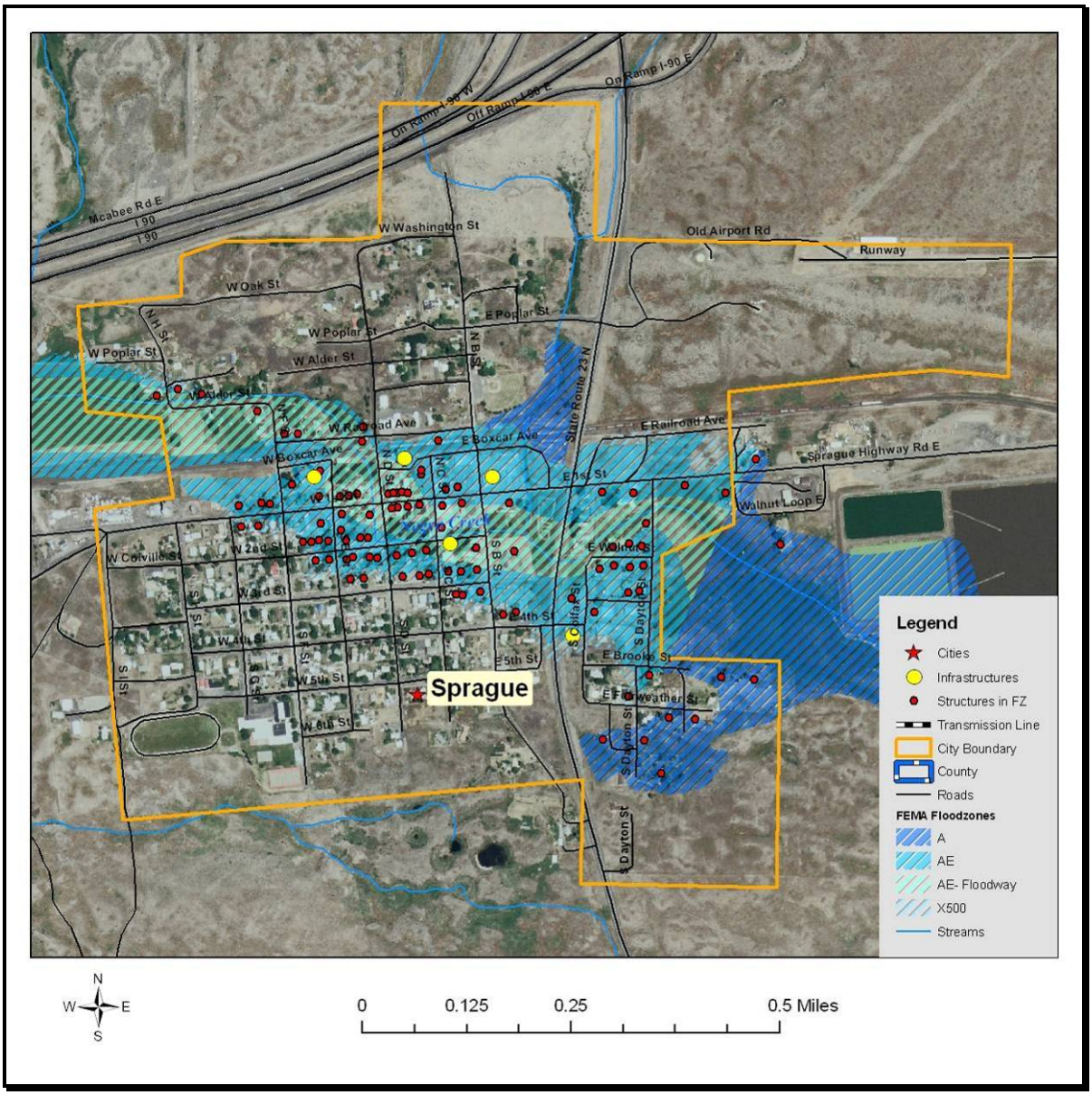
Negro Creek is extremely prone to flash flooding from localized weather events. Negro Creek drains hundreds of acres to northeast before passing through the community. Rain-on-snow events can also have a significant effect on this watershed. Warm rains result in a significantly increased rate of snowmelt. Often this melting occurs while the ground is frozen and the water cannot be absorbed into the soil, resulting in increased overland flows. Flood waters recede slowly as rain-on-snow weather events tend to last for several days. Low velocity flooding occurs in several of the nearby tributaries almost annually during the spring runoff period.

Rural residences, ranches, farms, and roadways located near smaller waterways may be at significant flood risk. The onset of flooding in the smaller drainages can range from extremely slow to very fast. This variability depends on the cause of flooding and other factors such as rainfall intensity, the areas receiving the rain, temperature, and the condition of the soil. Floods that occur quickly are usually caused by thunderstorms, while floods that occur more slowly are often the result of moderate, but prolonged rainfall, snowmelt, or a combination of both. In the case of intense rainfall immediately above developed areas, the onset of flooding may occur in a matter of minutes.

The major impacts from flooding in Sprague are the restricted use of several streets, commercial, and residential areas. There are numerous bridge and culvert crossings over Negro Creek throughout its extent within the City and the surrounding area.

A high level of sediment is prevalent during periods of intense runoff. This sediment tends to cause a deteriorating condition in streambeds and channels through deposition. Natural obstructions to flood waters include trees, brush, and other vegetation along the stream banks in the floodplain area. Considerable debris has been allowed to accumulate in these channels, plugging culverts and bridges at several locations throughout the county.

Figure 5.4. City of Sprague FEMA Flood Insurance Rate Map.



Value of Resources at Risk

The County's parcel layer for Sprague is incomplete, but it is estimated that there are approximately 100 structures within the FEMA-identified floodplains (100- and 500-year) in Sprague, yielding a total structure value of $7.4 million. The average damage to structures was estimated based on the parcel's location as either completely within or out of the flood zone. The estimated value of contents is ½ the value of the improvements equating to an additional $3.7 million in potential losses. In reality, the damages will most likely not be equally distributed between buildings based on building materials, building location, and flood location. However, these estimates provide a basic approximation.

Critical infrastructure located within the identified floodplain for Sprague includes the agricultural chemical plant, the city hall/fire station, a gas station, and two grain elevators. Also, a portion of the city's wastewater treatment facility just east of the city limits is within the floodplain.

Earthquake

There are no recorded occurrences of earthquakes significantly impacting the city of Sprague; however, some minimal shaking has been felt as a result of larger earthquakes elsewhere. The City has 10% chance of exceeding a 6-7% pga in the next 50 years.[66] Sprague does not have any differing issues or levels of risk associated with this hazard than Lincoln County as a whole.

Value of Resources at Risk

Unreinforced masonry (URM) structures and unreinforced chimneys of homes will likely be damaged in the event of an earthquake. There are several publicly accessible unreinforced masonry structures in Sprague in addition to the numerous homes and other buildings throughout the City with unreinforced chimneys. Damaged or collapsed chimneys could result in the secondary hazard of fire. Nonstructural damage caused by falling and swinging objects may be considerable after any magnitude earthquake. Damage to some older, more fragile bridges and land failure causing minor slides along roadways may isolate some residents.

In Sprague, nearly all of the downtown structures are assumed to be unreinforced masonry including Kathy's Market, Carrie's Beauty Salon, Rae-Lynn's Oasis, and Sprague City Hall. These structures were built prior to the inclusion of articles for seismic stability in the Uniform Building Codes in 1972. The number and value of unreinforced masonry homes or homes with masonry chimneys in Sprague is unknown, but estimated to include at least 30 buildings.

Landslide

The city of Sprague has a very low probability of experiencing damaging landslides. The mild south aspect slope on the north side of town is generally less than 35% and presents little risk. However, because building and road construction have likely weakened the stability of the hillside, it is possible that small slides could occur when the soils are saturated or as a result of additional construction undermining the toeslope.

While small, low angle slumps may occur on eyebrows of the surrounding rolling hills, these will be infrequent and likely the result of water saturation or a major disturbance such as an earthquake or road construction. It is also probable that small slides will continue to occur on the cut and fill slopes of some roads. This type of slide is generally small with little permanent damage to the road or other infrastructure; however, there is some risk of traffic being delayed temporarily while road crews clear the debris and stabilize the bank.

---

[66] USGS. 2008 United States National Seismic Hazard Maps. U.S. Geological Survey. U.S. Department of Interior. Available online at http://earthquake.usgs.gov/hazards/products/conterminous/2008/. October 2009.

Value of Resources at Risk

There are no structures directly at risk from landslides within the city of Sprague. Small slumps may occur along State Route 23, Oak Street, North D Street, or other secondary roads. In many cases, this will cause temporary sediment delivery into nearby streams and/or plug culverts. These types of events are cleaned up by county or city road departments with little complications. Road slumps are generally reported as regular maintenance; thus, there are few records associated with these events.

Severe Weather

The city of Sprague does not have any differing levels of risk associated with this hazard than Lincoln County as a whole.

Value of Resources at Risk

It is difficult to estimate the cost of potential winter storm damages to structures and the economy in Sprague. Damage to roofs by heavy snow accumulations depends on the moisture content of the snow and the structural characteristics of the buildings. In general, snow in this region tends to have low moisture content because of the low temperatures and arid environment. Additionally, snow rarely accumulates for long periods of time due to regular wind events. Frozen water pipes are the most common damage to residential and business structures. Older homes tend to be at a higher risk to frozen water pipes than newer ones. Snow plowing in within the city limits is accomplished by the city's public works department. Private landowners are responsible for maintaining their own driveways or other private roads. Utility supplies are impacted during severe winter storms as power is lost on a regional basis. This has a two-fold impact on residents as not only is power cut to homes and businesses, but primary heating is lost for many residents. Gas furnaces and wood stoves supplement electrical heating, but with wood heating the senior population is at a disadvantage. Emergency response to severe winter storms includes site visits by police or fire department personnel, opening of shelters, or assistance with shopping, medical attention, and communications. The economic losses caused by severe winter storms may frequently be greater than structural damages. Employees may not be able to travel to work for several days and businesses may not open. Damages are seen in the form of structural repair and loss of economic activity. Lincoln County schools are occasionally closed during and right after a severe winter storm because of cold temperatures and snow covered roads.

Thunderstorms are not likely to be severe enough in Sprague to cause significant damages. However, the loss potential from flooding that results from severe thunderstorms could be significant.

Although the financial impacts of hail can be substantial and extended, accurately quantifying these impacts is problematic. Hail typically causes direct losses to structures and other personal property within Sprague. The most significant losses are most clearly seen in the agriculture sectors of the economy. Potential losses to agriculture can be disastrous. Crop damage from hail will also be different depending on the time of year and the type of crop. Most farmers carry insurance on their crops to help mitigate the potential financial loss resulting from a localized hail storm. Homeowners in Sprague rarely incur severe damage to structures (roofs); however, hail damage to vehicles is not uncommon. The damage to vehicles is difficult to estimate because the number of vehicles impacted by a specific ice storm is unknown. Additionally, most hail damage records are kept by various insurance agencies.

It is difficult to estimate potential losses in Sprague due to windstorms and tornadoes. Construction throughout the County has been implemented in the presence of high wind events, and therefore, the community is at a higher level of preparedness to high wind events than many other areas experiencing lower average wind speeds.

We have estimated losses based on wind and tornado damage as follows:

- 3% of the buildings damaged causing 50% of value loss (loss could be from downed or damaged trees, damaged outbuildings, damaged fences/poles, damage to siding, damaged landscaping etc.)
- 5% of the buildings received damage to roof (requiring replacement of roof equaling $3,000)

Damages associated with sensitive receptor irritation have not been estimated. We have also not estimated the potential for a large scale wildfire event associated with high winds. Based on the data provided by the County, there are 271 total structures in Sprague with a total value of approximately $20.1 million. Using the criteria outlined above an estimate of the impact of high winds in Sprague has been made. The potential wind and tornado damage to all buildings is estimated at approximately $697,180. The estimated damage to roofs is approximately $42,000.

Power failure often accompanies severe storms. Prolonged failure, especially during cold winter temperatures can have disastrous effects. All communities should be prepared to deal with power failures. Community shelters equipped with alternative power sources will help local residents stay warm and prepare food. A community-based system for monitoring and assisting elderly or disabled residents should also be developed. All households should maintain survival kits that include warm blankets, flashlights, extra batteries, nonperishable food items, and clean drinking water.

Wildland Fire

The channeled scablands are a dominant landscape in Lincoln County and surround Sprague. This unique geological feature was created by ice age floods that swept across eastern Washington and down the Columbia River Plateau periodically during the Pleistocene era. The massive erosion caused by the flood events scoured the landscape down to the underlying basalt creating vast areas of rocky cliffs, river valleys, channel ways and pothole lakes. Typical vegetation found throughout this landscape is grass, mixed shrub and sagebrush with areas of wetlands, marsh, ponderosa pine islands, cultivated crops and CRP fields. The channeled scablands landscape prevails in the central, southern and southeastern portions of the county and along the major waterways of Crab Creek, Blue Stem Creek, Lake Creek and Cow Creek. New development is occurring primarily near the community and along major roads. Most of the pressure for multi-housing subdivisions occurs in close proximity to town. Rural development is widely dispersed consisting primarily of isolated ranching headquarters, home sites, irrigation systems, and developed springs or wells. In nearly all developed areas, structures are in close proximity to vegetation that becomes a significant fire risk at certain times of the year.

The channeled scablands landscape has a moderate to high wildfire potential due to a characteristically high occurrence of shrubby fuels mixed with grass, sloping terrain and somewhat limited access. Large expanses of open rangeland or pasture provide a continuous fuel bed that could, if ignited, threaten

structures and infrastructure under extreme weather conditions. Cattle grazing will often reduce fine, flashy fuels reducing a fire's rate of spread; however, high winds increase the rate of fire spread and intensity of rangeland fires. A wind-driven fire in dry, native fuel complexes on variable terrain produces a rapidly advancing, very intense fire with large flame lengths, which enables spotting ahead of the fire front.

Wildfire risk near Sprague is at its highest during summer and fall when daily temperatures are high and relative humidity is low. Fires burning in some types of unharvested fields would be expected to burn more intensely with larger flame lengths due to the greater availability of fuels. Fields enrolled in conservation programs or managed for wildlife habitat, can burn very intensely due to an increased amount of fuel build-up from previous years' growth. Fires in this fuel type are harder to extinguish completely due to the dense duff layer, which often leads to hold-over fires that may reemerge at a later date causing additional fire starts.

Residents living in Sprague have access to the municipal water supply system and public fire hydrants. Outside these areas, development relies on individual, co-op or multiple-home well systems. Creeks, ponds and developed drafting areas provide water sources for emergency fire suppression in the rural areas to a limited extent. Water tanks have been set up at several ranches throughout the area as a supplemental water supply during fire season. Irrigation systems are capable of providing additional water supplies for suppression equipment on a limited basis. Additional water resources distributed and documented throughout the agricultural landscape are needed to provide adequate water for fire suppression.

Public utility lines travel both above and below ground along roads and cross-country to remote facilities. Many irrigation systems and wells rely on above ground power lines for electricity. These power poles pass through areas of dense wildland fuels that could be destroyed or compromised in the event of a wildfire.

Lincoln County Fire District #1 protects the community of Sprague. The fire district provides structural fire protection as well as wildland fire protection. Mutual aid agreements between fire districts supplement the wildland fire protection response when needed. Additional fire protection is provided by the Washington DNR, which provides wildfire protection and suppression on privately-owned forestland and state-owned forestland north of Highway 2 in Lincoln County. The DNR does not provide structural fire suppression, but it does provide wildfire protection on non-forested land that threatens DNR-protected lands. BLM provides wildfire protection on their lands within Lincoln County and has mutual aid agreements with the DNR for protection of forested land. BLM also does not provide structural fire suppression.

Value of Resources at Risk

It is difficult to estimate potential losses in Sprague from wildland fire due to the unpredictability of wildfire behavior and the nature of ignition sources. It is impossible to forecast the path a wildfire will take and what type of assets and resources, manmade and ecological, will be at risk. Thus, no value estimates were made for this hazard.

Typically, structures located in forested areas without an adequate defensible space or fire resistant landscaping have the highest risk of loss. Nevertheless, homes and other structures located in the grasslands or agricultural regions are not without wildfire risk. Grass fires are often the most dangerous

due to high rates of spread. Fires in this fuel type are considered somewhat easier to suppress given the right resources, but they can also be the most destructive. Homes along the perimeter of the community would have the highest risk due to their adjacency to flashy fuels.

Avalanche

The city of Sprague will not be directly impacted by this type of localized event due to the gentle topography and low snow accumulations.

Value of Resources at Risk

The city of Sprague has no assets at risk to avalanches.

Tsunami

Although Lincoln County's northern border has a moderate risk of being impact by an inland tsunami on Lake Roosevelt, the city of Sprague will not be directly impacted by this type of localized event.

Value of Resources at Risk

The city of Sprague has no assets at risk to inland tsunamis.

Volcano

The city of Sprague does not have any differing levels of risk associated with this hazard than Lincoln County as a whole.

Value of Resources at Risk

The city of Sprague has no assets at direct risk of being impacted by a volcanic eruption. However, the secondary effects of ash and airborne particulates may have varying degrees of negative effects. Damages to property will likely be limited to vehicles and cleanup costs. Additionally, residents of Sprague will be at risk to health problems associated with the respiratory effects of breathing airborne particulates.

Drought

The city of Sprague does not have any differing levels of risk associated with this hazard than Lincoln County as a whole. However, the city does have its own policies concerning water conservation practices during the dry months. Additionally, the city may develop programs to deal with residents and businesses significantly impacted by drought if necessary.

Value of Resources at Risk

The city of Sprague has no assets directly at risk to drought; however, the economic impacts of a drought or a wildland fire caused by extended dry periods would have a great impact on the community. The majority of the population is employed either directly by the agriculture industry or to a service industry dependent on agriculture. Crop losses resulting from extended droughts would likely be considered a disaster for the community.

Town of Almira Annex

Flood

The town of Almira is affected by the floodplain of several small feeder tributaries of Wilson Creek. Water flowing out of Corbett and Childers Draw to the northeast passes through the town just east of the town center. Additionally, a larger unnamed tributary flows through a portion of the downtown area. This stream enters the community near the railroad tracks in the northwest corner and exits along the southern town boundary crossing U.S. Highway 2, Main Street, and several other secondary roads. Two additional small springs flow into this collector stream at Almira; one from the north and the other from the west.

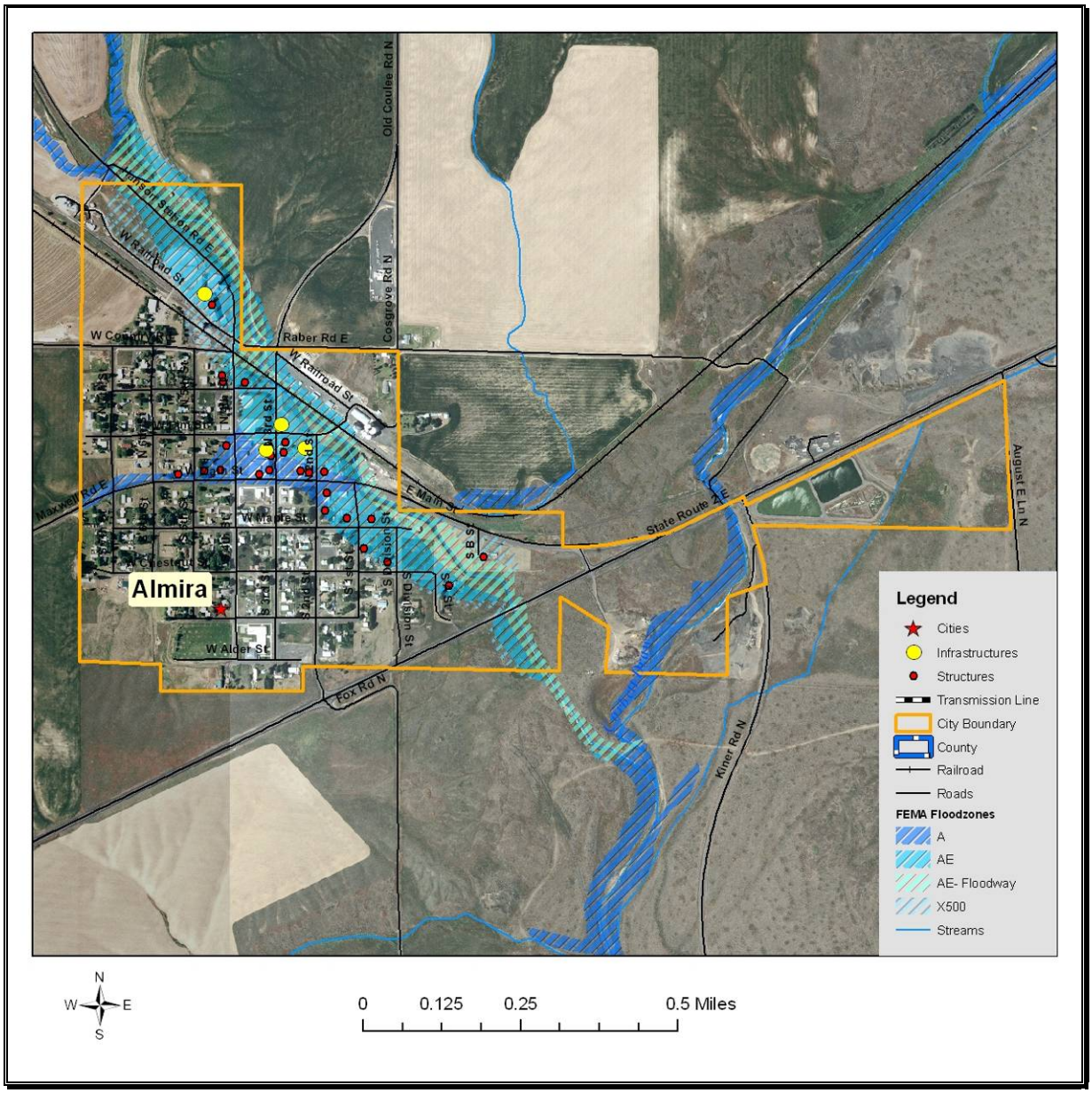
All of these waterways are extremely prone to flash flooding from localized weather events due to typically shallow channels and wide floodplains.. Rain-on-snow events can also have a significant effect on this watershed. Warm rains result in a significantly increased rate of snowmelt. Often this melting occurs while the ground is frozen and the water cannot be absorbed into the soil, resulting in increased overland flows. Flood waters recede slowly as rain-on-snow weather events tend to last for several days. Low velocity flooding occurs in several of the nearby tributaries almost annually during the spring runoff period.

Rural residences, ranches, farms, and roadways located near smaller waterways may be at significant flood risk. The onset of flooding in the smaller drainages can range from extremely slow to very fast. This variability depends on the cause of flooding and other factors such as rainfall intensity, the areas receiving the rain, temperature, and the condition of the soil. Floods that occur quickly are usually caused by thunderstorms, while floods that occur more slowly are often the result of moderate, but prolonged rainfall, snowmelt, or a combination of both. In the case of intense rainfall immediately above developed areas, the onset of flooding may occur in a matter of minutes.

The major impacts from flooding in Almira are the restricted use of several streets, commercial, and residential areas. There are numerous bridge and culvert crossings both within the Town and in the surrounding area.

A high level of sediment is prevalent during periods of intense runoff. This sediment tends to cause a deteriorating condition in streambeds and channels through deposition. Natural obstructions to flood waters include trees, brush, and other vegetation along the stream banks in the floodplain area. Considerable debris has been allowed to accumulate in these channels, plugging culverts and bridges at several locations throughout the county.

Figure 5.5. Town of Almira FEMA Flood Insurance Rate Map.



Value of Resources at Risk

There are approximately 305 parcels and 28 structures within the FEMA-identified floodplains (100- and 500-year) in Almira, yielding a total structure value of $2.1 million. The average damage to structures was estimated based on the parcel's location as either completely within or out of the flood zone. The estimated value of contents is ½ the value of the improvements equating to an additional $1 million in potential losses. In reality, the damages will most likely not be equally distributed between buildings based on building materials, building location, and flood location. However, these estimates provide a basic approximation.

Critical infrastructure located within the identified floodplain for Almira includes the fire station, the post office, town hall, and a grain elevator.

Earthquake

There are no recorded occurrences of earthquakes significantly impacting the town of Almira; however, some minimal shaking has been felt as a result of larger earthquakes elsewhere. The Town has 10% chance of exceeding a 7-8% pga in the next 50 years.[67] Almira does not have any differing issues or levels of risk associated with this hazard than Lincoln County as a whole.

Value of Resources At Risk

Unreinforced masonry (URM) structures and unreinforced chimneys of homes will likely be damaged in the event of an earthquake. There are several publicly accessible unreinforced masonry structures in Almira in addition to the numerous homes and other buildings throughout the Town with unreinforced chimneys. Damaged or collapsed chimneys could result in the secondary hazard of fire. Nonstructural damage caused by falling and swinging objects may be considerable after any magnitude earthquake. Damage to some older, more fragile bridges and land failure causing minor slides along roadways may isolate some residents.

In Almira, nearly all of the downtown structures are assumed to be unreinforced masonry. These structures were built prior to the inclusion of articles for seismic stability in the Uniform Building Codes in 1972. The number and value of unreinforced masonry homes or homes with masonry chimneys in Almira is unknown, but estimated to include at least 20-40 buildings.

Landslide

The town of Almira has a very low probability of experiencing damaging landslides. Slopes in and around the community are generally less than 25%. While small, low angle slumps may occur on eyebrows of the surrounding rolling hills, these will be infrequent and likely the result of water saturation or a major disturbance such as an earthquake or road construction. It is also probable that small slides will continue to occur on the cut and fill slopes of some roads. This type of slide is generally small with little permanent damage to the road or other infrastructure; however, there is some risk of traffic being delayed temporarily while road crews clear the debris and stabilize the bank.

Value of Resources at Risk

There are no structures directly at risk from landslides within the town of Almira. Small slumps may occur along U.S. Highway 2 or other secondary roads. In many cases, this will cause temporary sediment delivery into nearby streams and plugged culverts. These types of events are cleaned up by county or town road departments with little complications. Road slumps are generally reported as regular maintenance; thus, there are few records associated with these events.

---

[67] USGS. 2008 United States National Seismic Hazard Maps. U.S. Geological Survey. U.S. Department of Interior. Available online at http://earthquake.usgs.gov/hazards/products/conterminous/2008/. October 2009.

Severe Weather

The town of Almira does not have any differing levels of risk associated with this hazard than Lincoln County as a whole.

Value of Resources at Risk

It is difficult to estimate the cost of potential winter storm damages to structures and the economy in Almira. Damage to roofs by heavy snow accumulations depends on the moisture content of the snow and the structural characteristics of the buildings. In general, snow in this region tends to have low moisture content because of the low temperatures and arid environment. Additionally, snow rarely accumulates for long periods of time due to regular wind events. Frozen water pipes are the most common damage to residential and business structures. Older homes tend to be at a higher risk to frozen water pipes than newer ones. Snow plowing in within the town limits is accomplished by the town's public works department. Private landowners are responsible for maintaining their own driveways or other private roads. Utility supplies are impacted during severe winter storms as power is lost on a regional basis. This has a two-fold impact on residents as not only is power cut to homes and businesses, but primary heating is lost for many residents. Gas furnaces and wood stoves supplement electrical heating, but with wood heating the senior population is at a disadvantage. Emergency response to severe winter storms includes site visits by police or fire department personnel, opening of shelters, or assistance with shopping, medical attention, and communications. The economic losses caused by severe winter storms may frequently be greater than structural damages. Employees may not be able to travel to work for several days and businesses may not open. Damages are seen in the form of structural repair and loss of economic activity. Lincoln County schools are occasionally closed during and right after a severe winter storm because of cold temperatures and snow covered roads.

Thunderstorms are not likely to be severe enough in Almira to cause significant damages. However, the loss potential from flooding that results from severe thunderstorms could be significant.

Although the financial impacts of hail can be substantial and extended, accurately quantifying these impacts is problematic. Hail typically causes direct losses to structures and other personal property within Almira. The most significant losses are most clearly seen in the agriculture sectors of the economy. Potential losses to agriculture can be disastrous. Crop damage from hail will also be different depending on the time of year and the type of crop. Most farmers carry insurance on their crops to help mitigate the potential financial loss resulting from a localized hail storm. Homeowners in Almira rarely incur severe damage to structures (roofs); however, hail damage to vehicles is not uncommon. The damage to vehicles is difficult to estimate because the number of vehicles impacted by a specific ice storm is unknown. Additionally, most hail damage records are kept by various insurance agencies.

It is difficult to estimate potential losses in Almira due to windstorms and tornadoes. Construction throughout the County has been implemented in the presence of high wind events, and therefore, the community is at a higher level of preparedness to high wind events than many other areas experiencing lower average wind speeds.

We have estimated losses based on wind and tornado damage as follows:

- 3% of the buildings damaged causing 50% of value loss (loss could be from downed or damaged trees, damaged outbuildings, damaged fences/poles, damage to siding, damaged landscaping etc.)
- 5% of the buildings received damage to roof (requiring replacement of roof equaling $3,000)

Damages associated with sensitive receptor irritation have not been estimated. We have also not estimated the potential for a large scale wildfire event associated with high winds. Based on the data provided by the County, there are 176 total structures in Almira with a total value of approximately $13.1 million. Using the criteria outlined above an estimate of the impact of high winds in Almira has been made. The potential wind and tornado damage to all buildings is estimated at approximately $185,737. The estimated damage to roofs is approximately $27,000.

Power failure often accompanies severe storms. More rural parts of the County like Almira are sometimes better prepared to deal with power outages for a few days due to the frequent occurrence of such events; however, prolonged failure, especially during cold winter temperatures can have disastrous effects. All communities should be prepared to deal with power failures. Community shelters equipped with alternative power sources will help local residents stay warm and prepare food. A community-based system for monitoring and assisting elderly or disabled residents should also be developed. All households should maintain survival kits that include warm blankets, flashlights, extra batteries, nonperishable food items, and clean drinking water.

Wildland Fire

The agricultural landscape is widespread across Lincoln County and surrounds Almira. Vast areas of deep, rich soil deposits provide for extensive agriculture development. Lincoln County is the second highest wheat and barley producing county in the state. Other crops include grass seed, oats, hay and potatoes as well as extensive areas of fallow land set aside in the CRP. Most of these crops are vulnerable to wildfire at certain times of the year. The agriculture landscape is the predominant cover vegetation and fuel type throughout the county dominating the south, northwest and east central portions of the county. Interspersed throughout this landscape are stream channels and rocky scabland areas. New development occurs primarily near the community and along major roads. Occasionally farmland is subdivided between family members for new home sites or for development of new farming facilities. Most of the pressure for multi-housing subdivisions occurs in close proximity to town. In nearly all developed areas, structures are in close proximity to vegetation that becomes a significant fire risk at certain times of the year.

Wildfire potential in the agricultural landscape is moderate in the rural farmland and moderate to high in the shrubby draws and waterways, pastures, and scattered patches of scabland. Virtually all of the populated areas within the agricultural landscape face similar challenges related to wildfire control and opportunities for fuels mitigation efforts. Farming and ranching activities have the potential to increase the risk of a human-caused ignition. Large expanses of crops, CRP, rangeland or pasture provide areas of continuous fuels that may threaten homes and farmsteads. Under extreme weather conditions, escaped fires in these fuels could threaten individual homes or a town site; however, this type of fire is usually quickly controlled. Clearings and fuel breaks disrupt a slow moving wildfire enabling suppression before a fire can ignite heavier fuels. High winds increase the rate of fire spread and intensity of crop and rangeland

fires. It is imperative that homeowners implement fire mitigation measures to protect their structures and families prior to a wildfire event in these areas.

Wildfire risk in the agricultural landscape is at its highest during late summer and fall when crops are cured and daily temperatures are at their highest. A wind-driven fire in agricultural fuels or dry native fuel complexes would produce a rapidly advancing, but variable intensity fire. Fires burning in some types of unharvested fields would be expected to burn more intensely with larger flame lengths due to the greater availability of fuels resulting from the higher productivity of the vegetation. Fields enrolled in the CRP or set aside for wildlife habitat can burn very intensely due to an increased amount of fuel build-up from previous years' growth. Fires in these types of fuels are harder to extinguish completely due to the dense duff layer, often leading to hold over fires that may reemerge at a later date causing additional fire starts.

Residents living in Almira have access to the municipal water supply system and public fire hydrants. Outside these areas, development relies on individual, co-op, or multiple-home well systems. Creeks, ponds, and developed drafting areas provide water sources for emergency fire suppression in the rural areas to a limited extent. Irrigation systems are capable of providing additional water supply for suppression equipment on a limited basis. Additional water resources distributed and documented throughout the agricultural landscape are needed to provide water for fire suppression.

Above ground, high voltage transmission lines cross the planning area in many directions in corridors cleared of most vegetation, which provides for a defensible space around the power line infrastructure and may provide a control point for fire suppression, if well maintained. Local public electrical utility lines are both above and below ground traveling through back yards and along roads and highways. Many of these lines are exposed to damage from falling trees and branches. Power and communications may be cut to some of these during a wildfire event.

Lincoln County Fire District #8 protects the community of Almira. The fire district provides structural fire protection as well as wildland fire protection. Mutual aid agreements between fire districts supplement wildland fire protection when needed. Additional fire protection is provided by the Washington DNR, which provides wildfire protection and suppression on privately owned forestland and state-owned forestland north of Highway 2 in Lincoln County. The DNR does not provide structural fire suppression, but does provide wildfire protection on non-forested land that threatens DNR-protected lands. The BLM provides wildfire protection on their ownership within Lincoln County and has mutual aid agreements with the DNR for protection of forested land. BLM also does not provide structural fire suppression.

Value of Resources at Risk

It is difficult to estimate potential losses in Almira from wildland fire due to the unpredictability of wildfire behavior and the nature of ignition sources. It is impossible to forecast the path a wildfire will take and what type of assets and resources, manmade and ecological, will be at risk. Thus, no value estimates were made for this hazard.

Typically, structures located in forested areas without an adequate defensible space or fire resistant landscaping have the highest risk of loss. Nevertheless, homes and other structures located in the grasslands or agricultural regions are not without wildfire risk. Grass fires are often the most dangerous

due to high rates of spread. Fires in this fuel type are considered somewhat easier to suppress given the appropriate resources, but they can also be the most destructive. Homes along the perimeter of the community would have the highest risk due to their adjacency to flashy fuels.

Avalanche

The town of Almira will not be directly impacted by this type of localized event due to the gentle topography and low snow accumulations.

Value of Resources at Risk

The town of Almira has no assets at risk to avalanches.

Tsunami

Although Lincoln County's northern border has a moderate risk of being impact by an inland tsunami on Lake Roosevelt, the town of Almira will not be directly impacted by this type of localized event.

Value of Resources at Risk

The town of Almira has no assets at risk to inland tsunamis.

Volcano

The town of Almira does not have any differing levels of risk associated with this hazard than Lincoln County as a whole.

Value of Resources at Risk

The town of Almira has no assets at direct risk of being impacted by a volcanic eruption. However, the secondary effects of ash and airborne particulates may have varying degrees of negative effects. Damages to property will likely be limited to vehicles and cleanup costs. Additionally, residents of Almira will be at risk to health problems associated with the respiratory effects of breathing airborne particulates.

Drought

The town of Almira does not have any differing levels of risk associated with this hazard than Lincoln County as a whole. However, the town does have its own policies concerning water conservation practices during the dry months. Additionally, the town may develop programs to deal with residents and businesses significantly impacted by drought if necessary.

Value of Resources at Risk

The town of Almira has no assets directly at risk to drought; however, the economic impacts of a drought or a wildland fire caused by extended dry periods would have a great impact on the community. The majority of the population is employed either directly by the agriculture industry or to a service industry dependent on agriculture. Crop losses resulting from extended droughts would likely be considered a disaster for the community.

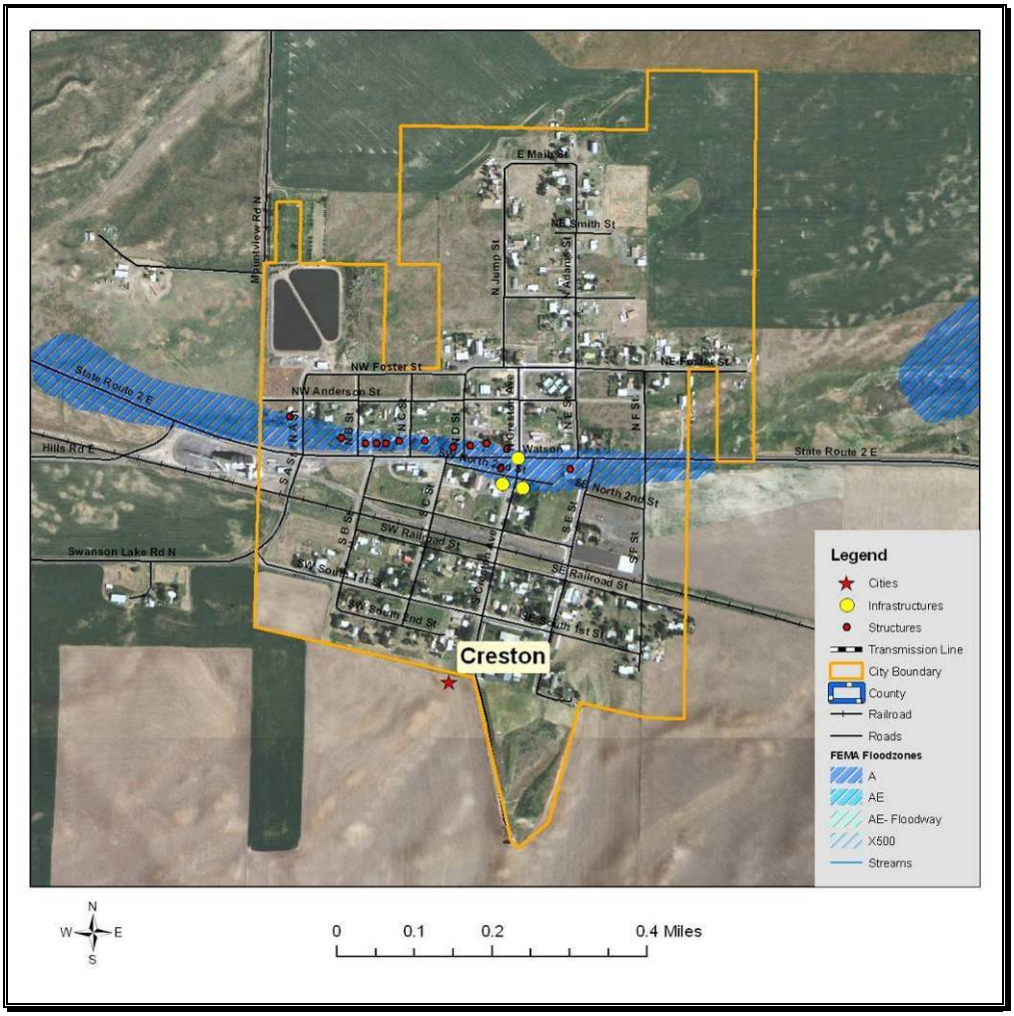
Town of Creston Annex

Flood

The town of Creston is affected by a small floodplain caused by a high water table. During wet years, water collects in this area and becomes a tributary to Sinking Creek to the south. Within the community, the floodplain primarily affects U.S. Highway 2 and SW North 2nd Street and crosses North D, North C, North B, and North A Streets. Most of this area is residential; however, a few commercial and public buildings could also be impacted.

Creston is most at risk to rain-on-snow and rapid spring runoff events that causes water to collect in this area. Warm rains result in a significantly increased rate of snowmelt. Often this melting occurs while the ground is frozen and the water cannot be absorbed into the soil, resulting in increased overland flows. Flood waters recede slowly as rain-on-snow weather events tend to last for several days. Low velocity flooding occurs in several of the nearby tributaries almost annually during the spring runoff period.

Figure 5.5. Town of Creston FEMA Flood Insurance Rate Map.



Value of Resources at Risk

The County's parcel layer for Creston is incomplete, but it is estimated that there are approximately 15 structures within the FEMA-identified floodplains (100- and 500-year) in Creston, yielding a total structure value of $1.1 million. The average damage to structures was estimated based on the parcel's location as either completely within or out of the flood zone. The estimated value of contents is ½ the value of the improvements equating to an additional $557,217 in potential losses. In reality, the damages will most likely not be equally distributed between buildings based on building materials, building location, and flood location. However, these estimates provide a basic approximation.

Critical infrastructure located within the identified floodplain for Creston includes the post office and town hall.

Earthquake

There are no recorded occurrences of earthquakes significantly impacting the town of Creston; however, some minimal shaking has been felt as a result of larger earthquakes elsewhere. The Town has 10% chance of exceeding a 6-7% pga in the next 50 years.[68] Creston does not have any differing issues or levels of risk associated with this hazard than Lincoln County as a whole.

Value of Resources at Risk

Unreinforced masonry (URM) structures and unreinforced chimneys of homes will likely be damaged in the event of an earthquake. There are several publicly accessible unreinforced masonry structures in Creston in addition to the numerous homes and other buildings throughout the Town with unreinforced chimneys. Damaged or collapsed chimneys could result in the secondary hazard of fire. Nonstructural damage caused by falling and swinging objects may be considerable after any magnitude earthquake. Damage to some older, more fragile bridges and land failure causing minor slides along roadways may isolate some residents.

In Creston, nearly all of the downtown structures are assumed to be unreinforced masonry. These structures were built prior to the inclusion of articles for seismic stability in the Uniform Building Codes in 1972. The number and value of unreinforced masonry homes or homes with masonry chimneys in Creston is unknown, but estimated to include at least 20-40 buildings.

Landslide

The town of Creston has a very low probability of experiencing damaging landslides. Slopes in and around the community are generally less than 35%. While small, low angle slumps may occur on eyebrows of the hills south of town, these will be infrequent and likely the result of water saturation or a major disturbance such as an earthquake or road construction.

---

[68] USGS. 2008 United States National Seismic Hazard Maps. U.S. Geological Survey. U.S. Department of Interior. Available online at http://earthquake.usgs.gov/hazards/products/conterminous/2008/. October 2009.

Value of Resources at Risk

There are no structures or infrastructure directly at risk from landslides within the town of Creston.

Severe Weather

The town of Creston does not have any differing levels of risk associated with this hazard than Lincoln County as a whole.

January 2009 Ice Storm – Creston experienced an episode of freezing fog lasting for 10 days. A total of 32 trees within the town limits had up to 2 inches of ice buildup resulting in breakage, cracking, and bending limbs that were determined to be an immediate threat to public health and safety.

Value of Resources at Risk

It is difficult to estimate the cost of potential winter storm damages to structures and the economy in Creston. Damage to roofs by heavy snow accumulations depends on the moisture content of the snow and the structural characteristics of the buildings. In general, snow in this region tends to have low moisture content because of the low temperatures and arid environment. Additionally, snow rarely accumulates for long periods of time due to regular wind events. Frozen water pipes are the most common damage to residential and business structures. Older homes tend to be at a higher risk to frozen water pipes than newer ones. Snow plowing in within the town limits is accomplished by the town's public works department. Private landowners are responsible for maintaining their own driveways or other private roads. Utility supplies are impacted during severe winter storms as power is lost on a regional basis. This has a two-fold impact on residents as not only is power cut to homes and businesses, but primary heating is lost for many residents. Gas furnaces and wood stoves supplement electrical heating, but with wood heating the senior population is at a disadvantage. Emergency response to severe winter storms includes site visits by police or fire department personnel, opening of shelters, or assistance with shopping, medical attention, and communications. The economic losses caused by severe winter storms may frequently be greater than structural damages. Employees may not be able to travel to work for several days and businesses may not open. Damages are seen in the form of structural repair and loss of economic activity. Lincoln County schools are occasionally closed during and right after a severe winter storm because of cold temperatures and snow covered roads.

Thunderstorms are not likely to be severe enough in Creston to cause significant damages. However, the loss potential from flooding that results from severe thunderstorms could be significant.

Although the financial impacts of hail can be substantial and extended, accurately quantifying these impacts is problematic. Hail typically causes direct losses to structures and other personal property within Creston. The most significant losses are most clearly seen in the agriculture sectors of the economy. Potential losses to agriculture can be disastrous. Crop damage from hail will also be different depending on the time of year and the type of crop. Most farmers carry insurance on their crops to help mitigate the potential financial loss resulting from a localized hail storm. Homeowners in Creston rarely incur severe damage to structures (roofs); however, hail damage to vehicles is not uncommon. The damage to vehicles is difficult to estimate because the number of vehicles impacted by a specific ice storm is unknown. Additionally, most hail damage records are kept by various insurance agencies.

It is difficult to estimate potential losses in Creston due to windstorms and tornadoes. Construction throughout the County has been implemented in the presence of high wind events, and therefore, the community is at a higher level of preparedness to high wind events than many other areas experiencing lower average wind speeds.

We have estimated losses based on wind and tornado damage as follows:

- 3% of the buildings damaged causing 50% of value loss (loss could be from downed or damaged trees, damaged outbuildings, damaged fences/poles, damage to siding, damaged landscaping etc.)
- 5% of the buildings received damage to roof (requiring replacement of roof equaling $3,000)

Damages associated with sensitive receptor irritation have not been estimated. We have also not estimated the potential for a large scale wildfire event associated with high winds. Based on the data provided by the County, there are 140 total structures in Creston with a total value of approximately $10.4 million. Using the criteria outlined above an estimate of the impact of high winds in Creston has been made. The potential wind and tornado damage to all buildings is estimated at approximately $148,590. The estimated damage to roofs is approximately $21,000.

Power failure often accompanies severe storms. More rural parts of the County like Creston are sometimes better prepared to deal with power outages for a few days due to the frequent occurrence of such events; however, prolonged failure, especially during cold winter temperatures can have disastrous effects. All communities should be prepared to deal with power failures. Community shelters equipped with alternative power sources will help local residents stay warm and prepare food. A community-based system for monitoring and assisting elderly or disabled residents should also be developed. All households should maintain survival kits that include warm blankets, flashlights, extra batteries, nonperishable food items, and clean drinking water.

Wildland Fire

The agricultural landscape is widespread across Lincoln County and surrounds Creston. Vast areas of deep, rich soil deposits provide for extensive agriculture development. Lincoln County is the second highest wheat and barley producing county in the state. Other crops include grass seed, oats, hay and potatoes as well as extensive areas of fallow land set aside in the CRP. Most of these crops are vulnerable to wildfire at certain times of the year. The agriculture landscape is the predominant cover vegetation and fuel type throughout the county dominating the south, northwest and east central portions of the county. Interspersed throughout this landscape are stream channels and rocky scabland areas. New development occurs primarily near the community and along major roads. Occasionally farmland is subdivided between family members for new home sites or for development of new farming facilities. Most of the pressure for multi-housing subdivisions occurs in close proximity to town. In nearly all developed areas, structures are in close proximity to vegetation that becomes a significant fire risk at certain times of the year.

Wildfire potential in the agricultural landscape is moderate in the rural farmland and moderate to high in the shrubby draws and waterways, pastures, and scattered patches of scabland. Virtually all of the populated areas within the agricultural landscape face similar challenges related to wildfire control and

opportunities for fuels mitigation efforts. Farming and ranching activities have the potential to increase the risk of a human-caused ignition. Large expanses of crops, CRP, rangeland or pasture provide areas of continuous fuels that may threaten homes and farmsteads. Under extreme weather conditions, escaped fires in these fuels could threaten individual homes or a town site; however, this type of fire is usually quickly controlled. Clearings and fuel breaks disrupt a slow moving wildfire enabling suppression before a fire can ignite heavier fuels. High winds increase the rate of fire spread and intensity of crop and rangeland fires. It is imperative that homeowners implement fire mitigation measures to protect their structures and families prior to a wildfire event in these areas.

Wildfire risk in the agricultural landscape is at its highest during late summer and fall when crops are cured and daily temperatures are at their highest. A wind-driven fire in agricultural fuels or dry native fuel complexes would produce a rapidly advancing, but variable intensity fire. Fires burning in some types of unharvested fields would be expected to burn more intensely with larger flame lengths due to the greater availability of fuels resulting from the higher productivity of the vegetation. Fields enrolled in the CRP or set aside for wildlife habitat can burn very intensely due to an increased amount of fuel build-up from previous years' growth. Fires in these types of fuels are harder to extinguish completely due to the dense duff layer, often leading to hold over fires that may reemerge at a later date causing additional fire starts.

Residents living in Creston have access to the municipal water supply system and public fire hydrants. Outside these areas, development relies on individual, co-op, or multiple-home well systems. Creeks, ponds, and developed drafting areas provide water sources for emergency fire suppression in the rural areas to a limited extent. Irrigation systems are capable of providing additional water supply for suppression equipment on a limited basis. Additional water resources distributed and documented throughout the agricultural landscape are needed to provide water for fire suppression.

Above ground, high voltage transmission lines cross the planning area in many directions in corridors cleared of most vegetation, which provides for a defensible space around the power line infrastructure and may provide a control point for fire suppression, if well maintained. Local public electrical utility lines are both above and below ground traveling through back yards and along roads and highways. Many of these lines are exposed to damage from falling trees and branches. Power and communications may be cut to some of these during a wildfire event.

Lincoln County Fire District #7 protects the community of Creston. The fire district provides structural fire protection as well as wildland fire protection. Mutual aid agreements between fire districts supplement wildland fire protection when needed. Additional fire protection is provided by the Washington DNR, which provides wildfire protection and suppression on privately owned forestland and state-owned forestland north of Highway 2 in Lincoln County. The DNR does not provide structural fire suppression, but does provide wildfire protection on non-forested land that threatens DNR-protected lands. The BLM provides wildfire protection on their ownership within Lincoln County and has mutual aid agreements with the DNR for protection of forested land. BLM also does not provide structural fire suppression.

Value of Resources at Risk

It is difficult to estimate potential losses in Creston from wildland fire due to the unpredictability of wildfire behavior and the nature of ignition sources. It is impossible to forecast the path a wildfire will take and

what type of assets and resources, manmade and ecological, will be at risk. Thus, no value estimates were made for this hazard.

Typically, structures located in forested areas without an adequate defensible space or fire resistant landscaping have the highest risk of loss. Nevertheless, homes and other structures located in the grasslands or agricultural regions are not without wildfire risk. Grass fires are often the most dangerous due to high rates of spread. Fires in this fuel type are considered somewhat easier to suppress given the appropriate resources, but they can also be the most destructive. Homes along the perimeter of the community would have the highest risk due to their adjacency to flashy fuels.

Avalanche

The town of Creston will not be directly impacted by this type of localized event due to the gentle topography and low snow accumulations.

Value of Resources at Risk

The town of Creston has no assets at risk to avalanches.

Tsunami

Although Lincoln County's northern border has a moderate risk of being impact by an inland tsunami on Lake Roosevelt, the town of Creston will not be directly impacted by this type of localized event.

Value of Resources at Risk

The town of Creston has no assets at risk to inland tsunamis.

Volcano

The town of Creston does not have any differing levels of risk associated with this hazard than Lincoln County as a whole.

Value of Resources at Risk

The town of Creston has no assets at direct risk of being impacted by a volcanic eruption. However, the secondary effects of ash and airborne particulates may have varying degrees of negative effects. Damages to property will likely be limited to vehicles and cleanup costs. Additionally, residents of Creston will be at risk to health problems associated with the respiratory effects of breathing airborne particulates.

Drought

The town of Creston does not have any differing levels of risk associated with this hazard than Lincoln County as a whole. However, the town does have its own policies concerning water conservation practices during the dry months. Additionally, the town may develop programs to deal with residents and businesses significantly impacted by drought if necessary.

Value of Resources at Risk

The town of Creston has no assets directly at risk to drought; however, the economic impacts of a drought or a wildland fire caused by extended dry periods would have a great impact on the community. The majority of the population is employed either directly by the agriculture industry or to a service industry dependent on agriculture. Crop losses resulting from extended droughts would likely be considered a disaster for the community.

Town of Harrington Annex

Flood

The town of Harrington is affected by the floodplain from two tributaries of Coal Creek, which eventually flows into Sylvan Lake to the southwest. The primary collector stream flows in a southerly direction along the western edge of town paralleling State Highway 28. A smaller tributary enters the community along its eastern boundary and forms a confluence near the culmination of North 4th Street.

All of these waterways are extremely prone to flash flooding from localized weather events due to typically shallow channels and wide floodplains. Rain-on-snow events can also have a significant effect on this watershed. Warm rains result in a significantly increased rate of snowmelt. Often this melting occurs while the ground is frozen and the water cannot be absorbed into the soil, resulting in increased overland flows. Flood waters recede slowly as rain-on-snow weather events tend to last for several days. Low velocity flooding occurs in several of the nearby tributaries almost annually during the spring runoff period.

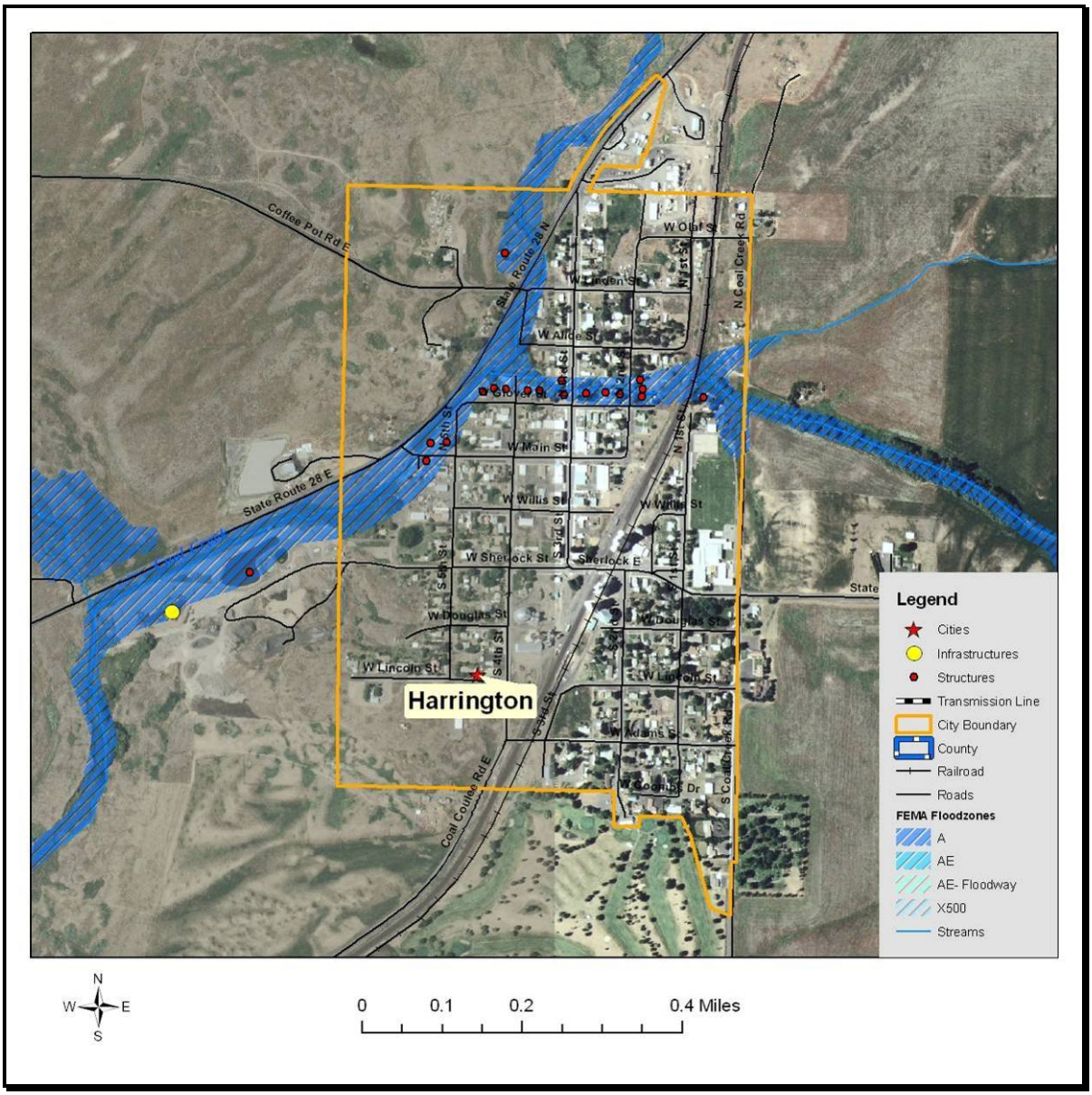
A flood drainage channel runs from the eastern city limits westward through town and drains into the Coal Creek tributary near State Route 28. The Main Street Bridge is a 6 foot by 25 foot culvert that was designed to handle a large flood event. Additionally, there are two large culverts on State Route 28 that provide for passage of peak flows.

Rural residences, ranches, farms, and roadways located near smaller waterways may be at significant flood risk. The onset of flooding in the smaller drainages can range from extremely slow to very fast. This variability depends on the cause of flooding and other factors such as rainfall intensity, the areas receiving the rain, temperature, and the condition of the soil. Floods that occur quickly are usually caused by thunderstorms, while floods that occur more slowly are often the result of moderate, but prolonged rainfall, snowmelt, or a combination of both. In the case of intense rainfall immediately above developed areas, the onset of flooding may occur in a matter of minutes.

The major impacts from flooding in Harrington are the restricted use of several streets including State Highways 23 and 28, commercial areas along State Highway 23, and several residential areas that are above the corrected Flood Zone A designation. There are numerous bridge and culvert crossings both within the Town and in the surrounding area.

An elevated level of sediment is prevalent during periods of intense runoff. This sediment tends to cause a deteriorating condition in streambeds and channels through deposition. Natural obstructions to flood waters include trees, brush, and other vegetation along the stream banks in the floodplain area. Debris has accumulates in these channels and is periodically removed to prevent plugged culverts and bridges at several locations.

Figure 5.6. Town of Harrington FEMA Flood Insurance Rate Map*.



**The 1988 edition of the FIRM shown here is not the current floodplain map used in Harrington. With FEMA's written permission, the city uses the 1985 version of the FIRM. The "Value of Resources at Risk" section is based on the 1985 FIRM.*

Value of Resources at Risk

There are approximately 10 parcels and 2 structures within the corrected FEMA-identified floodplains (100- and 500-year) in Harrington, yielding a total structure value of $100,000. The estimated value of contents is ½ the value of the improvements equating to an additional $50,000 in potential losses. In reality, the damages will most likely not be equally distributed between buildings based on building materials, building location, and flood location. However, these estimates provide a basic approximation. In most cases, damages could be prevented by minor sandbagging.

The sewer lagoons are the only critical infrastructure within the floodplain in Harrington and these are protected by a flood drainage channel.

Earthquake

There are no recorded occurrences of earthquakes significantly impacting the town of Harrington; however, some minimal shaking has been felt as a result of larger earthquakes elsewhere. The Town has 10% chance of exceeding a 6-7% pga in the next 50 years.[69] Harrington does not have any differing issues or levels of risk associated with this hazard than Lincoln County as a whole.

Value of Resources At Risk

Unreinforced masonry (URM) structures and unreinforced chimneys of homes will likely be damaged in the event of an earthquake. There are several publicly accessible unreinforced masonry structures in Harrington in addition to the 35-40 homes and other buildings throughout the Town with unreinforced chimneys. Damaged or collapsed chimneys could result in the secondary hazard of fire. Nonstructural damage caused by falling and swinging objects may be considerable after any magnitude earthquake. Damage to some older, more fragile bridges and land failure causing minor slides along roadways may isolate some residents.

In Harrington, nearly all of the 25 downtown structures are assumed to be unreinforced masonry including the Opera Hall and City Hall. These structures were built prior to the inclusion of articles for seismic stability in the Uniform Building Codes in 1972. The value of structures in the downtown district is unknown. There are approximately 18 unreinforced masonry homes and 35-40 homes with masonry chimneys in Harrington. The value of URM homes is estimated at $1.3 million using an average improvement value of $74,296.

Landslide

The town of Harrington has a very low probability of experiencing damaging landslides. Slopes in and around the community are generally less than 30%. While small, low angle slumps may occur on eyebrows of surrounding rolling hills, particularly those to the west of town, these will be infrequent and likely the result of water saturation or freeze/thaw cycles. It is probable that small slides will continue to occur on the cut and fill slopes of some roads. This type of slide is generally small with little permanent damage to the road or other infrastructure; however, there is some risk of traffic being delayed temporarily while road crews clear the debris and stabilize the bank.

Value of Resources at Risk

There are no structures directly at risk from landslides within the town of Harrington. Small slumps may occur along State Route 28 or other secondary roads. In many cases, this will cause temporary sediment delivery into nearby streams and plug culverts. These types of events are cleaned up by county or town

[69] USGS. 2008 United States National Seismic Hazard Maps. U.S. Geological Survey. U.S. Department of Interior. Available online at http://earthquake.usgs.gov/hazards/products/conterminous/2008/. October 2009.

road departments with little complications. Road slumps are generally reported as regular maintenance; thus, there are few records associated with these events.

Severe Weather

The town of Harrington does not have any differing levels of risk associated with this hazard than Lincoln County as a whole.

Value of Resources at Risk

It is difficult to estimate the cost of potential winter storm damages to structures and the economy in Harrington. Damage to roofs by heavy snow accumulations depends on the moisture content of the snow and the structural characteristics of the buildings. In general, snow in this region tends to have low moisture content because of the low temperatures and arid environment. Additionally, snow rarely accumulates for long periods of time due to regular wind events. Frozen water pipes are the most common damage to residential and business structures. Older homes tend to be at a higher risk to frozen water pipes than newer ones. Snow plowing in within the town limits is accomplished by the town's public works department. Private landowners are responsible for maintaining their own driveways or other private roads. Utility supplies are impacted during severe winter storms as power is lost on a regional basis. This has a two-fold impact on residents as not only is power cut to homes and businesses, but primary heating is lost for many residents. Gas furnaces and wood stoves supplement electrical heating, but with wood heating the senior population is at a disadvantage. Emergency response to severe winter storms includes site visits by police or fire department personnel, opening of shelters, or assistance with shopping, medical attention, and communications. The economic losses caused by severe winter storms may frequently be greater than structural damages. Employees may not be able to travel to work for several days and businesses may not open. Damages are seen in the form of structural repair and loss of economic activity. Lincoln County schools are occasionally closed during and right after a severe winter storm because of cold temperatures and snow covered roads.

Thunderstorms are not likely to be severe enough in Harrington to cause significant damages. However, the loss potential from flooding that results from severe thunderstorms could be significant.

Although the financial impacts of hail can be substantial and extended, accurately quantifying these impacts is problematic. Hail typically causes direct losses to structures and other personal property within Harrington. The most significant losses are most clearly seen in the agriculture sectors of the economy. Potential losses to agriculture can be disastrous. Crop damage from hail will also be different depending on the time of year and the type of crop. Most farmers carry insurance on their crops to help mitigate the potential financial loss resulting from a localized hail storm. Homeowners in Harrington rarely incur severe damage to structures (roofs); however, hail damage to vehicles is not uncommon. The damage to vehicles is difficult to estimate because the number of vehicles impacted by a specific ice storm is unknown. Additionally, most hail damage records are kept by various insurance agencies.

It is difficult to estimate potential losses in Harrington due to windstorms and tornadoes. Construction throughout the County has been implemented in the presence of high wind events, and therefore, the

community is at a higher level of preparedness to high wind events than many other areas experiencing lower average wind speeds.

We have estimated losses based on wind and tornado damage as follows:

- 3% of the buildings damaged causing 50% of value loss (loss could be from downed or damaged trees, damaged outbuildings, damaged fences/poles, damage to siding, damaged landscaping etc.)
- 5% of the buildings received damage to roof (requiring replacement of roof equaling $3,000)

Damages associated with sensitive receptor irritation have not been estimated. We have also not estimated the potential for a large scale wildfire event associated with high winds. Based on the data provided by the County, there are 247 total structures in Harrington with a total value of approximately $18.4 million. Using the criteria outlined above an estimate of the impact of high winds in Harrington has been made. The potential wind and tornado damage to all buildings is estimated at approximately $260,032. The estimated damage to roofs is approximately $36,000.

Power failure often accompanies severe storms. More rural parts of the County like Harrington are sometimes better prepared to deal with power outages for a few days due to the frequent occurrence of such events; however, prolonged failure, especially during cold winter temperatures can have disastrous effects. All communities should be prepared to deal with power failures. Community shelters equipped with alternative power sources will help local residents stay warm and prepare food. A community-based system for monitoring and assisting elderly or disabled residents should also be developed. All households should maintain survival kits that include warm blankets, flashlights, extra batteries, nonperishable food items, and clean drinking water.

Wildland Fire

The agricultural landscape is widespread across Lincoln County and surrounds Harrington. Vast areas of deep, rich soil deposits provide for extensive agriculture development. Lincoln County is the second highest wheat and barley producing county in the state. Other crops include grass seed, oats, hay and potatoes as well as extensive areas of fallow land set aside in the CRP. Most of these crops are vulnerable to wildfire at certain times of the year. The agriculture landscape is the predominant cover vegetation and fuel type throughout the county dominating the south, northwest and east central portions of the county. Interspersed throughout this landscape are stream channels and rocky scabland areas. New development occurs primarily near the community and along major roads. Occasionally farmland is subdivided between family members for new home sites or for development of new farming facilities. Most of the pressure for multi-housing subdivisions occurs in close proximity to town. In nearly all developed areas, structures are in close proximity to vegetation that becomes a significant fire risk at certain times of the year.

Wildfire potential in the agricultural landscape is moderate in the rural farmland and moderate to high in the shrubby draws and waterways, pastures, and scattered patches of scabland. Virtually all of the populated areas within the agricultural landscape face similar challenges related to wildfire control and opportunities for fuels mitigation efforts. Farming and ranching activities have the potential to increase the risk of a human-caused ignition. Large expanses of crops, CRP, rangeland or pasture provide areas of

continuous fuels that may threaten homes and farmsteads. Under extreme weather conditions, escaped fires in these fuels could threaten individual homes or a town site; however, this type of fire is usually quickly controlled. Clearings and fuel breaks disrupt a slow moving wildfire enabling suppression before a fire can ignite heavier fuels. High winds increase the rate of fire spread and intensity of crop and rangeland fires. It is imperative that homeowners implement fire mitigation measures to protect their structures and families prior to a wildfire event in these areas.

Wildfire risk in the agricultural landscape is at its highest during late summer and fall when crops are cured and daily temperatures are at their highest. A wind-driven fire in agricultural fuels or dry native fuel complexes would produce a rapidly advancing, but variable intensity fire. Fires burning in some types of unharvested fields would be expected to burn more intensely with larger flame lengths due to the greater availability of fuels resulting from the higher productivity of the vegetation. Fields enrolled in the CRP or set aside for wildlife habitat can burn very intensely due to an increased amount of fuel build-up from previous years' growth. Fires in these types of fuels are harder to extinguish completely due to the dense duff layer, often leading to hold over fires that may reemerge at a later date causing additional fire starts.

Residents living in Harrington have access to the municipal water supply system and public fire hydrants. Outside these areas, development relies on individual, co-op, or multiple-home well systems. Creeks, ponds, and developed drafting areas provide water sources for emergency fire suppression in the rural areas to a limited extent. Irrigation systems are capable of providing additional water supply for suppression equipment on a limited basis. Additional water resources distributed and documented throughout the agricultural landscape are needed to provide water for fire suppression.

Above ground, high voltage transmission lines cross the planning area in many directions in corridors cleared of most vegetation, which provides for a defensible space around the power line infrastructure and may provide a control point for fire suppression, if well maintained. Local public electrical utility lines are both above and below ground traveling through back yards and along roads and highways. Many of these lines are exposed to damage from falling trees and branches. Power and communications may be cut to some of these during a wildfire event.

Lincoln County Fire District #6 protects the community of Harrington. The fire district provides structural fire protection as well as wildland fire protection. Mutual aid agreements between fire districts supplement wildland fire protection when needed. Additional fire protection is provided by the Washington DNR, which provides wildfire protection and suppression on privately owned forestland and state-owned forestland north of Highway 2 in Lincoln County. The DNR does not provide structural fire suppression, but does provide wildfire protection on non-forested land that threatens DNR-protected lands. The BLM provides wildfire protection on their ownership within Lincoln County and has mutual aid agreements with the DNR for protection of forested land. BLM also does not provide structural fire suppression.

Value of Resources at Risk

It is difficult to estimate potential losses in Harrington from wildland fire due to the unpredictability of wildfire behavior and the nature of ignition sources. It is impossible to forecast the path a wildfire will take

and what type of assets and resources, manmade and ecological, will be at risk. Thus, no value estimates were made for this hazard.

Typically, structures located in forested areas without an adequate defensible space or fire resistant landscaping have the highest risk of loss. Nevertheless, homes and other structures located in the grasslands or agricultural regions are not without wildfire risk. Grass fires are often the most dangerous due to high rates of spread. Fires in this fuel type are considered somewhat easier to suppress given the appropriate resources, but they can also be the most destructive. Homes along the perimeter of the community would have the highest risk due to their adjacency to flashy fuels.

Avalanche

The town of Harrington will not be directly impacted by this type of localized event due to the gentle topography and low snow accumulations.

Value of Resources at Risk

The town of Harrington has no assets at risk to avalanches.

Tsunami

Although Lincoln County's northern border has a moderate risk of being impact by an inland tsunami on Lake Roosevelt, the town of Harrington will not be directly impacted by this type of localized event.

Value of Resources at Risk

The town of Harrington has no assets at risk to inland tsunamis.

Volcano

The town of Harrington does not have any differing levels of risk associated with this hazard than Lincoln County as a whole.

Value of Resources at Risk

The town of Harrington has no assets at direct risk of being impacted by a volcanic eruption. However, the secondary effects of ash and airborne particulates may have varying degrees of negative effects. Damages to property will likely be limited to vehicles and cleanup costs. Additionally, residents of Harrington will be at risk to health problems associated with the respiratory effects of breathing airborne particulates.

Drought

The town of Harrington does not have any differing levels of risk associated with this hazard than Lincoln County as a whole. However, the town does have its own policies concerning water conservation practices during the dry months. Additionally, the town may develop programs to deal with residents and businesses significantly impacted by drought if necessary.

Value of Resources at Risk

The town of Harrington has no assets directly at risk to drought; however, the economic impacts of a drought or a wildland fire caused by extended dry periods would have a great impact on the community. The majority of the population is employed either directly by the agriculture industry or to a service industry dependent on agriculture. Crop losses resulting from extended droughts would likely be considered a disaster for the community.

Town of Odessa Annex

Flood

Most of the western half of Odessa is affected by the floodplain of Crab Creek. This collector stream flows into the community at its eastern border near State Highway 28, passes through the downtown area, and edits near the railroad tracks on the western edge of town. Duck Creek increases the floodplain area as it drains into Crab Creek near the corner of East Marjorie Avenue and South 3rd Street.

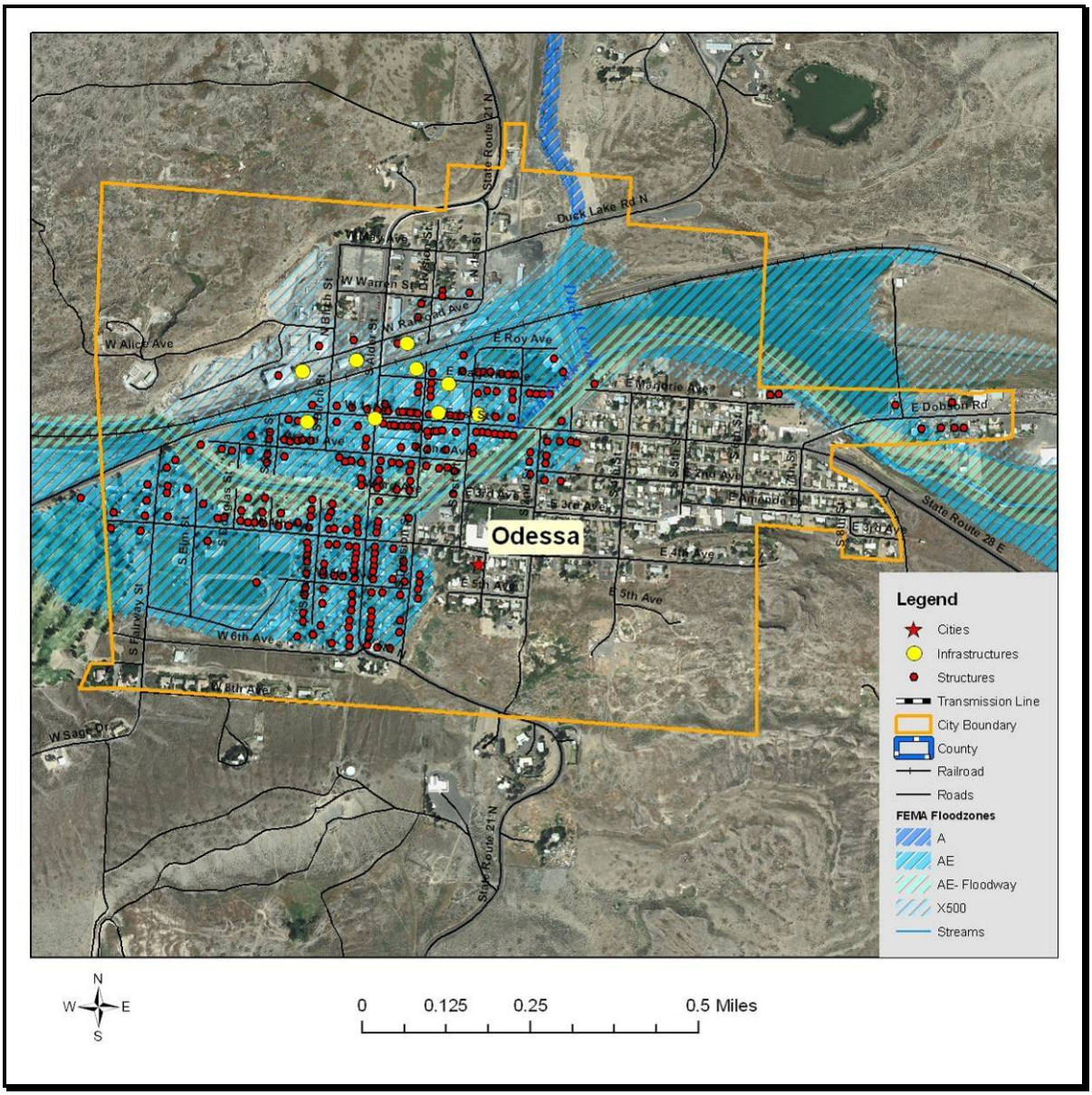
Duck Creek and Crab Creek are prone to flash flooding from localized weather events due to typically shallow channels and wide floodplains as well as less water permeable soils. Additionally, both of these watersheds drain thousands of acres in Lincoln County. Rain-on-snow events and rapid spring runoff can also have a significant effect on this watershed. Warm rains result in a significantly increased rate of snowmelt. Often this melting occurs while the ground is frozen and the water cannot be absorbed into the soil, resulting in increased overland flows. Flood waters recede slowly as rain-on-snow weather events tend to last for several days. Low velocity flooding occurs in several of the nearby tributaries almost annually during the spring runoff period.

Rural residences, ranches, farms, and roadways located near smaller waterways may be at significant flood risk. The onset of flooding in the smaller drainages can range from extremely slow to very fast. This variability depends on the cause of flooding and other factors such as rainfall intensity, the areas receiving the rain, temperature, and the condition of the soil. Floods that occur quickly are usually caused by thunderstorms, while floods that occur more slowly are often the result of moderate, but prolonged rainfall, snowmelt, or a combination of both. In the case of intense rainfall immediately above developed areas, the onset of flooding may occur in a matter of minutes.

The major impacts from flooding in Odessa are the restricted use of several streets, particularly State Highway 28. This route crosses Crab Creek in two places; one on each side of downtown Odessa. Restriction of the channel due to debris or ice jamming at these crossings could lead to water backing up and substantial flooding within the community. A significant number of commercial (most of the business district), industrial (rail yard and grain elevators), and residential properties would also be heavily impacted. The town of Odessa maintains a cache of sand, sandbags, and other equipment available during a flood event.

A high level of sediment is prevalent during periods of intense runoff. This sediment tends to cause a deteriorating condition in streambeds and channels through deposition. Natural obstructions to flood waters include trees, brush, and other vegetation along the stream banks in the floodplain area. Considerable debris has been allowed to accumulate in these channels, plugging culverts and bridges at several locations throughout the county.

Figure 5.7. Town of Odessa FEMA Flood Insurance Rate Map.



Value of Resources at Risk

There are approximately 698 parcels and 267 structures within the FEMA-identified floodplains (100- and 500-year) in Odessa, yielding a total structure value of $19.8 million. The average damage to structures was estimated based on the parcel's location as either completely within or out of the flood zone. The estimated value of contents is ½ the value of the improvements equating to an additional $9.9 million in potential losses. In reality, the damages will most likely not be equally distributed between buildings based on building materials, building location, and flood location. However, these estimates provide a basic approximation.

Critical infrastructure located within the identified floodplain for Odessa includes the fire station, police station, three grain elevators, the post office, the town hall/library, and central control for Centurylink.

Earthquake

There are no recorded occurrences of earthquakes significantly impacting the town of Odessa; however, some minimal shaking has been felt as a result of larger earthquakes elsewhere. The Town has 10% chance of exceeding a 7-8% pga in the next 50 years.[70] Odessa does not have any differing issues or levels of risk associated with this hazard than Lincoln County as a whole.

Value of Resources At Risk

Unreinforced masonry (URM) structures and unreinforced chimneys of homes will likely be damaged in the event of an earthquake. There are several publicly accessible unreinforced masonry structures in Odessa in addition to the numerous homes and other buildings throughout the Town with unreinforced chimneys. Damaged or collapsed chimneys could result in the secondary hazard of fire. Nonstructural damage caused by falling and swinging objects may be considerable after any magnitude earthquake. Damage to some older, more fragile bridges and land failure causing minor slides along roadways may isolate some residents.

In Odessa, nearly all of the downtown structures are assumed to be unreinforced masonry including two churches, a hospital/nursing home, and the Odessa schools complex. These structures were built prior to the inclusion of articles for seismic stability in the Uniform Building Codes in 1972. The number and value of unreinforced masonry homes or homes with masonry chimneys in Odessa is unknown, but estimated to include at least 50 brick construction homes and approximately 385 residences with masonry chimneys.

Landslide

The town of Odessa has a very low probability of experiencing damaging landslides. Due to the geologic history of the area, there is very little topsoil or unstable slopes. Slopes in and around the community are generally less than 35%. While small, low angle slumps may occur on eyebrows of the surrounding hills, these will be infrequent and likely the result of rocks coming loose due to the freeze/thaw cycle or a major disturbance such as an earthquake or road construction.

Value of Resources at Risk

There are no structures directly at risk from landslides within the town of Odessa. Small slumps may occur along State Route 21, Duck Lake Road, or other secondary roads. In many cases, this will cause temporary sediment delivery into nearby streams and plugged culverts. These types of events are cleaned up by county or town road departments with little complications. Road slumps are generally reported as regular maintenance; thus, there are few records associated with these events.

Severe Weather

The town of Odessa does not have any differing levels of risk associated with this hazard than Lincoln County as a whole.

---

[70] USGS. 2008 United States National Seismic Hazard Maps. U.S. Geological Survey. U.S. Department of Interior. Available online at http://earthquake.usgs.gov/hazards/products/conterminous/2008/. October 2009.

Value of Resources at Risk

It is difficult to estimate the cost of potential winter storm damages to structures and the economy in Odessa. Damage to roofs by heavy snow accumulations depends on the moisture content of the snow and the structural characteristics of the buildings. In general, snow in this region tends to have low moisture content because of the low temperatures and arid environment. Additionally, snow rarely accumulates for long periods of time due to regular wind events. Frozen water pipes are the most common damage to residential and business structures. Older homes tend to be at a higher risk to frozen water pipes than newer ones. Snow plowing in within the town limits is accomplished by the town's public works department and the Washington Department of Transportation. Private landowners are responsible for maintaining their own driveways or other private roads. Utility supplies are impacted during severe winter storms as power is lost on a regional basis. This has a two-fold impact on residents as not only is power cut to homes and businesses, but primary heating is lost for many residents. Gas furnaces and wood stoves supplement electrical heating, but with wood heating the senior population is at a disadvantage. Emergency response to severe winter storms includes site visits by police or fire department personnel, opening of shelters, or assistance with shopping, medical attention, and communications. The economic losses caused by severe winter storms may frequently be greater than structural damages. Employees may not be able to travel to work for several days and businesses may not open. Damages are seen in the form of structural repair and loss of economic activity. Lincoln County schools are occasionally closed during and right after a severe winter storm because of cold temperatures and snow covered roads.

Thunderstorms are not likely to be severe enough in Odessa to cause significant damages. However, the loss potential from flooding that results from severe thunderstorms could be significant.

Although the financial impacts of hail can be substantial and extended, accurately quantifying these impacts is problematic. Hail typically causes direct losses to structures and other personal property within Odessa. The most significant losses are most clearly seen in the agriculture sectors of the economy. Potential losses to agriculture can be disastrous. Crop damage from hail will also be different depending on the time of year and the type of crop. Most farmers carry insurance on their crops to help mitigate the potential financial loss resulting from a localized hail storm. Homeowners in Odessa rarely incur severe damage to structures (roofs); however, hail damage to vehicles is not uncommon. The damage to vehicles is difficult to estimate because the number of vehicles impacted by a specific ice storm is unknown. Additionally, most hail damage records are kept by various insurance agencies.

It is difficult to estimate potential losses in Odessa due to windstorms and tornadoes. Construction throughout the County has been implemented in the presence of high wind events, and therefore, the community is at a higher level of preparedness to high wind events than many other areas experiencing lower average wind speeds.

We have estimated losses based on wind and tornado damage as follows:

- 3% of the buildings damaged causing 50% of value loss (loss could be from downed or damaged trees, damaged outbuildings, damaged fences/poles, damage to siding, damaged landscaping etc.)
- 5% of the buildings received damage to roof (requiring replacement of roof equaling $3,000)

Damages associated with sensitive receptor irritation have not been estimated. We have also not estimated the potential for a large scale wildfire event associated with high winds. Based on the data provided by the County, there are 560 total structures in Odessa with a total value of approximately $41.6 million. Using the criteria outlined above an estimate of the impact of high winds in Odessa has been made. The potential wind and tornado damage to all buildings is estimated at approximately $1.5 million. The estimated damage to roofs is approximately $84,000.

Power failure often accompanies severe storms. Prolonged failure, especially during cold winter temperatures can have disastrous effects. All communities should be prepared to deal with power failures. Community shelters equipped with alternative power sources will help local residents stay warm and prepare food. A community-based system for monitoring and assisting elderly or disabled residents should also be developed. All households should maintain survival kits that include warm blankets, flashlights, extra batteries, nonperishable food items, and clean drinking water.

Wildland Fire

The channeled scablands are a dominant landscape in Lincoln County and surround Odessa. This unique geological feature was created by ice age floods that swept across eastern Washington and down the Columbia River Plateau periodically during the Pleistocene era. The massive erosion caused by the flood events scoured the landscape down to the underlying basalt creating vast areas of rocky cliffs, river valleys, channel ways and pothole lakes. Typical vegetation found throughout this landscape is grass, mixed shrub and sagebrush with areas of wetlands, marsh, ponderosa pine islands, cultivated crops and CRP fields. The channeled scablands landscape prevails in the central, southern and southeastern portions of the county and along the major waterways of Crab Creek, Blue Stem Creek, Lake Creek and Cow Creek. New development is occurring primarily near the community and along major roads. Most of the pressure for multi-housing subdivisions occurs in close proximity to town. Rural development is widely dispersed consisting primarily of isolated ranching headquarters, home sites, irrigation systems, and developed springs or wells. In nearly all developed areas, structures are in close proximity to vegetation that becomes a significant fire risk at certain times of the year.

The channeled scablands landscape has a moderate to high wildfire potential due to a characteristically high occurrence of shrubby fuels mixed with grass, sloping terrain and somewhat limited access. Large expanses of open rangeland or pasture provide a continuous fuel bed that could, if ignited, threaten structures and infrastructure under extreme weather conditions. Cattle grazing will often reduce fine, flashy fuels reducing a fire's rate of spread; however, high winds increase the rate of fire spread and intensity of rangeland fires. A wind-driven fire in dry, native fuel complexes on variable terrain produces a rapidly advancing, very intense fire with large flame lengths, which enables spotting ahead of the fire front.

Wildfire risk near Odessa is at its highest during summer and fall when daily temperatures are high and relative humidity is low. Fires burning in some types of unharvested fields would be expected to burn more intensely with larger flame lengths due to the greater availability of fuels. Fields enrolled in conservation programs or managed for wildlife habitat, can burn very intensely due to an increased amount of fuel build-up from previous years' growth. Fires in this fuel type are harder to extinguish completely due to the dense

duff layer, which often leads to hold-over fires that may reemerge at a later date causing additional fire starts.

Residents living in Odessa have access to the municipal water supply system and public fire hydrants. Outside these areas, development relies on individual, co-op or multiple-home well systems. Creeks, ponds and developed drafting areas provide water sources for emergency fire suppression in the rural areas to a limited extent. Water tanks have been set up at several ranches throughout the area as a supplemental water supply during fire season. Irrigation systems are capable of providing additional water supplies for suppression equipment on a limited basis. Additional water resources distributed and documented throughout the agricultural landscape are needed to provide adequate water for fire suppression.

Public utility lines travel both above and below ground along roads and cross-country to remote facilities. Many irrigation systems and wells rely on above ground power lines for electricity. These power poles pass through areas of dense wildland fuels that could be destroyed or compromised in the event of a wildfire.

Lincoln County Fire District #3 protects the community of Odessa. The fire district provides structural fire protection as well as wildland fire protection. Mutual aid agreements between fire districts supplement the wildland fire protection response when needed. Additional fire protection is provided by the Washington DNR, which provides wildfire protection and suppression on privately-owned forestland and state-owned forestland north of Highway 2 in Lincoln County. The DNR does not provide structural fire suppression, but it does provide wildfire protection on non-forested land that threatens DNR-protected lands. BLM provides wildfire protection on their lands within Lincoln County and has mutual aid agreements with the DNR for protection of forested land. BLM also does not provide structural fire suppression.

Value of Resources at Risk

It is difficult to estimate potential losses in Odessa from wildland fire due to the unpredictability of wildfire behavior and the nature of ignition sources. It is impossible to forecast the path a wildfire will take and what type of assets and resources, manmade and ecological, will be at risk. Thus, no value estimates were made for this hazard.

Typically, structures located in forested areas without an adequate defensible space or fire resistant landscaping have the highest risk of loss. Nevertheless, homes and other structures located in the grasslands or agricultural regions are not without wildfire risk. Grass fires are often the most dangerous due to high rates of spread. Fires in this fuel type are considered somewhat easier to suppress given the right resources, but they can also be the most destructive. Homes along the perimeter of the community would have the highest risk due to their adjacency to flashy fuels.

Avalanche

The town of Odessa will not be directly impacted by this type of localized event due to the gentle topography and low snow accumulations.

Value of Resources at Risk

The town of Odessa has no assets at risk to avalanches.

Tsunami

Although Lincoln County's northern border has a moderate risk of being impact by an inland tsunami on Lake Roosevelt, the town of Odessa will not be directly impacted by this type of localized event.

Value of Resources at Risk

The town of Odessa has no assets at risk to inland tsunamis.

Volcano

The town of Odessa does not have any differing levels of risk associated with this hazard than Lincoln County as a whole.

Value of Resources at Risk

The town of Odessa has no assets at direct risk of being impacted by a volcanic eruption. However, the secondary effects of ash and airborne particulates may have varying degrees of negative effects. Damages to property will likely be limited to vehicles and cleanup costs. Additionally, residents of Odessa will be at risk to health problems associated with the respiratory effects of breathing airborne particulates.

Drought

The town of Odessa does not have any differing levels of risk associated with this hazard than Lincoln County as a whole. However, the town does have its own policies concerning water conservation practices during the dry months. Additionally, the town may develop programs to deal with residents and businesses significantly impacted by drought if necessary.

Value of Resources at Risk

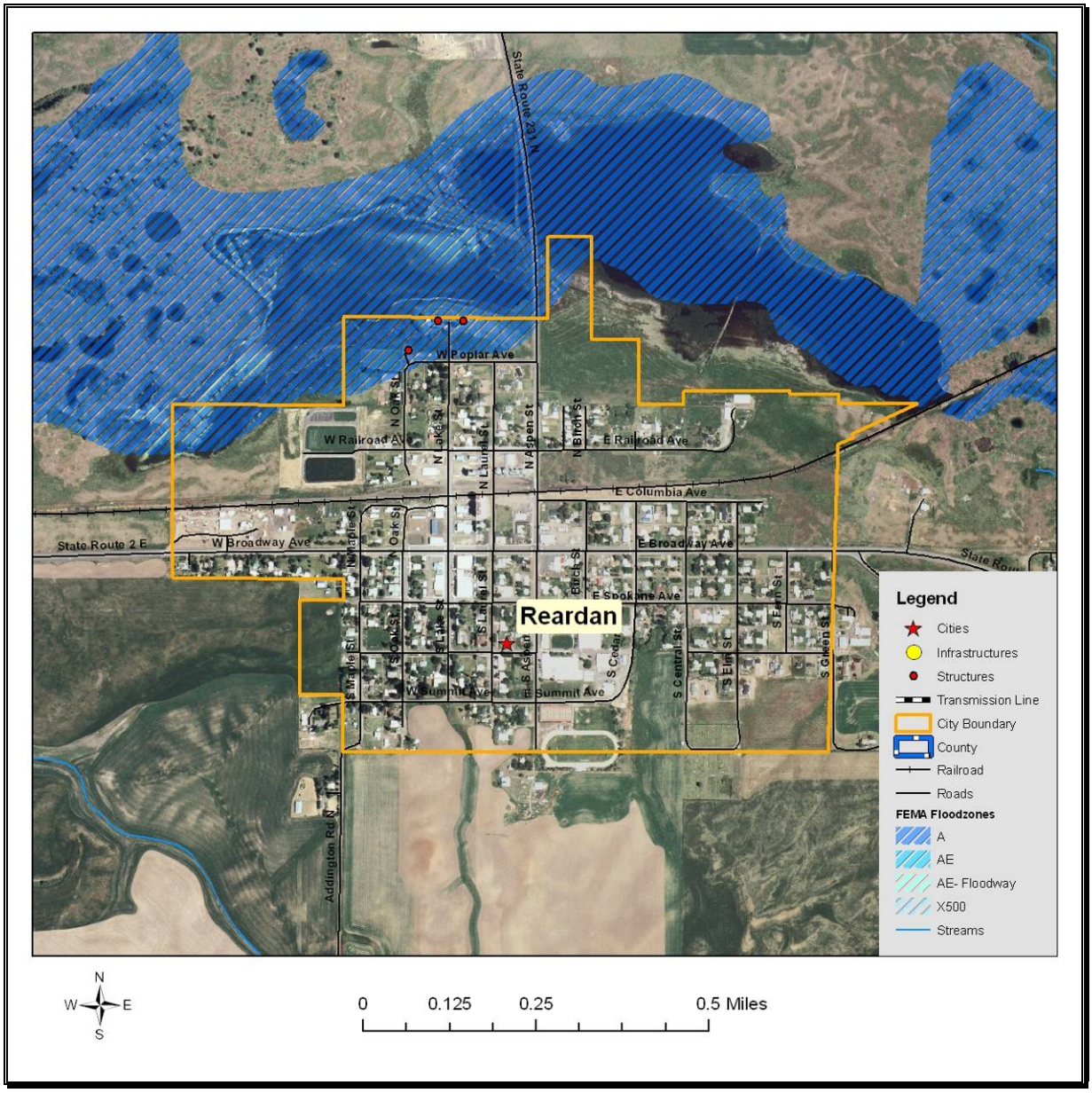
The town of Odessa has no assets directly at risk to drought; however, the economic impacts of a drought or a wildland fire caused by extended dry periods would have a great impact on the community. The majority of the population is employed either directly by the agriculture industry or to a service industry dependent on agriculture. Crop losses resulting from extended droughts would likely be considered a disaster for the community.

Town of Reardan Annex

Flood

Two large and numerous small potholes-type lakes north of Reardan create a large floodplain that could have a limited impact on a few residential properties in the community. This area is most affected by rain-on-snow and heavy spring runoff events as water would tend to accumulate in this area. Low velocity flooding occurs in several of the nearby tributaries almost annually during the spring runoff period.

Figure 5.8. Town of Reardan FEMA Flood Insurance Rate Map.



Value of Resources at Risk

There are approximately 123 parcels and 3 structures within the FEMA-identified floodplains (100- and 500-year) in Reardan, yielding a total structure value of $222,887. The average damage to structures was estimated based on the parcel's location as either completely within or out of the flood zone. The estimated value of contents is ½ the value of the improvements equating to an additional $111,443 in potential losses. In reality, the damages will most likely not be equally distributed between buildings based on building materials, building location, and flood location. However, these estimates provide a basic approximation.

There is no critical infrastructure located in Reardan's floodplain.

Earthquake

There are no recorded occurrences of earthquakes significantly impacting the town of Reardan; however, some minimal shaking has been felt as a result of larger earthquakes elsewhere. The Town has 10% chance of exceeding a 6-7% pga in the next 50 years.[71] Reardan does not have any differing issues or levels of risk associated with this hazard than Lincoln County as a whole.

Value of Resources At Risk

Unreinforced masonry (URM) structures and unreinforced chimneys of homes will likely be damaged in the event of an earthquake. There are several publicly accessible unreinforced masonry structures in Reardan in addition to the numerous homes and other buildings throughout the Town with unreinforced chimneys. Damaged or collapsed chimneys could result in the secondary hazard of fire. Nonstructural damage caused by falling and swinging objects may be considerable after any magnitude earthquake. Damage to some older, more fragile bridges and land failure causing minor slides along roadways may isolate some residents.

In Reardan, nearly all of the downtown structures are assumed to be unreinforced masonry including the R-Store, Bubba's Bar & Grill, Spokane Chimney, and the Red Rooster. These structures were built prior to the inclusion of articles for seismic stability in the Uniform Building Codes in 1972. The number and value of unreinforced masonry homes or homes with masonry chimneys in Reardan is unknown, but estimated to include 100+ buildings.

Landslide

The town of Reardan has a very low probability of experiencing damaging landslides. Slopes in and around the community are generally less than 25%. While small, low angle slumps may occur on eyebrows of the hills south of town, these will be infrequent and likely the result of water saturation or a major disturbance such as an earthquake or road construction.

[71] USGS. 2008 United States National Seismic Hazard Maps. U.S. Geological Survey. U.S. Department of Interior. Available online at http://earthquake.usgs.gov/hazards/products/conterminous/2008/. October 2009.

Value of Resources at Risk

There are no structures or infrastructure directly at risk from landslides within the town of Reardan.

Severe Weather

The town of Reardan does not have any differing levels of risk associated with this hazard than Lincoln County as a whole.

Value of Resources at Risk

It is difficult to estimate the cost of potential winter storm damages to structures and the economy in Reardan. Damage to roofs by heavy snow accumulations depends on the moisture content of the snow and the structural characteristics of the buildings. In general, snow in this region tends to have low moisture content because of the low temperatures and arid environment. Additionally, snow rarely accumulates for long periods of time due to regular wind events. Frozen water pipes are the most common damage to residential and business structures. Older homes tend to be at a higher risk to frozen water pipes than newer ones. Snow plowing in within the town limits is accomplished by the town's public works department. Private landowners are responsible for maintaining their own driveways or other private roads. Utility supplies are impacted during severe winter storms as power is lost on a regional basis. This has a two-fold impact on residents as not only is power cut to homes and businesses, but primary heating is lost for many residents. Gas furnaces and wood stoves supplement electrical heating, but with wood heating the senior population is at a disadvantage. Emergency response to severe winter storms includes site visits by police or fire department personnel, opening of shelters, or assistance with shopping, medical attention, and communications. The economic losses caused by severe winter storms may frequently be greater than structural damages. Employees may not be able to travel to work for several days and businesses may not open. Damages are seen in the form of structural repair and loss of economic activity. Lincoln County schools are occasionally closed during and right after a severe winter storm because of cold temperatures and snow covered roads.

Thunderstorms are not likely to be severe enough in Reardan to cause significant damages. However, the loss potential from flooding that results from severe thunderstorms could be significant.

Although the financial impacts of hail can be substantial and extended, accurately quantifying these impacts is problematic. Hail typically causes direct losses to structures and other personal property within Reardan. The most significant losses are most clearly seen in the agriculture sectors of the economy. Potential losses to agriculture can be disastrous. Crop damage from hail will also be different depending on the time of year and the type of crop. Most farmers carry insurance on their crops to help mitigate the potential financial loss resulting from a localized hail storm. Homeowners in Reardan rarely incur severe damage to structures (roofs); however, hail damage to vehicles is not uncommon. The damage to vehicles is difficult to estimate because the number of vehicles impacted by a specific ice storm is unknown. Additionally, most hail damage records are kept by various insurance agencies.

It is difficult to estimate potential losses in Reardan due to windstorms and tornadoes. Construction throughout the County has been implemented in the presence of high wind events, and therefore, the

community is at a higher level of preparedness to high wind events than many other areas experiencing lower average wind speeds.

We have estimated losses based on wind and tornado damage as follows:

- 3% of the buildings damaged causing 50% of value loss (loss could be from downed or damaged trees, damaged outbuildings, damaged fences/poles, damage to siding, damaged landscaping etc.)
- 5% of the buildings received damage to roof (requiring replacement of roof equaling $3,000)

Damages associated with sensitive receptor irritation have not been estimated. We have also not estimated the potential for a large scale wildfire event associated with high winds. Based on the data provided by the County, there are 284 total structures in Reardan with a total value of approximately $21.1 million. Using the criteria outlined above an estimate of the impact of high winds in Reardan has been made. The potential wind and tornado damage to all buildings is estimated at approximately $784,327. The estimated damage to roofs is approximately $42,000.

Power failure often accompanies severe storms. Prolonged failure, especially during cold winter temperatures can have disastrous effects. All communities should be prepared to deal with power failures. Community shelters equipped with alternative power sources will help local residents stay warm and prepare food. A community-based system for monitoring and assisting elderly or disabled residents should also be developed. All households should maintain survival kits that include warm blankets, flashlights, extra batteries, nonperishable food items, and clean drinking water.

Wildland Fire

The agricultural landscape is widespread across Lincoln County and surrounds Reardan. Vast areas of deep, rich soil deposits provide for extensive agriculture development. Lincoln County is the second highest wheat and barley producing county in the state. Other crops include grass seed, oats, hay and potatoes as well as extensive areas of fallow land set aside in the CRP. Most of these crops are vulnerable to wildfire at certain times of the year. The agriculture landscape is the predominant cover vegetation and fuel type throughout the county dominating the south, northwest and east central portions of the county. Interspersed throughout this landscape are stream channels and rocky scabland areas. New development occurs primarily near the community and along major roads. Occasionally farmland is subdivided between family members for new home sites or for development of new farming facilities. Most of the pressure for multi-housing subdivisions occurs in close proximity to town. In nearly all developed areas, structures are in close proximity to vegetation that becomes a significant fire risk at certain times of the year.

Wildfire potential in the agricultural landscape is moderate in the rural farmland and moderate to high in the shrubby draws and waterways, pastures, and scattered patches of scabland. Virtually all of the populated areas within the agricultural landscape face similar challenges related to wildfire control and opportunities for fuels mitigation efforts. Farming and ranching activities have the potential to increase the risk of a human-caused ignition. Large expanses of crops, CRP, rangeland or pasture provide areas of continuous fuels that may threaten homes and farmsteads. Under extreme weather conditions, escaped fires in these fuels could threaten individual homes or a town site; however, this type of fire is usually

quickly controlled. Clearings and fuel breaks disrupt a slow moving wildfire enabling suppression before a fire can ignite heavier fuels. High winds increase the rate of fire spread and intensity of crop and rangeland fires. It is imperative that homeowners implement fire mitigation measures to protect their structures and families prior to a wildfire event in these areas.

Wildfire risk in the agricultural landscape is at its highest during late summer and fall when crops are cured and daily temperatures are at their highest. A wind-driven fire in agricultural fuels or dry native fuel complexes would produce a rapidly advancing, but variable intensity fire. Fires burning in some types of unharvested fields would be expected to burn more intensely with larger flame lengths due to the greater availability of fuels resulting from the higher productivity of the vegetation. Fields enrolled in the CRP or set aside for wildlife habitat can burn very intensely due to an increased amount of fuel build-up from previous years' growth. Fires in these types of fuels are harder to extinguish completely due to the dense duff layer, often leading to hold over fires that may reemerge at a later date causing additional fire starts.

Residents living in Reardan have access to the municipal water supply system and public fire hydrants. Outside these areas, development relies on individual, co-op, or multiple-home well systems. Creeks, ponds, and developed drafting areas provide water sources for emergency fire suppression in the rural areas to a limited extent. Irrigation systems are capable of providing additional water supply for suppression equipment on a limited basis. Additional water resources distributed and documented throughout the agricultural landscape are needed to provide water for fire suppression.

Above ground, high voltage transmission lines cross the planning area in many directions in corridors cleared of most vegetation, which provides for a defensible space around the power line infrastructure and may provide a control point for fire suppression, if well maintained. Local public electrical utility lines are both above and below ground traveling through back yards and along roads and highways. Many of these lines are exposed to damage from falling trees and branches. Power and communications may be cut to some of these during a wildfire event.

Lincoln County Fire District #4 protects the community of Reardan. The fire district provides structural fire protection as well as wildland fire protection. Mutual aid agreements between fire districts supplement wildland fire protection when needed. Additional fire protection is provided by the Washington DNR, which provides wildfire protection and suppression on privately owned forestland and state-owned forestland north of Highway 2 in Lincoln County. The DNR does not provide structural fire suppression, but does provide wildfire protection on non-forested land that threatens DNR-protected lands. The BLM provides wildfire protection on their ownership within Lincoln County and has mutual aid agreements with the DNR for protection of forested land. BLM also does not provide structural fire suppression.

Value of Resources at Risk

It is difficult to estimate potential losses in Reardan from wildland fire due to the unpredictability of wildfire behavior and the nature of ignition sources. It is impossible to forecast the path a wildfire will take and what type of assets and resources, manmade and ecological, will be at risk. Thus, no value estimates were made for this hazard.

Typically, structures located in forested areas without an adequate defensible space or fire resistant landscaping have the highest risk of loss. Nevertheless, homes and other structures located in the grasslands or agricultural regions are not without wildfire risk. Grass fires are often the most dangerous due to high rates of spread. Fires in this fuel type are considered somewhat easier to suppress given the appropriate resources, but they can also be the most destructive. Homes along the perimeter of the community would have the highest risk due to their adjacency to flashy fuels.

Avalanche

The town of Reardan will not be directly impacted by this type of localized event due to the gentle topography and low snow accumulations.

Value of Resources at Risk

The town of Reardan has no assets at risk to avalanches.

Tsunami

Although Lincoln County's northern border has a moderate risk of being impact by an inland tsunami on Lake Roosevelt, the town of Reardan will not be directly impacted by this type of localized event.

Value of Resources at Risk

The town of Reardan has no assets at risk to inland tsunamis.

Volcano

The town of Reardan does not have any differing levels of risk associated with this hazard than Lincoln County as a whole.

Value of Resources at Risk

The town of Reardan has no assets at direct risk of being impacted by a volcanic eruption. However, the secondary effects of ash and airborne particulates may have varying degrees of negative effects. Damages to property will likely be limited to vehicles and cleanup costs. Additionally, residents of Reardan will be at risk to health problems associated with the respiratory effects of breathing airborne particulates.

Drought

The town of Reardan does not have any differing levels of risk associated with this hazard than Lincoln County as a whole. However, the town does have its own policies concerning water conservation practices during the dry months. Additionally, the town may develop programs to deal with residents and businesses significantly impacted by drought if necessary.

Value of Resources at Risk

The town of Reardan has no assets directly at risk to drought; however, the economic impacts of a drought or a wildland fire caused by extended dry periods would have a great impact on the community. The majority of the population is employed either directly by the agriculture industry or to a service industry

dependent on agriculture. Crop losses resulting from extended droughts would likely be considered a disaster for the community.

Town of Wilbur Annex

Flood

The town of Wilbur is affected by the floodplain of Goose Creek, which enters the community just north of U.S. Highway 2 on the eastern edge of town, flows through the downtown area, and exits along the western border. Goose Creek has a well defined channel in Wilbur with trees and other vegetation along its banks.

Goose Creek is extremely prone to flash flooding from localized weather events. Rain-on-snow events can also have a significant effect on this watershed. Warm rains result in a significantly increased rate of snowmelt. Often this melting occurs while the ground is frozen and the water cannot be absorbed into the soil, resulting in increased overland flows. Flood waters recede slowly as rain-on-snow weather events tend to last for several days. Low velocity flooding occurs in several of the nearby tributaries almost annually during the spring runoff period.

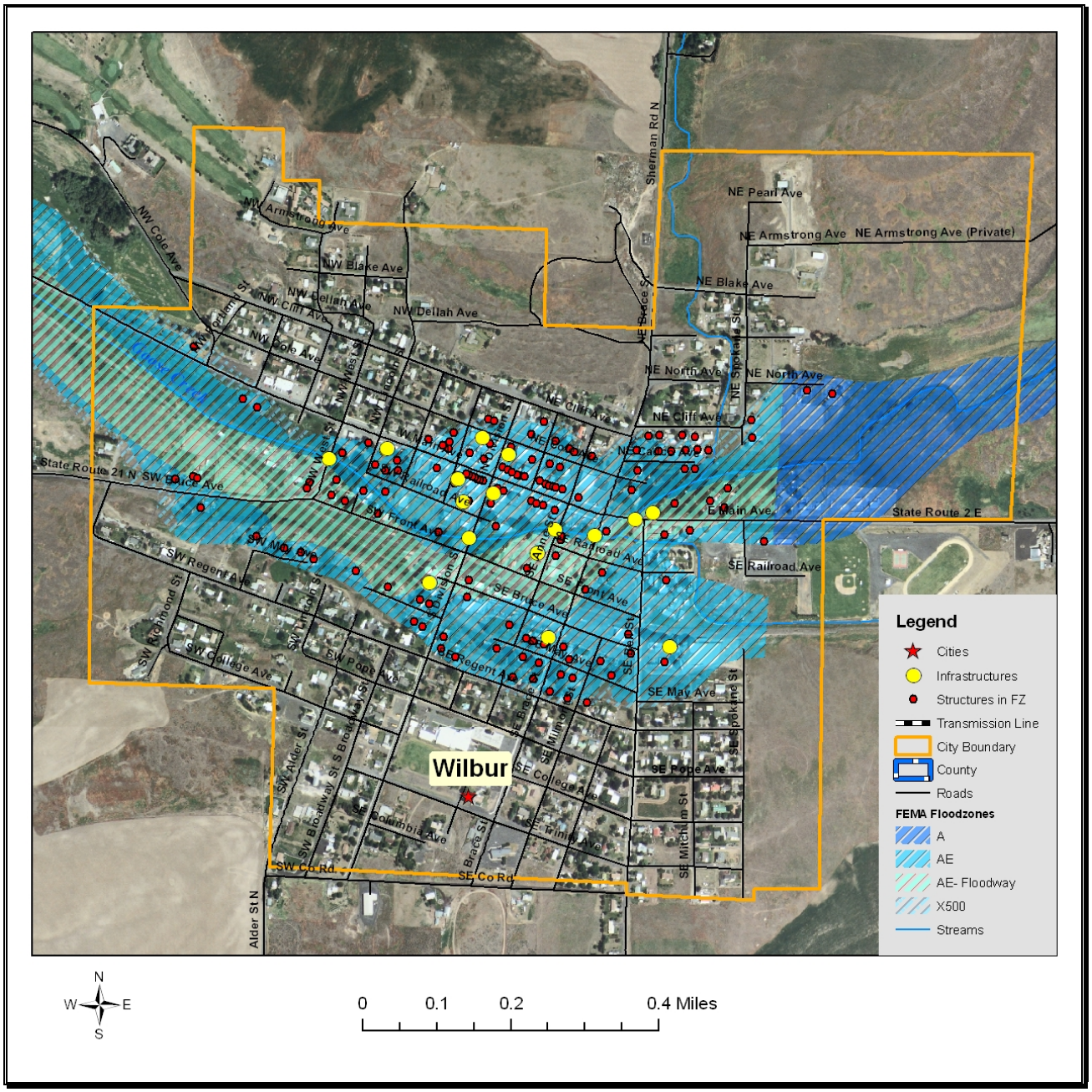
In 2010, Goose Creek within the town limits of Wilbur was dredged to remove built up sediments and accumulated debris in order to reduce the flood risk. The town determined that there are currently five sections of the Creek that are becoming more narrow and posing additional flood risks to sections of residential and commercial properties. The town of Wilbur has proposed constructing a dam on Goose Creek to assist with flood control as well as provide irrigation water to nearby agricultural operations.

Rural residences, ranches, farms, and roadways located near smaller waterways may be at significant flood risk. The onset of flooding in the smaller drainages can range from extremely slow to very fast. This variability depends on the cause of flooding and other factors such as rainfall intensity, the areas receiving the rain, temperature, and the condition of the soil. Floods that occur quickly are usually caused by thunderstorms, while floods that occur more slowly are often the result of moderate, but prolonged rainfall, snowmelt, or a combination of both. In the case of intense rainfall immediately above developed areas, the onset of flooding may occur in a matter of minutes.

The major impacts from flooding in Wilbur are the restricted use of several streets, particularly U.S. Highway 2/Main Street. Numerous commercial and residential areas as well as public facilities could also be impacted by flood events. There are several bridge and culvert crossings both within the Town and in the surrounding area.

A high level of sediment is prevalent during periods of intense runoff. This sediment tends to cause a deteriorating condition in streambeds and channels through deposition. Natural obstructions to flood waters include trees, brush, and other vegetation along the stream banks in the floodplain area. Considerable debris has been allowed to accumulate in these channels, plugging culverts and bridges at several locations throughout the county.

Figure 5.9. Town of Wilbur FEMA Flood Insurance Rate Map.



Value of Resources at Risk

There are approximately 1,309 parcels and 146 structures within the FEMA-identified floodplains (100- and 500-year) in Wilbur, yielding a total structure value of $10.8 million. The average damage to structures was estimated based on the parcel's location as either completely within or out of the flood zone. The estimated value of contents is ½ the value of the improvements equating to an additional $5.4 million in potential losses. In reality, the damages will most likely not be equally distributed between buildings based on building materials, building location, and flood location. However, these estimates provide a basic approximation.

Critical infrastructure located within the identified floodplain for Wilbur includes the fire station, the public works building, two grain elevators, the post office, the Wilbur Clinic, the police station, the County shop, the community center, a gas station, and 5 bridges.

Earthquake

There are no recorded occurrences of earthquakes significantly impacting the town of Wilbur; however, some minimal shaking has been felt as a result of larger earthquakes elsewhere. The Town has 10% chance of exceeding a 7-8% pga in the next 50 years.[72] Wilbur does not have any differing issues or levels of risk associated with this hazard than Lincoln County as a whole.

Value of Resources At Risk

Unreinforced masonry (URM) structures and unreinforced chimneys of homes will likely be damaged in the event of an earthquake. There are several publicly accessible unreinforced masonry structures in Wilbur in addition to the numerous homes and other buildings throughout the Town with unreinforced chimneys. Damaged or collapsed chimneys could result in the secondary hazard of fire. Nonstructural damage caused by falling and swinging objects may be considerable after any magnitude earthquake. Damage to some older, more fragile bridges and land failure causing minor slides along roadways may isolate some residents.

In Wilbur, nearly all of the downtown structures are assumed to be unreinforced masonry. These structures were built prior to the inclusion of articles for seismic stability in the Uniform Building Codes in 1972. The number and value of unreinforced masonry homes or homes with masonry chimneys in Wilbur is unknown, but estimated to include at least 25-50 buildings.

Landslide

The town of Wilbur has a very low probability of experiencing damaging landslides. Slopes in and around the community are generally less than 20%. While small, low angle slumps may occur on eyebrows of the surrounding hills, these will be infrequent and likely the result of water saturation or a major disturbance such as an earthquake or road construction.

Value of Resources at Risk

There are no structures or infrastructure directly at risk from landslides within the town of Wilbur.

Severe Weather

The town of Wilbur does not have any differing levels of risk associated with this hazard than Lincoln County as a whole.

[72] USGS. 2008 United States National Seismic Hazard Maps. U.S. Geological Survey. U.S. Department of Interior. Available online at http://earthquake.usgs.gov/hazards/products/conterminous/2008/. October 2009.

Value of Resources at Risk

It is difficult to estimate the cost of potential winter storm damages to structures and the economy in Wilbur. Damage to roofs by heavy snow accumulations depends on the moisture content of the snow and the structural characteristics of the buildings. In general, snow in this region tends to have low moisture content because of the low temperatures and arid environment. Additionally, snow rarely accumulates for long periods of time due to regular wind events. Frozen water pipes are the most common damage to residential and business structures. Older homes tend to be at a higher risk to frozen water pipes than newer ones. Snow plowing in within the town limits is accomplished by the town's public works department. Private landowners are responsible for maintaining their own driveways or other private roads. Utility supplies are impacted during severe winter storms as power is lost on a regional basis. This has a two-fold impact on residents as not only is power cut to homes and businesses, but primary heating is lost for many residents. Gas furnaces and wood stoves supplement electrical heating, but with wood heating the senior population is at a disadvantage. Emergency response to severe winter storms includes site visits by police or fire department personnel, opening of shelters, or assistance with shopping, medical attention, and communications. The economic losses caused by severe winter storms may frequently be greater than structural damages. Employees may not be able to travel to work for several days and businesses may not open. Damages are seen in the form of structural repair and loss of economic activity. Lincoln County schools are occasionally closed during and right after a severe winter storm because of cold temperatures and snow covered roads.

Thunderstorms are not likely to be severe enough in Wilbur to cause significant damages. However, the loss potential from flooding that results from severe thunderstorms could be significant.

Although the financial impacts of hail can be substantial and extended, accurately quantifying these impacts is problematic. Hail typically causes direct losses to structures and other personal property within Wilbur. The most significant losses are most clearly seen in the agriculture sectors of the economy. Potential losses to agriculture can be disastrous. Crop damage from hail will also be different depending on the time of year and the type of crop. Most farmers carry insurance on their crops to help mitigate the potential financial loss resulting from a localized hail storm. Homeowners in Wilbur rarely incur severe damage to structures (roofs); however, hail damage to vehicles is not uncommon. The damage to vehicles is difficult to estimate because the number of vehicles impacted by a specific ice storm is unknown. Additionally, most hail damage records are kept by various insurance agencies.

It is difficult to estimate potential losses in Wilbur due to windstorms and tornadoes. Construction throughout the County has been implemented in the presence of high wind events, and therefore, the community is at a higher level of preparedness to high wind events than many other areas experiencing lower average wind speeds.

We have estimated losses based on wind and tornado damage as follows:

- 3% of the buildings damaged causing 50% of value loss (loss could be from downed or damaged trees, damaged outbuildings, damaged fences/poles, damage to siding, damaged landscaping etc.)
- 5% of the buildings received damage to roof (requiring replacement of roof equaling $3,000)

Damages associated with sensitive receptor irritation have not been estimated. We have also not estimated the potential for a large scale wildfire event associated with high winds. Based on the data provided by the County, there are 476 total structures in Wilbur with a total value of approximately $35.5 million. Using the criteria outlined above an estimate of the impact of high winds in Wilbur has been made. The potential wind and tornado damage to all buildings is estimated at approximately $1.2 million. The estimated damage to roofs is approximately $72,000.

Power failure often accompanies severe storms. Prolonged failure, especially during cold winter temperatures can have disastrous effects. All communities should be prepared to deal with power failures. Community shelters equipped with alternative power sources will help local residents stay warm and prepare food. A community-based system for monitoring and assisting elderly or disabled residents should also be developed. All households should maintain survival kits that include warm blankets, flashlights, extra batteries, nonperishable food items, and clean drinking water.

Wildland Fire

The agricultural landscape is widespread across Lincoln County and surrounds Wilbur. Vast areas of deep, rich soil deposits provide for extensive agriculture development. Lincoln County is the second highest wheat and barley producing county in the state. Other crops include grass seed, oats, hay and potatoes as well as extensive areas of fallow land set aside in the CRP. Most of these crops are vulnerable to wildfire at certain times of the year. The agriculture landscape is the predominant cover vegetation and fuel type throughout the county dominating the south, northwest and east central portions of the county. Interspersed throughout this landscape are stream channels and rocky scabland areas. New development occurs primarily near the community and along major roads. Occasionally farmland is subdivided between family members for new home sites or for development of new farming facilities. Most of the pressure for multi-housing subdivisions occurs in close proximity to town. In nearly all developed areas, structures are in close proximity to vegetation that becomes a significant fire risk at certain times of the year.

Wildfire potential in the agricultural landscape is moderate in the rural farmland and moderate to high in the shrubby draws and waterways, pastures, and scattered patches of scabland. Virtually all of the populated areas within the agricultural landscape face similar challenges related to wildfire control and opportunities for fuels mitigation efforts. Farming and ranching activities have the potential to increase the risk of a human-caused ignition. Large expanses of crops, CRP, rangeland or pasture provide areas of continuous fuels that may threaten homes and farmsteads. Under extreme weather conditions, escaped fires in these fuels could threaten individual homes or a town site; however, this type of fire is usually quickly controlled. Clearings and fuel breaks disrupt a slow moving wildfire enabling suppression before a fire can ignite heavier fuels. High winds increase the rate of fire spread and intensity of crop and rangeland fires. It is imperative that homeowners implement fire mitigation measures to protect their structures and families prior to a wildfire event in these areas.

Wildfire risk in the agricultural landscape is at its highest during late summer and fall when crops are cured and daily temperatures are at their highest. A wind-driven fire in agricultural fuels or dry native fuel complexes would produce a rapidly advancing, but variable intensity fire. Fires burning in some types of unharvested fields would be expected to burn more intensely with larger flame lengths due to the greater

availability of fuels resulting from the higher productivity of the vegetation. Fields enrolled in the CRP or set aside for wildlife habitat can burn very intensely due to an increased amount of fuel build-up from previous years' growth. Fires in these types of fuels are harder to extinguish completely due to the dense duff layer, often leading to hold over fires that may reemerge at a later date causing additional fire starts.

Residents living in Wilbur have access to the municipal water supply system and public fire hydrants. Outside these areas, development relies on individual, co-op, or multiple-home well systems. Creeks, ponds, and developed drafting areas provide water sources for emergency fire suppression in the rural areas to a limited extent. Irrigation systems are capable of providing additional water supply for suppression equipment on a limited basis. Additional water resources distributed and documented throughout the agricultural landscape are needed to provide water for fire suppression.

Above ground, high voltage transmission lines cross the planning area in many directions in corridors cleared of most vegetation, which provides for a defensible space around the power line infrastructure and may provide a control point for fire suppression, if well maintained. Local public electrical utility lines are both above and below ground traveling through back yards and along roads and highways. Many of these lines are exposed to damage from falling trees and branches. Power and communications may be cut to some of these during a wildfire event.

Lincoln County Fire District #7 protects the community of Wilbur. The fire district provides structural fire protection as well as wildland fire protection. Mutual aid agreements between fire districts supplement wildland fire protection when needed. Additional fire protection is provided by the Washington DNR, which provides wildfire protection and suppression on privately owned forestland and state-owned forestland north of Highway 2 in Lincoln County. The DNR does not provide structural fire suppression, but does provide wildfire protection on non-forested land that threatens DNR-protected lands. The BLM provides wildfire protection on their ownership within Lincoln County and has mutual aid agreements with the DNR for protection of forested land. BLM also does not provide structural fire suppression.

Value of Resources at Risk

It is difficult to estimate potential losses in Wilbur from wildland fire due to the unpredictability of wildfire behavior and the nature of ignition sources. It is impossible to forecast the path a wildfire will take and what type of assets and resources, manmade and ecological, will be at risk. Thus, no value estimates were made for this hazard.

Typically, structures located in forested areas without an adequate defensible space or fire resistant landscaping have the highest risk of loss. Nevertheless, homes and other structures located in the grasslands or agricultural regions are not without wildfire risk. Grass fires are often the most dangerous due to high rates of spread. Fires in this fuel type are considered somewhat easier to suppress given the appropriate resources, but they can also be the most destructive. Homes along the perimeter of the community would have the highest risk due to their adjacency to flashy fuels.

Avalanche

The town of Wilbur will not be directly impacted by this type of localized event due to the gentle topography and low snow accumulations.

Value of Resources at Risk

The town of Wilbur has no assets at risk to avalanches.

Tsunami

Although Lincoln County's northern border has a moderate risk of being impact by an inland tsunami on Lake Roosevelt, the town of Wilbur will not be directly impacted by this type of localized event.

Value of Resources at Risk

The town of Wilbur has no assets at risk to inland tsunamis.

Volcano

The town of Reardan does not have any differing levels of risk associated with this hazard than Lincoln County as a whole.

Value of Resources at Risk

The town of Reardan has no assets at direct risk of being impacted by a volcanic eruption. However, the secondary effects of ash and airborne particulates may have varying degrees of negative effects. Damages to property will likely be limited to vehicles and cleanup costs. Additionally, residents of Reardan will be at risk to health problems associated with the respiratory effects of breathing airborne particulates.

Drought

The town of Wilbur does not have any differing levels of risk associated with this hazard than Lincoln County as a whole. However, the town does have its own policies concerning water conservation practices during the dry months. Additionally, the town may develop programs to deal with residents and businesses significantly impacted by drought if necessary.

Value of Resources at Risk

The town of Wilbur has no assets directly at risk to drought; however, the economic impacts of a drought or a wildland fire caused by extended dry periods would have a great impact on the community. The majority of the population is employed either directly by the agriculture industry or to a service industry dependent on agriculture. Crop losses resulting from extended droughts would likely be considered a disaster for the community.

Lincoln Hospital District Annex

Flood

The main Lincoln Hospital facility is located in Davenport on the northeast side of town. The compound is completely outside of any floodplains. However, the Wilbur Clinic operated by the Lincoln Hospital District is within a floodplain. In the event of a major flood event on Goose Creek in Wilbur, the Clinic would likely be impacted.

Additionally, the District may see an increase in injuries as a result of flood events. All of the Lincoln Hospital District's facilities are dependent on municipal water systems. A flood event may impact or contaminate the community's water supply; thus impacting the Hospital and its clinics directly.

Value of Resources at Risk

The Wilbur Clinic may be impacted by Goose Creek flood events. This facility and its contents are valued at approximately $500,000.

Earthquake

There are no recorded occurrences of earthquakes significantly impacting the Lincoln Hospital District. The area covered by the District has a 10% chance of exceeding a 6-7% pga in the next 50 years and does not have any differing issues or levels of risk associated with this hazard than Lincoln County as a whole. However, in the event of a damaging earthquake, Lincoln Hospital would likely experience an influx of injuries resulting from the quake. In the event that the Hospital structure or associated equipment was damaged, patients would require transport to other nearby medical facilities. Longer wait times may lead to more serious injuries or even deaths.

Value of Resources at Risk

The Lincoln Hospital in Davenport does have masonry components; however, the structure was built for use as a bomb shelter; thus it is likely well reinforced and not at significant risk to earthquakes. Nevertheless, severe damage to the building would likely result in closure of the hospital due to safety issues until repairs could be made. Additionally, structural damage may, in turn, cause damage or complete loss of much of the medical equipment within the building due to collapses or contamination.

Landslide

The Lincoln Hospital is located in the northeastern corner of Davenport. The surrounding area is nearly flat. The Hospital does not have any differing levels of risk associated with this hazard than Lincoln County as a whole. However, in the event of a significant landslide, the Lincoln Hospital would likely assist with any injuries.

Value of Resources at Risk

The Lincoln Hospital facility in Davenport is not at risk to landslides due to its location in a relatively flat, developed area. The District has no other known assets or other resources at risk to landslides.

Severe Weather

The Lincoln Hospital District does not have any differing levels of risk associated with this hazard than Lincoln County as a whole. However, any injuries, including traffic accidents, resulting from severe storms would likely be treated at the hospital.

Value of Resources at Risk

Lincoln Hospital will not likely incur major structural damages from severe weather events; however, damage to roofing, windows, or other structural components could result in closure of the hospital due to safety issues until repairs could be made. Additionally, structural damage may, in turn, cause damage or complete loss of much of the medical equipment within the building due to collapses or contamination.

Wildland Fire

The Lincoln Hospital District does not have any differing levels of risk associated with this hazard than Lincoln County as a whole. However, injuries resulting from a wildfire would likely be treated at the hospital including smoke inhalation and heat exhaustion.

Value of Resources at Risk

Due to its facilities' locations within developed communities, the Hospital District has a very low risk of being directly impacted by wildland fire.

Avalanche

The Lincoln Hospital District will not be directly impacted by this type of localized event due to the gentle topography and low snow accumulations.

Value of Resources at Risk

The Lincoln Hospital District has no assets at risk to avalanches.

Tsunami

Although Lincoln County's northern border has a moderate risk of being impact by an inland tsunami on Lake Roosevelt, the town of Creston will not be directly impacted by this type of localized event. Nevertheless, any injuries resulting from a tsunami event would be routed to the District's medical facilities in Davenport.

Value of Resources at Risk

The Lincoln Hospital District has no assets at risk to inland tsunamis.

Volcano

Lincoln Hospital District does not have any differing levels of risk associated with this hazard than Lincoln County as a whole. However, any injuries resulting from a volcano, including the respiratory effects caused by ash inhalation, would likely be treated at the hospital.

Value of Resources at Risk

The Lincoln Hospital District facilities do not have any direct risk to volcanoes; however, there may be damage to the structures and cleanup costs associated with the ash fallout.

Drought

The Lincoln Hospital District does not have any differing levels of risk associated with this hazard than Lincoln County as a whole.

Value of Resources at Risk

The Lincoln Hospital District does not have any direct risks to drought.

Odessa Memorial Healthcare Center Annex

The Odessa Memorial Healthcare Center is also known as the Lincoln County Public Hospital District No.1.

Flood

The Odessa Memorial Healthcare Center is located in Odessa on the southeast side of town. The hospital facilities are outside of any floodplains. Nevertheless, the hospital may see an increase in injuries as a result of flood events. In addition, the hospital facilities are dependent on Odessa's municipal water system. A flood event may impact or contaminate the community's water supply.

During normal operations, the Healthcare Center has approximately 25 available beds. Relocating individuals from this facility as a result of a flood or other hazard event would be very difficult.

Value of Resources at Risk

Odessa Memorial Healthcare Center has no known assets or other resources at direct risk to flooding.

Earthquake

There are no recorded occurrences of earthquakes significantly impacting the Odessa Memorial Healthcare Center. The area covered by the District has a 10% chance of exceeding a 7-8% pga in the next 50 years and does not have any differing issues or levels of risk associated with this hazard than Lincoln County as a whole. However, in the event of a damaging earthquake, Odessa Memorial Healthcare Center would likely experience an influx of injuries resulting from the quake. In the event that the Hospital structure or associated equipment was damaged, patients would require transport to other nearby medical facilities. Longer wait times may lead to more serious injuries or even deaths.

Value of Resources at Risk

The Odessa Memorial Healthcare Center is an unreinforced masonry structure valued at approximately $11,500,000 . Significant damage to the building would likely result in closure of the hospital until repairs are made due to safety issues. Additionally, structural damage may, in turn, cause damage or complete loss of much of the medical equipment within the building due to collapses or contamination.

Landslide

The Odessa Memorial Healthcare Center is located on the southwestern edge of Odessa. This area did not show a moderate or high risk in the Landslide Prone Landscapes model; however, there is some potential for slumps or rolling rocks in this area. The development along the base of this slope did not alter the hillside; thus, it is unlikely that the slope is unstable. During a severe storm or a prolonged freeze/thaw period, small-scale slumps or loose rocks may deliver mud and other debris into the Hospital parking lot. In extreme events, slide debris could damage the Hospital structure. The probability of this type of event is extremely low.

Value of Resources at Risk

The Odessa Memorial Healthcare Center structure as well as surrounding parking and travel ways may have a limited risk of experiencing a small slide originating on the slope to the south of facility. It is unlikely that

there would be significant damages to the Hospital; however, there would be cleanup costs associated with a slide event.

Severe Weather

The Odessa Memorial Healthcare Center does not have any differing levels of risk associated with this hazard than Lincoln County as a whole. However, any injuries, including traffic accidents, resulting from severe storms would likely be treated at Memorial Healthcare Center in Odessa.

Value of Resources at Risk

Memorial Healthcare Center will not likely incur major structural damages from severe weather events; however, damage to roofing, windows, or other structural components could result in closure of the hospital due to safety issues until repairs could be made. Additionally, structural damage may, in turn, cause damage or complete loss of much of the medical equipment within the building due to collapses or contamination.

Wildland Fire

The Odessa Memorial Healthcare Center does not have any differing levels of risk associated with this hazard than Lincoln County as a whole. However, injuries resulting from a wildfire would likely be treated at the hospital including smoke inhalation and heat exhaustion.

Value of Resources at Risk

Due to its facilities' locations within developed communities, the Hospital has a very low risk of being directly impacted by wildland fire.

Avalanche

The Odessa Memorial Healthcare Center will not be directly impacted by this type of localized event due to the gentle topography and low snow accumulations.

Value of Resources at Risk

The Odessa Memorial Healthcare Center has no assets at risk to avalanches.

Tsunami

Although Lincoln County's northern border has a moderate risk of being impact by an inland tsunami on Lake Roosevelt, the Odessa Memorial Healthcare Center will not be directly impacted by this type of localized event. Nevertheless, some injuries resulting from a tsunami event may be routed to the District's medical facilities in Odessa.

Value of Resources at Risk

The Odessa Memorial Healthcare Center has no assets at risk to inland tsunamis.

Volcano

The Odessa Memorial Healthcare Center does not have any differing levels of risk associated with this hazard than Lincoln County as a whole. However, many injuries resulting from a volcano, including the respiratory effects caused by ash inhalation, would likely be treated at the hospital.

Value of Resources at Risk

The Odessa Memorial Healthcare Center facilities do not have any direct risk to volcanoes; however, there may be damage to the structures and cleanup costs associated with the ash fallout.

Drought

The Odessa Memorial Healthcare Center does not have any differing levels of risk associated with this hazard than Lincoln County as a whole.

Value of Resources at Risk

The Odessa Memorial Healthcare Center does not have any direct risks to drought.

Chapter 6

Mitigation Strategy

IN THIS SECTION:

- Lincoln County Annex
  - City of Davenport Annex
  - City of Sprague Annex
  - Town of Almira Annex
  - Town of Creston Annex
  - Town of Harrington Annex
  - Town of Odessa Annex
  - Town of Reardan Annex
  - Town of Wilbur Annex
  - Lincoln Hospital District Annex
  - Odessa Memorial Healthcare Center Annex

Chapter 6 – Mitigation Strategy

Administration and Implementation of Action Items

Critical to the implementation of this Multi - Hazard Mitigation Plan will be the identification of, and implementation of, an integrated schedule of action items targeted at achieving an elimination of lives lost and reduction in structures destroyed, infrastructure compromised, and unique ecosystems damaged that serve to sustain the way-of-life and economy in Lincoln County, Washington. Since there are many management agencies and thousands of private landowners in this area, it is reasonable to expect that differing schedules of adoption will be made and varying degrees of compliance will be observed across all ownerships.

Lincoln County and the incorporated cities, encourage the philosophy of instilling disaster resistance in normal day-to-day operations. By implementing plan activities through existing programs and resources, the cost of mitigation is often a small portion of the overall cost of a project's design or program.

All risk assessments were made based on the conditions existing during 2010, thus, the recommendations in this section have been made in light of those conditions. However, the components of risk and the preparedness of the Counties' resources are not static. It will be necessary to fine-tune this Plan's recommendations annually to adjust for changes in the components of risk, population density changes, infrastructure modifications, and other factors.

Plan Monitoring and Maintenance

As part of the policy of Lincoln County in relation to this planning document, this entire Multi - Hazard Mitigation Plan should be reviewed annually (from date of adoption) at a special meeting of a joint planning committee, open to the public and involving all jurisdictions, where action items, priorities, budgets, and modifications can be made or confirmed. Lincoln County Emergency Management (or an official designee of the joint committee) is responsible for the scheduling, publicizing, and leadership of the annual review meeting. During this meeting, participating jurisdictions will report on their respective projects and identify needed changes and updates to the existing Plan. Maintenance to the Plan should be detailed at this meeting, documented, and attached to the formal plan as an amendment to the Multi - Hazard Mitigation Plan. Re-evaluation of this plan should be made on the 5th anniversary of its acceptance, and every 5-year period following.

Annual Review Agenda

The focus of the joint planning committee at the annual review meeting should include at least the following topics:

- Update historical events record based on any events in the past year.
- Review county profile and individual community assessments for each hazard and note any major changes or mitigation projects that have altered the vulnerability of each entity.
- Update the Emergency Resources information as necessary for each emergency response organization.
- Add a section to note accomplishments or current mitigation projects.
- All action items in Chapter 6 will need updated as projects are completed and as new needs or issues are identified.
- Address Emergency Operations Plans – how can we dovetail the two plans to make them work for each other? Specifically, how do we incorporate the County's EOP into the action items for the regional MHMP?
- Address Updated County Comprehensive Land Use Plans – how can we dovetail the two plans to make them work for each other?
- Incorporate additional hazard chapters as funding allows.

All meeting minutes, press releases, and other documentation of revisions should be kept on record by Lincoln County Emergency Management.

Five Year Re-evaluation Agenda

The focus of the planning committee at the five year re-evaluation should include all of the topics suggested for the annual review in addition to the following items:

- Update County demographic and socioeconomic data.
- Address any new planning documents, ordinances, codes, etc. that have been developed by the County or cities.
- Review listed communication sites.
- Review municipal water sources, particularly those in the floodplain or landslide impact areas.
- Redo all risk analysis models incorporating new information such as an updated County parcel master database, new construction projects, development trends, population vulnerabilities, changing risk potential, etc.
- Update county risk profiles and individual community assessments based on new information reflected in the updated models.

All meeting minutes, press releases, and other documentation of revisions should be kept on record by Lincoln County Emergency Management.

Prioritization of Action Items

The prioritization process includes a special emphasis on benefit-cost analysis review. The process will reflect that a key component in funding decision is a determination that the project will provide an equivalent or more in benefits over the life of the project when compared with the costs. Projects will be administered by local jurisdictions with overall coordination provided by the Lincoln County Emergency Manager.

County Commissioners and the elected officials of all jurisdictions have evaluated opportunities and established their own unique priorities to accomplish mitigation activities where existing funds and resources are available and there is community interest in implementing mitigation measures. If no federal funding is used in these situations, the prioritization process may be less formal. Often the types of projects that each county can afford to do on their own are in relation to improved codes and standards, department planning and preparedness, and education. These types of projects may not meet the traditional project model, selection criteria, and benefit-cost model. Lincoln County will use this Multi-Hazard Mitigation Plan as guidance when considering pre-disaster mitigation proposals brought before the Board of Commissioners by department heads, city officials, fire districts, and local civic groups.

When federal or state funding is available for hazard mitigation, there are usually requirements that establish a rigorous benefit-cost analysis as a guiding criterion in establishing project priorities. Lincoln County understands the basic federal grant program criteria which will drive the identification, selection, and funding of the most competitive and worthy mitigation projects. FEMA's three grant programs (the Hazard Mitigation Grant Program, the Flood Mitigation Assistance, and Pre-Disaster Mitigation program) that offer federal mitigation funding to state and local governments all include the benefit-cost and repetitive loss selection criteria.

The prioritization of new projects and deletion of completed projects will occur annually and be facilitated by the Lincoln County Emergency Manager and the joint planning committee. All mitigation activities, recommendations, and action items mentioned in this document are dependent on available funding and staffing.

Prioritization Scheme

All of the action item and project recommendations made in this Plan were prioritized by each respective jurisdiction. Each jurisdiction's representative on the planning committee met with their governing bodies and prioritized their own list of projects and mitigation measures through a group discussion and voting process. Projects were ranked on a "High", "Moderate", or "Low" scale with emphasis on project feasibility and the benefit/cost ratio.

Jurisdictional Mitigation Strategies

Lincoln County Annex

Table 6.1. Lincoln County Mitigation Strategies.

Hazard	Action Item	Goals Addressed	Responsible Departments or Organizations	Projected Completion Year
General	Install an amateur radio tower to provide additional coverage of the Sprague-Odessa area.	Goal #2, 3, 4, 5, and 8 Priority Ranking: High	**Partnership:** Lincoln County Emergency Management and Amateur Radio Group	2 years
	Work with local organizations to develop a sheltering plan for people affected by hazardous events in the Reardan and Edwall area.	Goal #1, 3, 4, 5, and 8 Priority Ranking: Moderate	**Partnership:** Lincoln County Emergency Management and Lincoln County Fire District #4	3 years
	Develop an alternative emergency access route for the subdivision in Hawk Creek canyon.	Goal #2, 3, 4, 5, and 8 Priority Ranking: High	Lincoln County Public Works	3 years
	Assess ingress and egress routes accessing rural subdivisions and develop a prioritized list for developing alternative emergency access routes.	Goal #2, 3, 4, and 8 Priority Ranking: High	Lincoln County Public Works	1 year
	Install emergency communications system updates to provide interoperability with all emergency services throughout the County.	Goal #2, 3, 4, and 8 Priority Ranking: High	Lincoln County Emergency Management	2 years
	Conduct a road inventory and assessment to determine deficiencies/inadequacies and develop a prioritized improvement schedule.	Goal #2, 3, 4, and 8 Priority Ranking: Moderate	Lincoln County Public Works	3 years
	Address problems with arsenic levels in public water supplies.	Goal #2, 3, 5, and 8 Priority Ranking: High	Lincoln County Public Health	2 years

Table 6.1. Lincoln County Mitigation Strategies.

Hazard	Action Item	Goals Addressed	Responsible Departments or Organizations	Projected Completion Year
	Develop an alternative access point from Edwall northbound connecting to State Route 231 in order to circumvent Burlington Northern blockages of existing routes.	Goal #2, 3, 4, 5, and 8 Priority Ranking: High	**Partnership:** Lincoln County Public Works, community of Edwall, and Burlington Northern Railroad	
Flood	Construct a dam or other flood control infrastructure on Crab Creek upstream of Edwall to reduce the flood risk from both seasonal flood events and 100 year events.	Goal #2, 3, 4, 5, and 8 Priority Ranking: High	Lincoln County Commission	5 years
	Encourage homeowners in flood prone areas to participate in the National Flood Insurance program.	Goal #1, 2, 3, and 8 Priority Ranking: Moderate	Lincoln County Emergency Management	Ongoing
Severe Weather	Develop a fund to be used for emergency plowing of secondary roads in unincorporated communities during high snow accumulation events.	Goal #2, 3, 6, and 8 Priority Ranking: Moderate	**Partnership:** Lincoln County Emergency Management and unincorporated communities	2 years
Wildland Fire	Continue to work on action items and proposed projects identified in the Lincoln County Community Wildfire Protection Plan.	Goal #1, 2, 3, 5, 7, and 8 Priority Ranking: High	**Partnership**: CWPP stakeholders	Ongoing

City of Davenport

Table 6.2. City of Davenport Mitigation Strategies.

Hazard	Action Item	Goals Addressed	Responsible Departments or Organizations	Projected Completion Year
General	Construct airport runway improvements to allow larger aircraft access for emergency deliveries or staging of supplies and to relieve safety concerns.	Goal #1, 3, 5, and 8 Priority Ranking: High	**Partnership**: Federal Aviation Administration, State of Washington, and City of Davenport	3 years
	Construct an aircraft hangar to be used by regional emergency personnel as a staging area, command post, and storage facility.	Goal #1, 3, 5, and 8 Priority Ranking: Moderate	**Partnership**: State of Washington, Lincoln County, and City of Davenport	4 years
	Construct an addition to the Airport Lounge to be used as a command center for air assault operations and briefing area for pilots and staff.	Goal #1, 2, 4, and 5 Priority Ranking: Moderate	**Partnership**: State of Washington, Lincoln County, and City of Davenport	5 years
Earthquake	Rebuild or reinforce masonry buildings subject to damage by earthquake, specifically the fire station, the library, and the well house.	Goal #1, 2, 5. 7, and 8 Priority Ranking: High	City of Davenport	6 years
Flood	Dredge Cottonwood Creek channel and remove vegetation to allow better flow during high water events.	Goal #1, 2, and 5 Priority Ranking: Moderate	City of Davenport	1 year
	Encourage homeowners in flood prone areas to participate in the National Flood Insurance program.	Goal #1, 2, 3, 5, 6, and 7 Priority Ranking: Moderate	City of Davenport	Ongoing
Severe Weather	Install backup generators on all major water sources and storage facilities.	Goal #1, 2, 5, and 8 Priority Ranking: High	City of Davenport	4 to 10 years

Table 6.2. City of Davenport Mitigation Strategies.

Hazard	Action Item	Goals Addressed	Responsible Departments or Organizations	Projected Completion Year
Wildland Fire	Continue to work on action items and proposed projects identified in the Lincoln County Community Wildfire Protection Plan.	Goal #1, 2, 3, 4, 5, and 7 Priority Ranking: Moderate	**Partnership**: CWPP stakeholders	Ongoing

City of Sprague

Table 6.3. City of Sprague Mitigation Strategies.

Hazard	Action Item	Goals Addressed	Responsible Departments or Organizations	Projected Completion Year
General	Plan and install a communication system at City Hall to alert the community that there has been a disaster situation and provide instructions. System may include a siren and public address system.	Goal #1, 2, and 3 Priority Ranking: High	Sprague City Council and Public Works Department	2 years
	Work with local organizations to develop a sheltering plan for people affected by hazardous events.	Goal #1, 2, 3, and 4 Priority Ranking: High	**Partnership:** Lincoln County Fire District #1, Sprague Chamber of Commerce, Sprague School District, and local churches	1 year
	Obtain and install a permanent backup generator for city well #3.	Goal #1 and 2 Priority Ranking: High	Sprague City Council and Public Works Department	1 year
	Obtain three portable backup generators to provide power at emergency shelters or wherever needed.	Goal #1, 2, and 4 Priority Ranking: Moderate	Sprague City Council and Public Works Department	1 year
	Upgrade 500 feet of 4 inch water main to 6 inch pipe to supply 2 fire hydrants.	Goal #1 and 2 Priority Ranking: Moderate	Sprague City Council and Public Works Department	3 years
	Upgrade the booster pump on the north side to improve water pressure to fire hydrants in that area.	Goal #1 and 2 Priority Ranking: Low	Sprague City Council and Public Works Department	5 years
Flood	Construction of a dam above Negro Creek, east of the City, to be used only during a high water flooding situation.	Goal #1, 2, and 3 Priority Ranking: Low	Lincoln County Commission	5 years

Table 6.3. City of Sprague Mitigation Strategies.

Hazard	Action Item	Goals Addressed	Responsible Departments or Organizations	Projected Completion Year
	Encourage homeowners in flood prone areas to participate in the National Flood Insurance program.	Goal #1, 2, and 3 Priority Ranking: Moderate	Sprague City Council and Public Works Department	Ongoing
	Clear obstructing vegetation from the Negro Creek channel.	Goal #1 and 2 Priority Ranking: Low	Sprague Public Works Department	1 year
Severe Weather	Establish an emergency snow plowing fund to assist in an extreme snow season.	Goal #1 and 2 Priority Ranking: Low	Sprague City Council and Public Works Department	1 year
Wildland Fire	Continue to work on action items and proposed projects identified in the Lincoln County Community Wildfire Protection Plan.	Goal #1, 2, and 3 Priority Ranking: Low	**Partnership**: CWPP stakeholders	Ongoing

Town of Almira

Table 6.4. Town of Almira Mitigation Strategies.

Hazard	Action Item	Priority Ranking Goals Addressed	Responsible Departments or Organizations	Projected Completion Year
General	Work with local organizations to develop a sheltering plan for people affected by hazardous events in the Almira area.	Goal #1 and 4 Priority Ranking: Moderate	**Partnership:** Lincoln County Emergency Management and Lincoln County Fire District #8	3 years
	Assess ingress and egress routes accessing rural subdivisions and develop a prioritized list for developing alternative emergency access routes.	Goal #2 and 4 Priority Ranking: High	**Partnership:** Lincoln County Public Works and town of Almira	1 year
	Install emergency communications system updates to provide interoperability with all emergency services throughout the County.	Goal #1 and 4 Priority Ranking: High	**Partnership:** Lincoln County Emergency Management and town of Almira	2 years
	Conduct a road inventory and assessment to determine deficiencies/inadequacies and develop a prioritized improvement schedule.	Goal #4 Priority Ranking: Moderate	**Partnership:** Lincoln County Public Works and town of Almira	3 years
	Address problems with arsenic levels in public water supply.	Goal #1, 2, 3, and 4 Priority Ranking: High	**Partnership:** Lincoln County Public Health and town of Almira	2 years
	Develop an alternative access point from Almira northbound connecting to State Route 231 in order to circumvent Burlington Northern blockages of existing routes.	Goal #2 and 4 Priority Ranking: High	**Partnership:** Lincoln County Public Works, community of Almira, and Burlington Northern Railroad	10 years
Flood	Construct a dam or other flood control infrastructure on Crab Creek upstream of Edwall to reduce the flood risk from both seasonal flood events and 100 year events.	Goal #4 Priority Ranking: High	Lincoln County Commission	5 years
	Encourage homeowners in flood prone areas to participate in the National Flood Insurance program.	Goal #1 and 4 Priority Ranking: Moderate	Community of Almira	Ongoing

Table 6.4. Town of Almira Mitigation Strategies.

Hazard	Action Item	Priority Ranking Goals Addressed	Responsible Departments or Organizations	Projected Completion Year
Severe Weather	Develop a fund to be used for emergency plowing of secondary roads in unincorporated communities during high snow accumulation events.	Goal #2 and 4 Priority Ranking: Moderate	**Partnership:** Lincoln County Emergency Management and unincorporated communities	2 years
Wildland Fire	Continue to work on action items and proposed projects identified in the Lincoln County Community Wildfire Protection Plan.	Goal #1, 2, and 4 Priority Ranking: High	**Partnership**: CWPP stakeholders	Ongoing

Town of Creston

Table 6.6. Town of Creston Mitigation Strategies.

Hazard	Action Item	Goals Addressed	Responsible Departments or Organizations	Projected Completion Year
General	Continue to establish the Town's Green House Gas Reduction Emission Policy to monitor the efficiency of the pumps in water and sewer systems and maintain them at peak efficiency.	Goal #2 and 4 Priority Ranking: Moderate	Town Council and Town Maintenance Operators	1 year
	Replace 4,400 existing 50+ year old 4" steel and AC water mains with 8" PVC water mains and approximately 30 water meters that have been identified to be in poor condition.	Goal #1 and 4 Priority Ranking: High	Town Council, Varella, and Associates Engineering, and private contractors	1 year
	Replace obsolete/substandard fire hydrants that cannot convey adequate fire flow at eight locations.	Goal #1 and 4 Priority Ranking: High	Town Council, Varella, and Associates Engineering, and private contractors	1 year
Flood	Identification, classification, and regulation of Critical Areas inundated by 100 year flood by the Dep. of Urban and Region Planning at EWU.	Goal #1 and 4 Priority Ranking: Moderate	Town Council, Eastern Washington University Department of Urban and Region Planning, and others	Ongoing
	Encourage homeowners in flood prone areas to participate in the National Flood Insurance program.	Goal #1, 2, and 4 Priority Ranking: Low	Town Council	Ongoing
Severe Weather	Work with local jurisdictions as well as FEMA to mitigate and lessen impacts of severe weather events, particularly prolonged freezing and ice storms.	Goal #1, 2, 3, 4, and 5 Priority Ranking: Moderate	Town Council	Ongoing
Wildland Fire	Continue to work on action items and proposed projects identified in the Lincoln County Community Wildfire Protection Plan.	Goal #1, 2, 3, and 4 Priority Ranking: Moderate	**Partnership**: CWPP stakeholders	Ongoing

Town of Harrington

Table 6.7. Town of Harrington Mitigation Strategies.

Hazard	Action Item	Goals Addressed	Responsible Departments or Organizations	Projected Completion Year
General	Re-line and repaint the city's water storage tank.	Goal #1 Priority Ranking: High	Town of Harrington	2012
	Assess the school facilities and Memorial Hall for sheltering capabilities and inventory needed equipment and supplies.	Goal #1 and 3 Priority Ranking: Moderate	Town of Harrington	2011
	Continue to enforce ordinances and regulations related to building in hazard areas.	Goal #2, 3, and 4 Priority Ranking: High	Town of Harrington	Ongoing
Flood	Encourage homeowners in flood prone areas to participate in the National Flood Insurance program.	Goal #3 Priority Ranking: Low	Town of Harrington	Ongoing
Wildland Fire	Continue to work on action items and proposed projects identified in the Lincoln County Community Wildfire Protection Plan.	Goal #3 Priority Ranking: Moderate	**Partnership**: CWPP stakeholders	Ongoing

Town of Odessa

Table 6.8. Town of Odessa Mitigation Strategies.

Hazard	Action Item	Goals Addressed	Responsible Departments or Organizations	Projected Completion Year
General	Obtain and install backup generator for Community Center.	Goal #1 and 2 Priority Ranking: High	Town of Odessa (Administration and Public Works)	4 years
	Obtain and install backup generators on Well #3 and #4.	Goal #1 and 2 Priority Ranking: High	Town of Odessa (Administration and Public Works)	5 years
Flood	Clear obstructing vegetation from the Crab Creek channel.	Goal #1 and 2 Priority Ranking: High	Partnership: Town of Odessa (Administration and Public Works) and FEMA	1 year
	Encourage homeowners in flood prone areas to participate in the National Flood Insurance program.	Goal #1 and 2 Priority Ranking: High	Town of Odessa	Ongoing
Severe Weather	Obtain and install backup generator at Public Works and Police Department building.	Goal #1 and 2 Priority Ranking: Moderate	Town of Odessa (Administration and Public Works)	6 years
Wildland Fire	Continue to work on action items and proposed projects identified in the Lincoln County Community Wildfire Protection Plan.	Goal #1 and 2 Priority Ranking: Moderate	Partnership: CWPP stakeholders	Ongoing

Town of Reardan

Table 6.9. Town of Reardan Mitigation Strategies.

Hazard	Action Item	Goals Addressed	Responsible Departments or Organizations	Projected Completion Year
General	Secure a portable generator that could power the town's primary well or the emergency well.	Goal #2 Priority Ranking: High	Town or Reardan	2 years
	Modify town wells to in order to be compatible with portable power sources.	Goal #2 Priority Ranking: High	Town of Reardan	2 years
	Establish emergency sheltering plan to coordinate the Community Hall, Fire Station, Churches, and High School and Grade School facilities.	Goal #1and 2 Priority Ranking: Moderate	Town or Reardan, School District, Fire District #4, Community Hall Association, and Church Administrations	Ongoing
	Replace approximately 8,000 feet of 50+ year old steel pipe with C-900 or equivalent plastic pipe.	Goal #2 Priority Ranking: Moderate	Town of Reardan	5 years
Earthquake	Organize sheltering, medical aid, and food preparation and distribution plans.	Goal #1 and 2 Priority Ranking: Low	Town or Reardan, Fire District #4, and Reardan Health Clinic	2 years
Flood	Draft evacuation options and possible sand bagging locations.	Goal #1 and 2 Priority Ranking: Low	Town or Reardan and Fire District #4	1 year
	Encourage homeowners in flood prone areas to participate in the National Flood Insurance program.	Goal #2 Priority Ranking: Low	Town of Reardan	Ongoing
Severe Weather	Develop town and school district communication systems.	Goal #2 Priority Ranking: High	Town or Reardan, School District, Fire District #4, and County Sheriff	5 years

Table 6.9. Town of Reardan Mitigation Strategies.

Hazard	Action Item	Goals Addressed	Responsible Departments or Organizations	Projected Completion Year
	For severe winter conditions, organize plan to handle heating outages due to prolonged power and/or natural gas outages.	Goal #1 and 2 Priority Ranking: High	Town or Reardan, School District, Fire District #4, Community Hall Association, Avista, and Church Administrations.	2 years
	Organize options for emergency medical transport and access to life critical medical supplies and medications.	Goal #2 Priority Ranking: Moderate	Town or Reardan, Fire District #4, Med Star, Reardan Clinic, County Sheriff, and Washington Department of Transportation.	3 years
Wildland Fire	Continue to work on action items and proposed projects identified in the Lincoln County Community Wildfire Protection Plan.	Goal #1 and 2 Priority Ranking: Moderate	**Partnership**: CWPP stakeholders	Ongoing

Town of Wilbur

Table 6.10. Town of Wilbur Mitigation Strategies.

Hazard	Action Item	Goals Addressed	Responsible Departments or Organizations	Projected Completion Year
General	Drill a well near the airport to provide adequate water supplies for the existing population as well as for future industrial growth and fire suppression.	Goal #2 and 3 Priority Ranking: Moderate	Town of Wilbur	1 year
Flood	Construct a dam on Goose Creek to assist with flood control and provide irrigation water.	Goal #2 and 3 Priority Ranking: High	Town of Wilbur Administration and Grants & Contracts	2 years
	Encourage homeowners in flood prone areas to participate in the National Flood Insurance program.	Goal #1 and 2 Priority Ranking: High	Town of Wilbur	Ongoing
	Remove obstructions for the Goose Creek stream channel to improve water flow and help prevent flooding.	Goal #2 and 3 Priority Ranking: High	Town of Wilbur Public Works	1 year
Severe Weather	Obtain three portable backup generators to power town wells and the community center or an alternative emergency shelter during severe weather events.	Goal #2 and 3 Priority Ranking: High	Town of Wilbur Public Works	1 year
	Obtain a permanent backup generator for town well #1.	Goal #2 and 3 Priority Ranking: High	Town of Wilbur Public Works	2 years
Wildland Fire	Continue to work on action items and proposed projects identified in the Lincoln County Community Wildfire Protection Plan.	Goal #1, 2, and 3 Priority Ranking: Moderate	**Partnership**: CWPP stakeholders	Ongoing

Lincoln Hospital District

Table 6.11. Lincoln Hospital District Mitigation Strategies.

Hazard	Action Item	Goals Addressed	Responsible Departments or Organizations	Projected Completion Year
General	Move and remodel Emergency Room from a 2 bed setup to a six bed setup with one bay designed as a temporary isolation/quiet room.	Goal #1, 2, and 3 Priority Ranking: High	Lincoln Hospital Facilities Management and Finance	4 years
	Build an addition off of the Operating Room area creating recovery rooms for surgery patients and an enhanced Operating Room	Goal #1, 2, and 3 Priority Ranking: High	Lincoln Hospital Facilities Management, Finance, and Operating Room	8 years
	Build a secured refrigerated area off the end of the new proposed Operating Room area to serve as a Region 9 disaster mortuary storage facility.	Goal #1, 2, and 3 Priority Ranking: Moderate	Lincoln Hospital Facilities Management, Finance, and Region 9 Hospital Planning Committee	8 to 40 years
Severe Weather	Wire proposed new construction projects (above) into the generator emergency power grid providing additional sheltering capabilities during severe weather events.	Goal #1, 2, and 3 Priority Ranking: High	Lincoln Hospital Facilities Management, Finance, and Operating Room	4 to 8 years
Wildland Fire	Continue to work on action items and proposed projects identified in the Lincoln County Community Wildfire Protection Plan.	Goal #1, 2, and 3 Priority Ranking: Low	**Partnership**: CWPP stakeholders	Ongoing

Odessa Memorial Healthcare Center

Table 6.12. Odessa Memorial Healthcare Center Mitigation Strategies.

Hazard	Action Item	Goals Addressed	Responsible Departments or Organizations	Projected Completion Year
General	Maintain and periodically test the backup generator for the hospital building.	Goal #1 and 2 Priority Ranking: High	Odessa Memorial Healthcare Center Environmental Services Department	At least annually
	Work with the city of Odessa to improve sheltering capacity within the community.	Goal #1, 2, 3, 4, and 5 Priority Ranking: High	Odessa Memorial Healthcare Center	Ongoing
	Continuously improve the Hospital's emergency operations plans and procedures by conducting interagency trainings and working collaboratively with other public agencies.	Goal #1, 3, and 4 Priority Ranking: High	Odessa Memorial Healthcare Center	At least annually
Severe Weather	Wire any new construction projects into the emergency power grid in order to provide additional sheltering capabilities during severe weather events.	Goal #1, 2, 4, and 5 Priority Ranking: High	Odessa Memorial Healthcare Center Environmental Services Department	Ongoing
Wildland Fire	Continue to work on action items and proposed projects identified in the Lincoln County Community Wildfire Protection Plan.	Goal #1, 4, and 6 Priority Ranking: Low	**Partnership**: CWPP stakeholders	Ongoing

This page was intentionally left blank.

Chapter 7

Appendices

IN THIS SECTION:

- List of Tables
- List of Figures
- Planning Committee Minutes
- Public Meeting Slideshow
- Literature Cited

Chapter 7 – Appendices

Supporting Information

List of Tables

Table 3.1. Vegetative Cover Types in Lincoln County. 30
Table 3.2. Lincoln County Historical Population Data. 33
Table 3.3. Income Categories (1999 data). 33
Table 3.4. Employment and Industry Statistics. 34
Table 3.5. Ownership Categories in Lincoln County. 35
Table 4.1. Largest Known Earthquakes Felt in Washington. 48
Table 4.2. Assessment of Historic Fire Regimes in Lincoln County, Washington. 59
Table 4.3. Assessment of Fire Regime Condition Class in Lincoln County, Washington. 61
Table 5.1. NFIP Policy Statistics as of 7/31/2010 in Lincoln County. 82
Table 5.2. Landslide Impact Zones in Lincoln County. 88
Table 5.3. Summary of ignitions in Lincoln County from Washington DNR database 2004-2008. 97
Table 5.4. Summary of Ignitions in Lincoln County Reported by Local Fire Districts 2003-2008. 98
Table 6.1. Lincoln County Mitigation Strategies. 172
Table 6.2. City of Davenport Mitigation Strategies. 174
Table 6.3. City of Sprague Mitigation Strategies. 176
Table 6.4. Town of Almira Mitigation Strategies. 178
Table 6.6. Town of Creston Mitigation Strategies. 180
Table 6.7. Town of Harrington Mitigation Strategies. 182
Table 6.8. Town of Odessa Mitigation Strategies. 184
Table 6.9. Town of Reardan Mitigation Strategies. 186
Table 6.10. Town of Wilbur Mitigation Strategies. 188
Table 6.11. Lincoln Hospital District Mitigation Strategies. 190
Table 6.12. Odessa Memorial Healthcare Center Mitigation Strategies. 192

List of Figures

Figure 2.1. Public Meeting Flyer. 26
Figure 3.1. Summary of SHELDUS Hazard Profile. 37
Figure 4.1. Cascadia Earthquake Sources. 45
Figure 4.2. Seismicity of Washington 1990-2006. 47
Figure 4.3. Washington Peak Acceleration Map. 49
Figure 4.4. Washington Geological Survey Landslide Database. 52
Figure 4.5. Annual Precipitation Map for Washington. 55
Figure 4.6. Historic Fire Regime in Lincoln County, Washington. 60
Figure 4.7. Fire Regime Condition Class in Lincoln County, Washington. 62
Figure 4.8. Wildland-Urban Interface Map for Lincoln County, Washington. 65
Figure 4.9. Record of Cascade Range Volcanic Eruptions. 72
Figure 4.10. U.S. Drought Monitor Map of Western Region. 75
Figure 4.11. Precipitation Record 1890 – Present. 76
Figure 4.12. Palmer Drought Severity Index Map. 77
Figure 5.1. FEMA 100 Year Riverine Flood Hazard Areas in Eastern Washington. 79
Figure 5.2. FEMA Floodplains in Lincoln County, Washington. 80
Figure 5.3. City of Davenport FEMA Flood Insurance Rate Map. 106
Figure 5.4. City of Sprague FEMA Flood Insurance Rate Map. 113
Figure 5.5. Town of Almira FEMA Flood Insurance Rate Map. 120
Figure 5.5. Town of Creston FEMA Flood Insurance Rate Map. 126
Figure 5.6. Town of Harrington FEMA Flood Insurance Rate Map*. 134
Figure 5.7. Town of Odessa FEMA Flood Insurance Rate Map. 142
Figure 5.8. Town of Reardan FEMA Flood Insurance Rate Map. 148
Figure 5.9. Town of Wilbur FEMA Flood Insurance Rate Map. 156

Planning Committee Minutes

June 30th, 2010 – Lincoln County Courthouse

Agenda Item #1 – Introduction:

Wade Magers, Lincoln County Emergency Management/Sheriff, began the meeting by asking for introductions and providing some background on the project.

Agenda Item #2 – NMI Presentation:

Tera gave a brief background of the process and explained the purpose of the Multi-Hazard Mitigation Plan and the integration of the Community Wildfire Protection Plan. Critical sections of the CWPP will be included in the MHMP to satisfy new requirements. After NMI explained the ramifications, the committee determined that the County and cities would be the only participating jurisdictions for now; however, there may be a few additional special districts. NMI also asked that the committee provide any hazard information, pertinent planning documents, hazard photos, etc. that may be useful in the development of the risk assessments.

Agenda Item #3 – Phase I Hazard Assessment:

NMI led the committee through an exercise to help determine their perspective on the potential severity of each hazard within the county. Each hazard was scored for its frequency and potential impact and placed in a matrix to show how each hazard ranked relative to each other. The results of the assessment are given below.

		Magnitude		
		Low	**Medium**	**High**
Frequency	**Low**	**Avalanche**	**Landslide** **Tsunami**	**Earthquake** **Volcano**
	Medium	**Flood**	**Drought**	
	High		**Wildland Fire** **Severe Weather**	

Agenda Item #4 – Mission and Goals Statements:

Each jurisdiction needs to complete a goals statement per new requirements. NMI provided examples and a fill-in goals worksheet that will also be distributed electronically. Tera asked that each jurisdiction complete their statement by the next meeting.

Agenda Item #5– Critical Facilities:

Tera handed out the critical facilities survey form. She explained how to fill it out based on communities or jurisdictions. All of the lists will be combined and used in the hazard assessments. Tera asked that the committee return the completed lists by July 14th for inclusion in the draft assessments prepared for the next meeting.

Agenda Item #6 – Press Release:

Tera handed out a draft press release announcing the start of the planning project. She asked the committee to review and send her any comments by July 9th.

Agenda Item #7 – Task List:

Information can be sent to Tera King at king@consulting-foresters.com .*

1. Complete Goals Statements by the next meeting – County and Cities
2. Send committee electronic copies of handouts – Tera
3. Send NMI revisions to press release by July 9th – Committee
4. Send NMI critical facilities forms by July 14th – County and Cities

Agenda Item #8 – Adjournment:

The Lincoln County MHMP update planning committee meeting was adjourned at 8 pm. The next meeting will be held on July 28th, 2010 at 6 pm in the Courthouse, Commissioners Chambers.

July 28th, 2010 – Lincoln County Courthouse

Agenda Item #1 – Introduction:

Wade Magers, Lincoln County Emergency Management/Sheriff, began the meeting by asking for introductions and providing some background on the project.

Agenda Item #2 – Old Business:

Tera gave a brief background on the purpose and scope of the planning project. Several items were left over from the last meeting, so Tera went through the tasks that NMI was still needing help with. Most of the jurisdictions had not yet returned their goals statements. These area a requirement; thus, Tera asked that representatives send them in right away. Vaiden has been working on the critical facilities list to be used in the hazard assessments. The most recent version of the list was handed out and Tera asked that committee review, make edits, and fill in missing info. In order to establish a historical record, Tera also ask that committee members send NMI any records, photos, etc of past hazard events as well as any pertinent planning documents that should be reviewed.

Agenda Item #3 – Flood and Landslide Hazards:

Vaiden has completed the modeling and mapping of the FEMA-identified floodplains and the landslide prone landscapes. Tera asked that the committee review the maps for accuracy as well as add any proposed projects and mark any existing problem areas. Phil noted that Public Works would be supplying a GIS layer of the main access roads as well as problem areas and projects.

Agenda Item #4 – Earthquake and Tsunami Hazards:

On one of the maps, Tera also asked that committee members also mark any significant infrastructure or high population areas along the Lake Roosevelt shoreline that would be impacted by a large wave (inland tsunami).Additionally, Tera asked that the committee start putting together estimates of unreinforced masonry within their respective jurisdictions. She needs this broken down by public buildings and private residences and other structures.

Agenda Item #5– Draft Review:

NMI handed out draft chapters 1-4 for committee review. Tera briefly explained the contents of the document and asked that the committee provide edits by August 18th.

Agenda Item #6 – Public Involvement:

Tera handed out a rough draft of the public meeting flyer for review. Public meeting dates were tentatively set for the week of September 27th.

Agenda Item #7 – Task List:

Information can be sent to Tera King at king@consulting-foresters.com .*

1. Complete Goals Statements asap – County and Cities
2. Send committee electronic copies of handouts – Tera
3. Send NMI revisions and additions to the critical facilities list immediately – Committee
4. Send NMI edits to draft chapters 1-4 by Aug 18th – Committee
5. Send NMI revisions to public meeting flyer by Aug 18th – Committee
6. Send NMI photos and other records of hazard events - Committee

Agenda Item #8 – Adjournment:

The Lincoln County MHMP planning committee meeting was adjourned at 8 pm. The next meeting will be held on August 25th, 2010 at 6 pm in the Courthouse, Commissioners Chambers.

August 25th, 2010 – Lincoln County Courthouse

Agenda Item #1 – Old Business:

Tera discussed the status of the goals statements received from the adopting jurisdictions. She also noted that NMI had not received any revisions to the draft Chapters 1.4 handed out at the last committee meeting. The committee was also reminded to send NMI any pictures or documentation of past hazard events.

Agenda Item #2 – Draft Review:

Tera handed out the partial draft of Chapter 5, which covers the hazard vulnerabilities for each jurisdiction. NMI is still working on the maps and GIS analysis for several of the hazards, but many of the sections were presented for review.

Tera also handed out the draft mitigation strategies for each jurisdiction. The projects and action items that NMI had received to date were included, but she asked that the jurisdictions review the section pertaining to them and add projects and ideas to it. This information needs to be justified in the risk assessment narratives and will be discussed at the public meetings.

Tera asked that the committee review and provide edits on both the draft chapter 5 and the mitigation strategy sections by September 17th.

Agenda Item #3 – Public Involvement:

The committee reviewed the public meeting flyer and press release. Public meetings will be scheduled for the week of September 27th in Reardan, Wilbur, Davenport, and Odessa. Tera will be working on making the arrangement and will send out the revised flyer and press release for final review.

Agenda Item #4 – Task List:

Information can be sent to Tera King at king@consulting-foresters.com .*

1. Complete Goals Statements asap – County and Cities
2. Send committee electronic copies of handouts – Tera
3. Send NMI edits to draft chapters 1-4 by immediately – Committee
4. Send NMI revisions to public meeting flyer immediately – Committee
5. Send NMI photos and other records of hazard events – Committee
6. Review and provide edits on draft Chapter 5 by September 17th – Committee
7. Review and provide additions to draft mitigation strategies by September 17th - Committee

Agenda Item #5 – Adjournment:

The Lincoln County MHMP planning committee meeting was adjourned at 7pm. The next meeting will be held on September 29th at 7pm at the Memorial Hall in conjunction with the public meeting in Davenport.

September 29th, 2010 – Lincoln County Courthouse

Agenda Item #1 – Old Business:

Vaiden discussed the information that was still missing from several jurisdictions. Sheriff Magers asked NMI to forward the forms and he would send them out to the committee. He will also coordinate with Tera to contact the jurisdictions and remind them of the information by phone, in person, or otherwise.

Agenda Item #2 – Draft Review:

Vaiden handed out the updated draft Chapter 5 indicating that the information in the Flood, Earthquake, Landslide, Severe Weather, and Tsunami annexes was new. After pointing out where some of the gaps were, he asked that the committee send in their comments and revisions by October 15th.

Vaiden also presented the draft Chapter 6. This chapter contains the mitigation strategies for each jurisdiction. Each section lists the action items currently recorded, their priority ranking, the organization responsible for implementation, and a timeline. At least one action item is required for each jurisdiction. The Lincoln Hospital District section is a good example of a completed list. Vaiden asked that each jurisdiction review or complete their respective lists and send the information to Tera by October 15th.

Agenda Item #3 – Public Involvement:

The committee reviewed the press release announcing the public comment period for the draft document. The public comment period will begin as soon as all the information can be collected from each jurisdiction. The target start date is November 1st.

Agenda Item #4 – Task List:

Information can be sent to Tera King at king@consulting-foresters.com .*

1. Complete Goals Statements asap – County and Cities
2. Send committee electronic copies of handouts – Tera

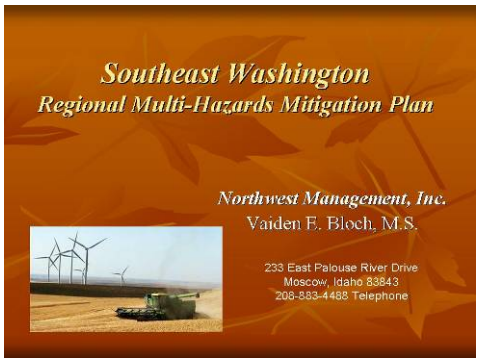
3. Send NMI edits to draft chapter 5 by October 15th – Committee
4. Send NMI revisions to draft chapter 6 (mitigation strategies) by October 15th – Committee

Agenda Item #5 – Adjournment:

The Lincoln County MHMP planning committee meeting was adjourned at 8 pm and followed by the Davenport public meeting. The next meeting is TBD as is necessary.

Public Meeting Slideshow

Slide 1



Slide 2

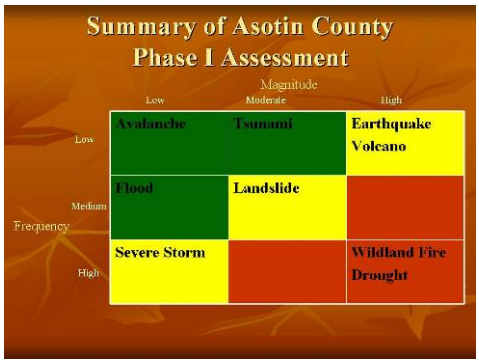
Slide 3

Slide 4

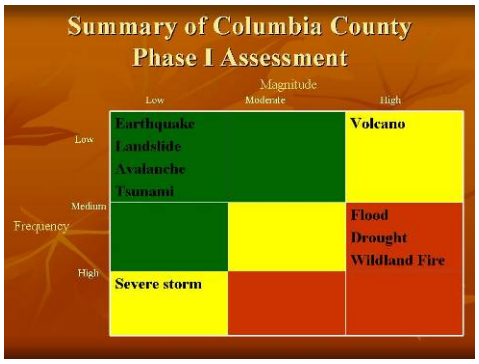
Slide 5

Slide 6

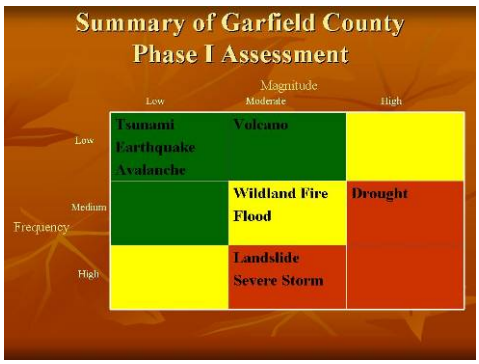
Slide 7



Slide 8

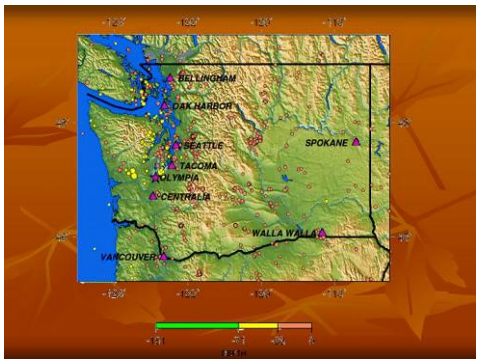


Slide 9

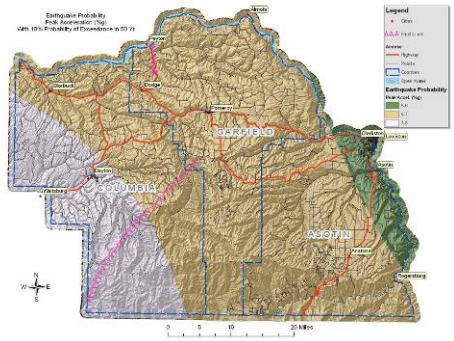


Slide 10

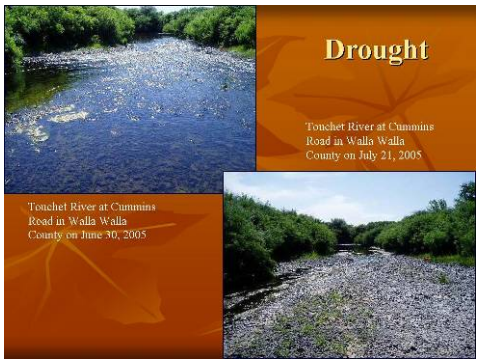
Slide 11



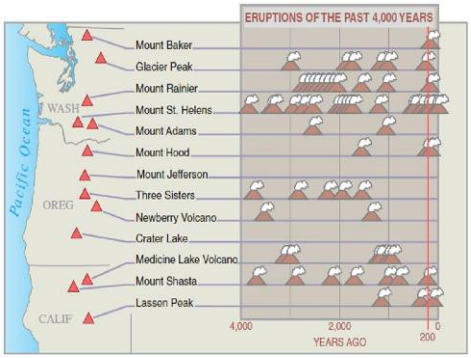
Slide 12



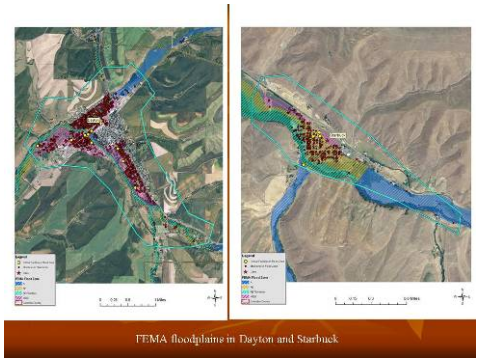
Slide 13



Slide 14

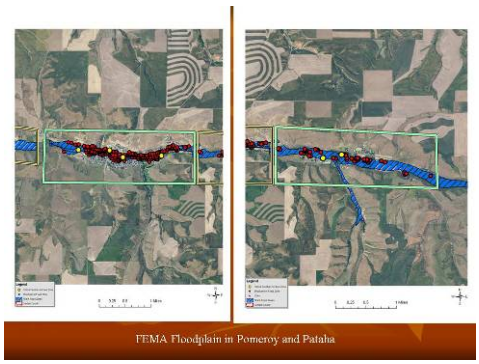


Slide 15

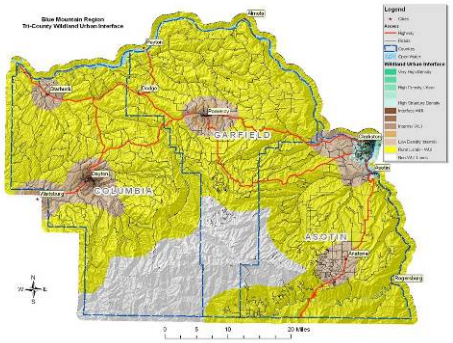


Slide 16

Slide 17



Slide 18



Slide 19

Landslides

- Currently working on assessments.
- See wall maps

Slide 20

Preparedness

- Emergency Services
- Fire Protection
- Weather Impacts
- Flood Protection/Programs
- Earthquake & Landslide Readiness
- Hospital Protection
- PUD/Highway District Readiness
- Communications

Slide 21

Types of Projects

- Defensible Space and Fuels Treatments
- Floodplain Management/Levee Maintenance
- Slope Stabilization
- Studies (e.g. watershed) and Evaluations (e.g. culvert capacity)
- Access Improvements
- Emergency Response Needs
- Policy Issues
- Public Education

Slide 22

Public Involvement

- Press Releases about planning efforts
- Informational flyers
- Public Meetings X4
- Public Review of the DRAFT Plans will be facilitated once all sections have been completed and reviewed by the committee
- Open public adoption hearings

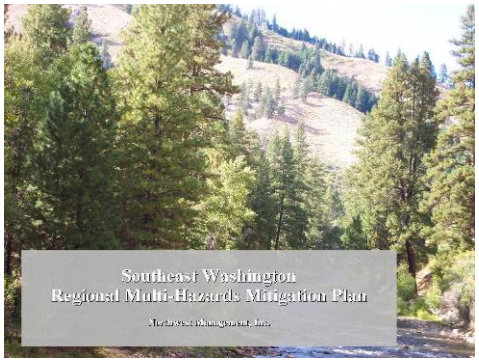
Slide 23

Your Input

- Maps on the walls – Mark them up!
- Talk to one of the planning committee members.
- Let us know your ideas and concerns.
- Make this YOUR Plan!

- Thank you for attending and participating! Please visit with us.

Slide 24



Potential Funding Sources

Program: **Rural Fire Assistance**
Source: Bureau of Land Management
Description: BLM provides funds to rural fire departments for wildfire fighting; also provides wildland fire equipment, training and/or prevention materials.
More info: Contact BLM RFA Coordinator

Program: **Communities at Risk**
Source: Bureau of Land Management
Description: Assistance to communities for hazardous fuels reduction projects in the wildland urban interface; includes funding for assessments and mitigation planning.
More info:

Program: **State Fire Assistance**
Source: US Forest Service
Description: USFS grants to state foresters through state and private grants, under authority of Cooperative Forestry Assistance Act. Grant objectives are to maintain and improve protection efficiency and effectiveness on non-federal lands, training, equipment, preparedness, prevention and education.
More info: www.fireplan.gov and www.fs.fed.us

Program: **State Fire Assistance Hazard Mitigation Program**
Source: National Fire Plan
Description: These special state Fire Assistance funds are targeted at hazard fuels treatment in the wildland-urban interface. Recipients include state forestry organizations, local fire services, county emergency planning committees and private landowners.
More info: www.fireplan.gov and www.fs.fed.us

Program: **Volunteer Fire Assistance**
Source: US Forest Service
Description: Provides funding and technical assistance to local and volunteer fire departments for organizing, training and equipment to enable them to effectively meet their structure and wildland protection responsibilities. US Forest Service grants provided to state foresters through state and private grants under the authority of Coop Forestry Assistance Act.
More info: www.fs.fed.us/fire/partners/vfa

Program: **Forest Land Enhancement Program**
Source: US Forest Service
Description: The 2002 Farm Bill repealed the Forestry Incentives Program (authorized in 1978) and Stewardship Incentive Program (1990) cost share programs and replaced it with a new Forest Land Enhancement Program (FLEP). FLEP purposes include 1) Enhance the productivity of timber, fish and wildlife habitat, soil and water quality, wetland, recreational resources, and aesthetic values of forest land through landowner cost share assistance, and 2) Establish a coordinated, cooperative federal, state and local sustainable forestry program to establish, manage, maintain, enhance and restore forests on non-industrial private forest land.
More info: www.usda.gov/farmbill

Program: **Federal Excess Property**
Source: US Forest Service
Description: Provides assistance to state, county and local governments by providing excess federal property (equipment, supplies, tools) for wildland and rural community fire response.
More info: Contact Washington Department of Natural Resources

Program: **Economic Action Program**
Source: US Forest Service
Description: A USFS, state and private program with involvement from local Forest Service offices to help identify projects. Addresses long-term economic and social health of rural areas; assists the development of enterprises through diversified uses of forest products, marketing assistance, and utilization of hazardous fuel byproducts.
More info:

Program: **Forest Stewardship Program**
Source: US Forest Service
Description: Funding helps enable preparation of management plans on state, private and tribal lands to ensure effective and efficient hazardous fuel treatment.
More info: Washington Department of Natural Resources

Program: **Community Planning**
Source: US Forest Service
Description: USFS provides funds to recipients with involvement of local Forest Service offices for the development of community strategic action and fire risk management plans to increase community resiliency and capacity.
More info:

Program: **Firefighters Assistance**
Source: Federal Emergency Management Agency and US Fire Administration Program
Description: Financial assistance to help improve fire-fighting operations, services and provide equipment.
More info: www.fema.gov

Program: **Pre-Disaster Mitigation Program**
Source: Federal Emergency Management Agency
Description: Emergency management assistance to local governments to develop hazard mitigation plans.
More info: Washington Military Department Emergency Management Division

Program: **Community Facilities Loans and Grants**
Source: Rural Housing Service (RHS) U. S. Dept. of Agriculture
Description: Provides grants (and loans) to cities, counties, states and other public entities to improve community facilities for essential services to rural residents. Projects can include fire and rescue services; funds have been provided to purchase fire-fighting equipment for rural areas. No match is required.
More info: http://www.rurdev.usda.gov or local county Rural Development office.

Program: **Sale of Federal Surplus Personal Property**
Source: General Services Administration
Description: This program sells property no longer needed by the federal government. The program provides individuals, businesses and organizations the opportunity to enter competitive bids for purchase of a wide variety of personal property and equipment. Normally, there is no use restrictions on the property purchased.
More info: www.gsa.gov

Program: **Reimbursement for Firefighting on Federal Property**
Source: U. S. Fire Administration, Federal Emergency Management Agency
Description: Program provides reimbursement to fire service organizations that have engaged in firefighting operations on federal land. Payments can be for direct expenses and direct losses.
More info: www.fema.gov

Program: **Fire Management Assistance Grant Program**
Source: Readiness, Response and Recovery Directorate, FEMA
Description: Program provides grants to states, tribal governments and local governments for the mitigation, management and control of any fire burning on publicly (nonfederal) or privately owned forest or grassland that threatens such destruction as would constitute a major disaster. The grants are made in the form of cost sharing with the federal share being 75 percent of total eligible costs. Grant approvals are made within 1 to 72 hours from time of request.
More info: www.fema.gov

Program: **Hazard Mitigation Grant Program**
Source: Federal Insurance and Mitigation Administration, FEMA
Description: Provides states and local governments with financial assistance to implement measures to reduce or eliminate damage and losses from natural hazards. Funded projects have included vegetation management projects. It is each State's responsibility to identify and select hazard mitigation projects.
More info: www.fema.gov

Program: **Boise State University Wildland Fire Academy**.
Source: Partnership between BSU and SWIFT (Southwest Idaho Fire Training, a group including the BLM, Forest Service, and the Idaho Department of Lands).
Description: Provides a full range of fire training classes during one week in June at the Selland College of Technology on the BSU campus. Tuition is required. Open to federal, state, local fire fighters, contractors, and the public. Housing is available on campus. (Separate from, but in conjunction with, this academy, BSU recently began offering an associate degree program in fire science.)
More info: BLM training officer at 208-384-3403 or BSU's Selland College at 208-426-1974.

This page was intentionally left blank.

This plan was developed by Northwest Management, Inc. under contract with Lincoln County Emergency Management.

Citation of this work:

King, Tera R. and V. Bloch. *Lead Authors.* Lincoln County, Washington Multi-Hazard Mitigation Plan. Northwest Management, Inc., Moscow, Idaho. 2011. Pp 210.

Northwest Management, Inc.
233 East Palouse River Drive
PO Box 9748
Moscow ID 83843

208-883-4488 Telephone
208-883-1098 Fax
NWManage@consulting-foresters.com
http://www.Consulting-Foresters.com/