Pend Oreille County
2018 Multi-Jurisdiction
Hazard Mitigation Plan Update
Volume 1: Planning-Area-Wide Elements

FINAL

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BRIDGEVIEW CONSULTING

PEND OREILLE COUNTY MULTI-JURISDICTION

2018 HAZARD MITIGATION PLAN UPDATE

VOLUME 1: PLANNING-AREA-WIDE ELEMENTS

FINAL APPROVED VERSION

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Pend Oreille County 2018 Multi-Jurisdiction Hazard Mitigation Plan Update
Volume 1—Planning-Area-Wide Elements

TABLE OF CONTENTS

LIST OF TABLES

No. *Title* *Page No.*

LIST OF FIGURES

EXECUTIVE SUMMARY

The federal Disaster Mitigation Act (DMA) promotes proactive pre-disaster planning by making it a condition of receiving financial assistance under the Robert T. Stafford Act. The DMA established a Pre-Disaster Mitigation Program and new requirements for the national post-disaster Hazard Mitigation Grant Program.

The DMA encourages state and local authorities to work together on pre-disaster planning, promoting sustainability as a strategy for disaster resistance. Sustainable hazard mitigation addresses the sound management of natural resources and local economic and social resiliency, and it recognizes that hazards and mitigation must be understood in a broad social and economic context. The planning network called for by the DMA helps local governments articulate accurate needs for mitigation, resulting in faster allocation of funding and more cost-effective risk-reduction projects.

A planning partnership made up of Pend Oreille County, the Kalispel Tribe, local governments, and special purpose districts worked together to create this Pend Oreille County 2018 Multi-Jurisdiction Hazard Mitigation Plan Update to fulfill the DMA requirements for all fully participating partners.

PLAN UPDATE

Federal regulations require hazard mitigation plans to include a plan for monitoring, evaluating, and updating the hazard mitigation plan. An update provides an opportunity to reevaluate recommendations, monitor the impacts of actions that have been accomplished, and determine if there is a need to change the focus of mitigation strategies. A jurisdiction covered by a plan that has expired is not able to pursue funding under the Robert T. Stafford Act for which a current hazard mitigation plan is a prerequisite.

Initial Response to the DMA in Pend Oreille County

The inevitability of natural hazards and the growing population and activities within the planning region created an urgent need to develop information, concepts, strategies and a coordination of resources to increase public awareness of the hazards of concern and the risk associated with those hazards. In an effort to reduce the impact of the hazards and assist the public in protecting life, property and the economy, the County determined that it was in the best interests of its citizenry to develop the 2004 Pend Oreille County Hazard Mitigation Plan, followed by an update in 2011. This 2018 Hazard Mitigation Plan is an update to the 2011 plan.

As time has progressed, new technologies, information and increased awareness brought about a wealth of information to enhance the validity of the initial plan, providing the opportunity, through development of the 2018 update to the Pend Oreille County Multi-Jurisdiction Hazard Mitigation Plan, to increase the resilience of the planning region.

The 2018 Pend Oreille County Plan Update—What has changed?

The updated plan differs from the initial plan for a variety of reasons:

- Better guidance now exists on what is required to meet the intent of the DMA.
- Science and technology have improved since the development of the initial plan.
- Newly available data and tools provide for a more detailed and accurate risk assessment.

Pend Oreille County is using the five-year update process to enhance the Pend Oreille County Multi-Jurisdictional Mitigation Plan in scope and content. Based on availability of new data and a better understanding of the Federal Emergency Management Agency's (FEMA's) guidance to develop mitigation plans, the following changes have been incorporated in the 2018 plan which differ from the previous edition:

- The layout of the plan varies significantly for ease in use by the planning partners. The 2018 edition utilizes a two-volume approach. Volume 1 includes general planning information and hazard profile data which is consistent with all entities involved, as well as the County-specific data. Volume 2 includes each jurisdiction's separate annex, as well as the linkage procedure for partners wishing to join at a later date.
- Hazards of concern were modified for this 2018 update. Climate Change was added as a new hazard to address potential impacts on the various other hazards of concern; however, no risk assessment was performed as there currently is no damage function which addresses such impact. Wildfire was enhanced due to the increase in wildfire occurrences throughout Washington over the course of the last several wildfire seasons, and the large amount of wooded lands. The technological, manmade and biological hazards were removed, as those hazards are addressed in detail within the Threat Hazard Identification and Risk Assessment (THIRA) which the County has previously developed. The Planning Team felt that addressing those hazards again in the Hazard Mitigation Plan would be redundant, and more appropriately placed within the THIRA, focusing the mitigation plan on the natural hazards of concern.
- The risk assessment was expanded to use additional methodologies and new studies to define risk and determine vulnerability. This edition is based on analysis using both GIS and Hazus (FEMA's hazard-modeling program), and focuses on determining impacts on people, property, environment, and the economy. New studies developed since the completion of the 2011 plan were reviewed for relevant data and incorporation into the plan. The planning process also enhanced structure data using the County's Assessor's data base.
- Critical infrastructure data was also reviewed and updated for the 2018 plan to include new structures within the planning area as identified throughout the process by the planning partners.
- The risk assessment has been prepared to better support future grant applications by providing risk and vulnerability information that will directly support the measurement of "cost-effectiveness" required under FEMA mitigation grant programs.
- The method of risk ranking is based on a Calculated Priority Risk Index Ranking for this edition rather than the Mitigation 20/20 as referenced in the 2011 plan. For those hazards with scientifically established probability factors, that information was incorporated into the document.
- A new Vulnerability Table was included, which addresses the social aspect of risk. The risk assessment was also broken down by planning partnership as appropriate, to include an analysis of the unincorporated areas of the County, and further by each planning partner involved. This will allow planning partners to annually review and determine accuracy of the greatest hazards of concern based on their specific impact, versus the entire planning area.
- All charts, graphs and maps have been updated with the most current data.
- All Census and Census-related data has been updated with the most current data available as referenced.
- Goals and objectives were reviewed and updated appropriately with some modifications.

- Strategies from the old edition were updated, and new strategies identified for the 2018 update. A new method of prioritizing strategies was used, including benefit cost analysis.
- A new planning partner joined this update process as identified in Chapter 2.
- A new plan maintenance strategy was developed for use with the 2018 plan.

THE PLANNING PARTNERSHIP

The planning partnership assembled for this plan was greatly expanded to include all cities and towns, and several of the special purpose districts as defined as "local governments" under the Disaster Mitigation Act. Jurisdictional annexes for those partners are included in Volume 2 of the plan. Jurisdictions not covered by this process can link to this plan at a future date by following the linkage procedures identified in Volume 2 of this plan.

PLAN DEVELOPMENT METHODOLOGY

Update of the Pend Oreille County hazard mitigation plan included seven phases:

- **Phase 1, Organize resources**——Under this phase, grant funding was secured to fund the effort, the planning partnership was formed and other stakeholders were assembled to oversee development of the plan. Also under this phase were coordination with local, state and federal agencies and a comprehensive review of existing programs that may support or enhance hazard mitigation.
- **Phase 2, Assess risk**—Risk assessment is the process of measuring the potential loss of life, personal injury, economic injury, and property damage resulting from natural hazards. This process focuses on the following parameters:
  - Identification of new hazards and updating hazard profiles
  - The impact of hazards on physical, social and economic assets
  - Vulnerability identification
  - Estimates of the cost of damage or costs that can be avoided through mitigation.

  Phase 2 occurred simultaneously with Phase 1, with the two efforts using information generated by one another.
- **Phase 3, Involve the public**—Under this phase, a public involvement strategy was developed that used multiple media sources to give the public multiple opportunities to provide comment on the plan. The strategy focused on three primary objectives:
  - Assess the public's perception of risk.
  - Assess the public's perception of vulnerability to those risks.
  - Identify mitigation strategies that will be supported by the public.
- **Phase 4, Identify goals, objectives and actions**—Under this phase, the goals and objectives were reviewed and updated, as well as a range of potential mitigation actions for each natural hazard identified. A "mitigation catalog" was used by each planning partner to guide the selection of recommended mitigation initiatives to reduce the effects of hazards on new development and existing inventory and infrastructure. A process was created under this phase for prioritizing, implementing, and administering action items based in part on a review of project benefits versus project costs.

- **Phase 5, Develop a plan maintenance strategy**—Under this phase, a strategy for long-term mitigation plan maintenance was created, with the following components:
  - A method for monitoring, evaluating, and updating the plan on a five-year cycle
  - A protocol for a progress report to be completed annually on the plan's accomplishments
  - A process for incorporating requirements of the mitigation plan into other planning mechanisms
  - Ongoing public participation in the mitigation plan maintenance process
  - "Linkage procedures" that address potential changes in the planning partnership.
- **Phase 6, Develop the plan**—The internal planning group for this effort assembled key information into a document to meet DMA requirements. The document was produced in two volumes: Volume 1 including all information that applies to the entire planning area; and Volume 2, including jurisdiction-specific information.
- **Phase 7, Implement and adopt the plan**—Once pre-adoption approval has been granted by the Washington Emergency Management Division and FEMA, the final adoption phase will begin. Each planning partner will be required to adopt the plan according to its own protocols.

MITIGATION GOALS

The 2011 goals were reviewed and modified for the 2018 update during the initial kick-off meeting. Objectives were also revised for the current update of the mitigation plan.

The goals and objectives were utilized to allow further assessment of mitigation strategies. Strategies were assessed to determine association with several general categories related not only to emergency management as a whole, but also inclusive of the Community Rating System, as follows:

- Prevention
- Public Information and Education
- Property Protection
- Emergency Services / Response
- Natural Resources
- Structural Projects
- Recovery

MITIGATION INITIATIVES

For the purposes of this document, mitigation initiatives are defined as activities designed to reduce or eliminate losses resulting from natural hazards. The mitigation initiatives are the key element of the hazard mitigation plan. It is through the implementation of these initiatives that the planning partners can strive to become disaster-resistant through sustainable hazard mitigation.

Although one of the driving influences for preparing this plan was grant funding eligibility, its purpose is more than just access to federal funding. It was important to the planning partnership to look at initiatives that will work through all phases of emergency management. Some of the initiatives outlined in this plan are not grant eligible; grant eligibility was not the primary focus of the selection. Rather, the focus was the initiatives' effectiveness in achieving the goals of the plan and whether they are within each entities' capabilities.

This planning process resulted in the identification of mitigation actions to be targeted for implementation by individual planning partners. These initiatives and their priorities can be found in Volume 2 of this plan. In addition, the planning partnership identified countywide initiatives benefiting the whole partnership that will be implemented by pooling resources based on capability. These countywide initiatives are identified in Chapter 15.

CONCLUSION

Full implementation of the recommendations of this plan will take time and resources. The measure of the plan's success will be the coordination and pooling of resources within the planning partnership. Keeping this coordination and communication intact will be the key to successful implementation of the plan. Teaming together to seek financial assistance at the state and federal level will be a priority to initiate projects that are dependent on alternative funding sources. This plan was built upon the effective leadership of a multi-disciplined Planning Team and a process that relied heavily on public input and support. The plan will succeed for the same reasons.

CHAPTER 1.
INTRODUCTION

Hazard mitigation is defined as the use of long- and short-term strategies to reduce or alleviate the loss of life, personal injury, and property damage that can result from a disaster. It involves strategies such as planning, policy changes, programs, projects, and other activities that can mitigate the impacts of hazards. The responsibility for hazard mitigation lies with many, including private property owners; business and industry; and local, state and federal government.

1.1 AUTHORITY

The federal Disaster Mitigation Act (DMA) (Public Law 106-390) required state and local governments to develop hazard mitigation plans as a condition for federal disaster grant assistance. Prior to 2000, federal disaster funding focused on disaster relief and recovery, with limited funding for hazard mitigation planning. The DMA increased the emphasis on planning for disasters before they occur. DMA 2000 amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act (the Act) by repealing the previous mitigation planning section (409) and replacing it with a new mitigation planning section (322). This new section emphasizes the need for state and local entities to closely coordinate mitigation planning and implementation efforts. To implement the DMA 2000 planning requirements, the Federal Emergency Management Agency (FEMA) published an Interim Final Rule in the Federal Register on February 26, 2002. This rule (Part 201 of Title 44 of the Code of Federal Regulations (44 CFR 201)) established the mitigation planning requirements for states and local communities. In 2010, the guidance was further enhanced and expanded, with this document incorporating all required changes.

The DMA encourages state and local authorities to work together on pre-disaster planning, and it promotes sustainability for disaster resistance. Sustainable hazard mitigation includes the sound management of natural resources and the recognition that hazards and mitigation must be understood in the largest possible social and economic context. The enhanced planning network called for by the DMA helps local governments articulate accurate needs for mitigation, resulting in faster allocation of funding and more cost-effective risk reduction projects.

The Pend Oreille County 2018 Multi-Jurisdiction Hazard Mitigation Plan Update has been developed pursuant to the requirements of 44 CFR 201.6 (Local Jurisdiction) and 44 CFR 201.7 (Tribal). The plan meets FEMA’s guidance for multi-jurisdictional mitigation planning.

1.2 ACKNOWLEDGEMENTS

Many groups and individuals have contributed to development of the Pend Oreille County 2018 Multi-Jurisdiction Hazard Mitigation Plan Update. The Pend Oreille County Department of Emergency Management provided support for all aspects of plan development. Pend Oreille County GIS also provided extensive assistance, including providing data identifying critical facilities and infrastructure. The Pend Oreille County Planning Department provided assistance with respect to existing plans and studies in place, as well as guidance and information concerning implementation of the Growth Management Act countywide, and the National Flood Insurance Program. The County’s LEPC provided information and assisted with public outreach throughout this process, serving as a primary planning partner. The planning partners met on a regular basis to guide the project, identify the hazards most threatening to the County, develop and prioritize mitigation projects, review draft deliverables, and attend public meetings.

Local communities participated in the planning process by attending public meetings and contributed to plan development by reviewing and commenting on the draft plan. Several planning partners provided assistance and guidance to support the efforts of smaller entities by providing data and information to help develop specific annex documents. Citizens' participation was exceptionally good during the plan's development, with citizens attending various public outreach sessions and providing invaluable information with respect to concerns, strategy ideas, and hazard information. Input was incorporated as appropriate throughout the document.

1.3 PURPOSE OF HAZARD MITIGATION PLANNING

This hazard mitigation plan identifies resources, information, and strategies for reducing risk from natural hazards. Elements and strategies in the plan were selected because they meet a program requirement and because they best meet the needs of the planning partners and their citizens. One of the benefits of multi-jurisdictional planning is the ability to pool resources and eliminate redundant activities within a planning area that has uniform risk exposure and vulnerabilities. FEMA encourages multi-jurisdictional planning under its guidance for the DMA. The plan will help guide and coordinate mitigation activities throughout Pend Oreille County. It was developed to meet the following objectives:

- Meet or exceed requirements of the DMA.
- Enable all planning partners to continue using federal grant funding to reduce risk through mitigation.
- Meet the needs of each planning partner as well as state and federal requirements.
- Create a risk assessment that focuses on Pend Oreille County hazards of concern.
- Create a single planning document that integrates all planning partners into a framework that supports partnerships within the county and puts all partners on the same planning cycle for future updates.
- Coordinate existing plans and programs so that high-priority initiatives and projects to mitigate possible disaster impacts are funded and implemented.

All citizens and businesses of Pend Oreille County are the ultimate beneficiaries of this hazard mitigation plan. The plan reduces risk for those who live in, work in, and visit the county. It provides a viable planning framework for all foreseeable natural hazards that may impact the county. Participation in development of the plan by key stakeholders in the county helped ensure that outcomes will be mutually beneficial. The resources and background information in the plan are applicable countywide, and the plan's goals and recommendations can lay groundwork for the development and implementation of local mitigation activities and partnerships.

Planning efforts such as the Hazard Mitigation Plan also integrate into other planning efforts, which provide even greater benefits to the planning community and its citizens. Four such efforts which further benefit from a Hazard Mitigation Plan is the National Flood Insurance Program (NFIP), the Community Rating System (CRS), Washington State's Flood Control Assistance Account Program (FCAAP), and the Community Wildfire Protection Plan (CWPP), among others.

1.3.1 National Flood Insurance Program

The National Flood Insurance Program (NFIP) is a federal program enabling property owners in participating communities to purchase insurance as a protection against flood losses in exchange for state and community floodplain management regulations that reduce future flood damage. The U.S. Congress established the NFIP with the passage of the National Flood Insurance Act of 1968 (FEMA's 2002 *National*

Flood Insurance Program (NFIP): Program Description). There are three components to the NFIP: flood insurance, floodplain management, and flood hazard mapping. Nearly 20,000 communities across the U.S. and its territories participate in the NFIP by adopting and enforcing floodplain management ordinances to reduce future flood damage. In exchange, the NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in these communities. Community participation in the NFIP is voluntary; however, in order to be a part of the NFIP, participants must regulate development in floodplain areas in accordance with NFIP criteria. More detail on the NFIP is provided within the flood hazard profile (Chapter 8). A part of the NFIP is the ability to administer a floodplain management program, regulated by the Community Rating System, which is an incentive program helping to reduce the flood insurance premiums.

1.3.2 CRS Steps for Comprehensive Floodplain Management

Throughout this Plan, activities that could count toward the Community Rating System (CRS) are included. As indicated, the CRS is a voluntary incentive program that recognizes and encourages community floodplain activities that exceed the minimum NFIP requirements. As a result, flood insurance premiums are discounted to reflect the reduced flood risk resulting from community actions that meet the three (3) goals of the CRS: (1) reduce flood losses; (2) facilitate accurate insurance rating; and (3) promote education and awareness of flood insurance.

For participating communities, flood insurance premium rates are discounted in increments of 5 percent. For example, a Class 1 community would receive a 45 percent premium discount, and a Class 9 community would receive a 5 percent discount. (Class 10 communities are those that do not participate in the CRS; they receive no discount.) A minimum of 500 points are necessary to enter the CRS program and receive a 5% flood insurance premium discount. This HMP could contribute points toward participation in the CRS.

Savings in flood insurance premiums are proportional to the points assigned to various activities. The CRS classes (1-10) for local communities are based on 18 creditable activities in the following categories:

- Public information
- Mapping and regulations
- Flood damage reduction
- Flood preparedness.

The CRS program credits NFIP communities a maximum of 100 points for organizing a planning committee composed of staff from various departments; involving the public in the planning process; and coordinating among other agencies and departments to resolve common problems relating to flooding and other known natural hazards. The County's planning team incorporates a wide variety of planning partners which serve a role in the review and application of floodplain management.

Developing a comprehensive floodplain management plan is also among the activities that earn CRS credits toward reduced flood insurance rates. To earn CRS credit for a floodplain management plan, the community's process for developing the plan is very similar to that of developing a Hazard Mitigation Plan. The floodplain management plan must include at least one item from each of the 10 steps.

- Planning process steps:
  - ✓ Step 1 – Organize
  - ✓ Step 2 – Involve the public
  - ✓ Step 3 – Coordinate

- Risk assessment steps:
  - ✓ Step 4 – Assess the hazard
  - ✓ Step 5 – Assess the problem

- Mitigation strategy steps:
  - ✓ Step 6 – Set goals
  - ✓ Step 7 – Review possible activities which reduce the flood risk (mitigation strategies)
  - ✓ Step 8 – Draft an action plan

- Plan Maintenance Steps:
  - ✓ Step 9 – Adopt the plan
  - ✓ Step 10 – Implement, evaluate and revise the plan content as needed.

CRS activities can help to save lives and reduce property damage. Communities participating in the CRS represent a significant portion of the nation's flood risk, with over 66 percent of the NFIP's policy base is located in these communities. Communities receiving premium discounts through the CRS range from small to large and represent a broad mixture of flood risks, including both coastal and riverine flood risks.

At the time of this planning effort, only the City of Westport is a participating CRS community, recognized as a Class 8. Other planning partners may be moving forward during the life cycle of this plan to gain CRS points. As such, each annex profile may have additional data to support those efforts to gain CRS points.

1.3.3 FCAAP Requirements for Comprehensive Flood Control Management Plan

Washington has had a legislatively-established flood control maintenance program for more than 50 years. In 1984, the state Legislature established the Flood Control Assistance Account Program to help local jurisdictions in comprehensive planning and flood control maintenance efforts. This is one of very few state programs in the country that provides grant funding to local governments for flood plain management planning and implementation actions. The account historically has been funded at $4 million per state biennium, unless modified by the state Legislature. Projects include planning, maintenance projects, feasibility studies, match for federal projects, and emergency projects. Eligibility for Washington's FCAAP funding for flood projects requires that the requesting jurisdiction complete a comprehensive flood control management plan. The plan must include six components, as summarized below.

- Determination of the need for flood control work;
- Alternative flood control work;
- Identification and consideration of potential impacts of in-stream flood control work on the in-stream uses and resources;
- Coverage, at a minimum, of the area of the 100-year floodplain within a reach of the watershed of sufficient length to ensure that a comprehensive evaluation can be made of the flood problems for a specific reach of the watershed, as well as flood hazard areas not subject to riverine flooding (e.g., coastal flooding, flash flooding, or flooding from inadequate drainage);
- Conclusion and proposed solutions;
- Certification from Washington State Emergency Management that the local emergency management organization is administering an acceptable comprehensive emergency operations plan.
- Additional information on the FCAAP program is available at the following link: https://www.ecology.wa.gov/About-us/How-we-operate/Grants-loans/Find-a-grant-or-loan/Flood-control-assistance.

1.3.4 Community Wildfire Protection Plan

In response to several significant fires occurring throughout the United States from 1995 to 2000, Congress implemented the National Fire Plan—now called the National Cohesive Wildland Fire Management Strategy (Cohesive Strategy)—to seek national solutions for wildfire management. To participate, a community must identify its WUIs and then develop strategies to reduce their impact. This often includes development of a Community Wildfire Protection Plan (CWPP). Many communities also elect to become a Firewise Community (discussed in Chapter 13).

For this current update, the Wildfire profile was enhanced to meet the requirements of a CWPP. As such, the Pend Oreille County Hazard Mitigation Plan now also serves as the County's 2018 Update to its Community Wildfire Protection Plan as all elements of the CWPP are incorporated into the HMP. Adoption by the various Planning Team Members constitutes adoption of this document as their respective CWPP.

1.3.5 Plan Integration into Other Planning Efforts

During meetings and conversations, the integration of planning efforts was extensively discussed to ensure a full understanding of the benefits derived from the development of an HMP, and how that data can be integrated into other on-going planning efforts, as well as how the data from other plans supports the HMP process beyond those identified above. Capital Improvement Plans which identify potential structures for development or revitalization would be supported by data contained in the mitigation plan to determine areas of risk, and identify potential structural mitigation efforts which would structurally enhance facilities to be more resilient and better sustain the impacts from the hazards of concern. Some examples such as elevating HVAC systems, retrofitting structures for higher snow- or wind-load capacities, or pre-wiring facilities for generators were identified as potential projects. Discussions further included the integration of HMP data into future capital improvement or facilities planning, land use regulations, building design, safety plans, evacuation plans, comprehensive land use plans, etc.

Concern was raised by several of the jurisdictions as many are very, very small in nature both in population size, and staff (populations under 200, with a staff of 1.5 FTEs, plus councils). Many jurisdictions rely on the County to provide land use planning, building codes, inspections, and zoning regulations, among others.

Several of the communities felt they may qualify as small impoverished communities, but are unsure whether they meet the necessary criteria for such funding, and do not have the resources to make such determination. Many planning partners referenced the fact that without the assistance from the County and in some cases the Kalispel Tribe, they would not be able to make repairs or maintain much of its infrastructure in place, or even respond to incidents as they occur, such as the most recent flood in the town of Cusick, for which the town received assistance from both the Kalispel Tribe and the County.

Others, such as the Town of Metaline, seek out assistance from agencies such as USACE in their attempt to obtain backing for water and sewer upgrades, as their budgets cannot afford to make those upgrades (this strategy was identified in Metaline's Annex).

All of the planning partners understand how the relevant data from the HMP can be utilized in other planning efforts, while also supporting potential future grants. Those that are currently in the process of updating plans (City of Newport and Town of Ione) have already begun utilizing the data in their efforts to update their Comprehensive Land Use Plans, as well as other planning efforts. Other planning partners will utilize the data as plan updates occur during their normal cycle for updates, as they do not have the staff nor funding to devote otherwise. The capabilities assessment in Chapter 15 identifies different areas which the HMP data can support, which include not only planning, but also programmatic and policy development, as well as response and recovery efforts to ensure life safety and protection of assets and resources.

1.4 PLAN ADOPTION

44 CFR 201.6(c)(5) and 44 CFR 201.7(c)(5) requires documentation that a hazard mitigation plan has been formally adopted by the governing body of the jurisdiction requesting federal approval of the plan. For multi-jurisdictional plans, each jurisdiction requesting approval must document that is has been formally adopted. This plan will be submitted for a pre-adoption review to the Washington State Division of Emergency Management and FEMA prior to adoption. Once pre-adoption approval has been provided, all planning partners will formally adopt the plan. All partners understand that DMA compliance and its benefits cannot be achieved until the plan is adopted. Copies of the resolutions adopting the plan as well as the FEMA approval letter can be found in Appendix C of this volume.

1.5 SCOPE AND PLAN ORGANIZATION

The process followed to update the Pend Oreille County 2018 Multi-Jurisdiction Hazard Mitigation Plan included the following:

- Review and prioritize disaster events that are most probable and destructive. For planning purposes, this plan covers those incidents and information which have occurred since the previous plan was developed (2010), through December 31, 2017. Future updates shall begin assimilation of data beginning January 1, 2018.
- Update and identify new critical facilities.
- Review and update areas within the community that are most vulnerable.
- Update and identify new goals for reducing the effects of a disaster event.
- Review and identify new projects to be implemented for each goal.
- Review and identify new procedures for monitoring progress and updating the hazard mitigation plan.
- Review the draft hazard mitigation plan.
- Adopt the updated hazard mitigation plan.

This plan has been set up in two volumes so that elements that are jurisdiction-specific can easily be distinguished from those that apply to the whole planning area:

- Volume 1 includes all federally required elements of a disaster mitigation plan that apply to the entire planning area. This includes the description of the planning process, public involvement strategy, goals and objectives, countywide hazard risk assessment, countywide mitigation initiatives, and a plan maintenance strategy.
- Volume 2 includes all federally required jurisdiction-specific elements, assimilated into specific annexes for each participating jurisdiction. Volume 2 also includes a description of the participation requirements for planning partners. Volume 2 also includes "linkage" procedures for eligible jurisdictions that did not participate in development of this plan but wish to adopt it in the future, as well as contact information to obtain the annex template and instructions.

All planning partners will adopt Volume 1 and the associated appendices in their entirety, as well as each partner's jurisdiction-specific annex contained in Volume 2.

The following appendices provided at the end of Volume 1 include information or explanations to support the main content of the plan:

- Appendix A—A glossary of acronyms and definitions
- Appendix B—Public outreach information, including the hazard mitigation questionnaire/ survey and summary and documentation of public meetings
- Appendix C—Plan adoption resolutions from planning partners
- Appendix D—A template for progress reports to be completed as this plan is implemented.

CHAPTER 2.
PLANNING PROCESS

2.1 PRIMARY PLANNING OBJECTIVES

The primary project objectives utilized to develop the Pend Oreille County Hazard Mitigation Plan included the following:

- Secure grant funding;
- Form an internal planning group;
- Establish a planning partnership;
- Coordinate with individual and agency stakeholders;
- Review existing plans and studies;
- Engage the public:
  - Conduct a hazard survey;
  - Hold public meetings;
  - Review the draft hazard mitigation plan.

These objectives are discussed in the following sections.

2.2 SECURE GRANT FUNDING

This planning effort was supplemented by a Hazard Disaster Mitigation Grant Program (HMGP) grant from FEMA. Pend Oreille County was the applicant agent for the grant. The grant was applied for originally in 2014, and funding was appropriated in 2016. It covered 75 percent of the cost for development of this plan; the County and its planning partners covered 12.5 percent of the cost through in-kind contributions, and the state of Washington provided the balance.

2.3 INTERNAL PLANNING GROUP FORMATION

Through an open solicitation process, Pend Oreille County hired Bridgeview Consulting, LLC to assist with development and implementation of the plan. The Bridgeview Consulting project manager assumed the role of the lead planner, reporting directly to a County-designated project manager. An internal planning group was formed to lead the planning effort, made up of the following members:

Pend Oreille County Hazards Mitigation Plan Work Group

JoAnn Boggs	Deputy Director, HMP Project Manager, Department of Emergency Management
Steve West	Communications /E911 Coordinator
Josh Shelton	Pend Oreille County GIS Manager/Interim ITS Director
Cesar Stoddard	Pend Oreille County GIS

Beverly O'Dea	Bridgeview Consulting, LLC Project Manager Lead Planner
Cathy Walker Ed Whitford	Bridgeview Consulting, LLC Risk Analysts

2.4 PLANNING PARTNERSHIP

Pend Oreille County opened this planning effort to those eligible entities within the county which expressed an interest in participating in the planning process, including all cities, towns and special purpose districts. Emergency Management personnel made presentations at various meetings and conducted one-on-one meetings with potential planning partners to solicit letters of intent to participate to support the County's grant application. Each jurisdiction wishing to join the planning partnership was asked to provide an executed Letter of Intent to Participate. That letter designated a point of contact for the jurisdiction and confirmed the jurisdiction's commitment to the process and understanding of expectations. Table 2-1 summarizes the received Letters of Intent to participate by the planning partners, as well as the level of participation and involvement throughout the planning process.

Table 2-1- Hazard Mitigation Planning Partners and Level of Participation

County, City, Town or Entity Represented	Primary Point of Contact	Alternate Point(s) of Contact	Date of Previous Plan	Letter of Participation	Kick-Off Meeting	Participated in Planning Meetings	Conducted Public Outreach	Completed Annex Template	Draft Plan Review	Final Plan Review	Adoption Month
County	Commissioner Mike Manus	Commissioner Karen Skoog	2011		X	X			X	X	
County	JoAnn Boggs, Deputy Director Emergency Mgmt.; Chair, Planning Team	Steve West, PO County Communications / E911 Coordinator	2011		X	X	X	X	X	X	
County	Sheriff Alan Botzheim				X		X		X	X	
County	Greg Snow Community Development Director Andy Huddleston, Floodplain Manager	Don Ramsey, PE;							X	X	
County	Josh Shelton, GIS Manager	Cesar Stoddard, GIS			X	X	X		X	X	
County	Brian Egland, Public Works	Teresa Deal, Public Works			X	X			X		
Tribal											
Kalispel Tribe of Indians	Ray Entz	Chief Corrie Johnson	NA	X	X	X	X	X	X	X	

County, City, Town or Entity Represented	Primary Point of Contact	Alternate Point(s) of Contact	Date of Previous Plan	Letter of Participation	Kick-Off Meeting	Participated in Planning Meetings	Conducted Public Outreach	Completed Annex Template	Draft Plan Review	Final Plan Review	Adoption Month
Towns of											
Cusick	Jennifer Lee	Chris Evers, Mayor	2011	X	X	X	X	X	X	X	
Ione	Ken Timmreck		2011	X	X	X	X	X			
Metaline	Mayor Pete Daggett	E. Diane Brown	2011	X	X		X	X	X	X	
Metaline Falls	Mayor Tara Leininger		2011	X							
City											
Newport	Nickole North, Clerk/Treasurer Councilmember Nancy Thompson	Keith Campbell, Mayor Pro-Tem Russ Pelleberg, City Administrator	2011	X	X	X	X	X	X		
Fire											
Fire District No. 2	Chief Robyn Turcotte		2011	X	X	X	X				
Fire District No. 4	Chief Nick Knaack		2011	X	X		X				
Fire District No. 5	Chief Jay Foster	(will add on via linkage)	2011	X	X						
Fire District No. 6	Chief Mark Ford (initial)	Chief Mike Nokes (finalized process)	2011	X	X	X	X	X	X	X	
Fire District No. 8	Chief Larry Hiebert		2011	X	X						
South Pend Oreille Fire & Rescue	Chief Mike Nokes		2011	X	X	X	X	X	X	X	
Hospital Districts / Hospitals											
Health District #1 – Newport Hospital and Health Services	Christina Wagar	Tom Wilbur	2011	X		X	X	X	X	X	
Public Utility Districts											
Pend Oreille County Public Utility	Paul Kiss Autumn Rice	Cecil Taylor	2011	X	X	X	X	X	X	X	
Port Districts											
Port of Pend Oreille	Kelly Driver		2011	X	X	X	X	X	X	X	
School Districts											
Cusick	Paul Haas	Don Hawpe	2011	X	X	X	X	X	X	X	
Newport	Scott Armstrong	Troy Whittle	2011	X		X	X	X	X	X	
Selkirk	Greg Goodnight	Nancy Lotze	2011	X	X	X					
Consultants and Planning Team Facilitator											
Bridgeview Consulting, LLC – Beverly O'Dea, Project Manager											
David O'Dea, Lead Strategic Analyst and Public Facilitator											

For those jurisdictions invited but who could not participate, linkage procedures have been established (see Volume 2 of this plan) for any jurisdiction wishing to join the Pend Oreille County plan in the future. The linkage procedures were revised from the previous plan for the 2018 update.

Responsibilities of the planning partners included participating in mandatory planning workshops and conference calls to discuss plan development; providing data for analysis in the risk assessment; attending public meetings; providing input and feedback on mitigation strategies; developing an annex document; reviewing the draft plan document, and supporting the plan throughout the adoption process.

The initial kickoff planning workshop took place on March 20, 2018. Key workshop objectives were as follows:

- Provide an overview of the Disaster Mitigation Act.
- Describe the reasons for a plan.
- Outline the County work plan.
- Outline and adopt planning partner expectations necessary to establish a jurisdictional annex to the County's Plan.
- Confirm hazards of concern.
- Review and update, as appropriate, the Goals and Objectives.
- Establish the Planning Partnership's definition of Critical Facilities.
- Establish a Public Outreach Strategy for use during this update cycle.
- Discuss strategy development.
- Discuss integration of planning efforts.

During the initial workshop, the planning partners also established meeting guidelines which applied to all meetings. In addition, the planning partnership also elected a chairperson to act as spokesperson for the planning effort; identified a minimum attendance by Planning Team members to gain an active level of participation; established the decision-making method (quorum or majority rules by attendance); identified the concept of alternative representatives for Planning Team members unable to attend, and identified the method in which the public would address the Planning Team during meetings. Specific guidelines concerning public comments followed the same public meeting regulations as utilized by the Pend Oreille County Board of Commissioners. During the initial workshop meeting, JoAnn Boggs was elected Chairperson of the Planning Team, and the team determined that decisions would be made based on the majority of members in attendance.

Agenda and/or materials discussed during meetings (i.e. example mitigation strategies, examples of projects eligible for FEMA funding, etc.) were sent to meeting participants. All members issuing Letters Intent were engaged as a planning partner throughout this process.

2.5 COORDINATION WITH AGENCIES AND OTHER STAKEHOLDERS

Hazard mitigation planning enhances collaboration and support among diverse parties whose interests can be affected by hazard losses. 44 CFR requires that opportunities for involvement in the planning process be provided to neighboring communities, local and regional agencies involved in hazard mitigation, agencies with authority to regulate development, businesses, academia, and other private and nonprofit interests (Section 201(6)(b)(2)). Stakeholders were identified and invited to participate in this effort:

- County stakeholders included County Commissioners, Mayors, Public Administrators, emergency managers, the floodplain coordinator, Planning/Building Director, Community Development Director, the GIS Department, the Health Department, and the Sheriff's Office. Their participation included providing data, attending public meetings, and reviewing the draft hazard mitigation plan.
- The Pend Oreille County Wildfire Workgroup Group were utilized to discuss and identify wildfire specific data, information and outreach. Likewise, during the springtime flooding events, public meetings which related to the flood hazard were also utilized to obtain and disseminate information to stakeholders and citizens.
- Stakeholders from throughout the County were invited. Invitations were distributed to members of various other county departments, police and fire chiefs, representatives from the local PUDs, hospital, and port districts, Red Cross, LEPCs, and others. Their participation included providing data, attending public meetings, and reviewing the draft hazard mitigation plan.
- Washington State stakeholders and information included various representatives from the Department of Natural Resources, Department of Ecology, and Department of Transportation, the State Hazard Mitigation Officer, and the Hazard Mitigation Grant Program Officer. Their participation included providing data, attending meetings, and reviewing the draft hazard mitigation plan.
- Federal agency stakeholders and information included the FEMA Region X, National Weather Service (NWS), U.S. Army Corps of Engineers, U.S. Geologic Survey, Federal Energy Regulatory Commission (FERC), U.S. Forest Service, and U.S. Fish and Wildlife Service, among others. These agencies provided information on plan development, attended public meetings, and were invited to review the draft hazard mitigation plan.
- Non-government stakeholders included the American Red Cross, Chamber of Commerce, and local private industries, among others.

The County's internal email distribution list was utilized, which reaches in excess of 160 individuals from various departments, agencies, and organizations. The PUD also utilized their Facebook account, reaching over 1,400 citizens, as well as utilizing their Public Relations personnel to assist in distributing information concerning the on-going Hazard Mitigation Planning and CWPP update process. Many of the planning partners utilized their websites to also provide information, attended public meetings, and/or reviewed the draft hazard mitigation plan update.

Stakeholders received a variety of information during the project, including meeting notices, documents for review, and the draft mitigation strategy. Stakeholders also provided input on the plan, particularly for the risk assessment.

Table 2-2- Hazard Mitigation Stakeholders and Areas of Participation

Stakeholders			Data and Information Provided
FEMA Region X	Kelly Stone		Email communications (until February until departure for new position)
WA EMD	Derrick Hiebert		Various communications throughout process
WA EMD	Tim Cook	Todd Kilpatrick	RFC/SRL data; grant management tracking
WA DNR	Tim Walsh		Landslide and earthquake information and data
WA DOE	Jerry Franklin		Flood data, SRL and CRS data and information

Stakeholders			Data and Information Provided
WA DOE	Dave Byers		Reporting Hazmat sites in county
FERC			Hydro project data with respect to licensing and public outreach concerning dam safety and citizen notifications.
Northeast Tri County Health District	Matt Schanz	Karen Paugh	Meeting attendance and information on various hazards of concern related to health, water, environmental impact and data.
Seattle City Light	Brad Larson		Dam data, critical facilities information
Pend Oreille Conservation District	David Marcell		Meeting attendance and information on wildfire concern, including existing mitigation strategies completed by the District, and upcoming efforts to support development of the CWPP.

2.6 REVIEW OF PLANS AND STUDIES

44 CFR states that hazard mitigation planning must include review and incorporation as appropriate of existing plans, studies, reports and technical information (Section 201.6.b(3)). Laws and ordinances in effect in the planning area that can affect hazard mitigation initiatives are reviewed in Chapter 16. The list of references at the end of this volume presents sources used to capture information necessary to complete this planning effort. In addition to data referenced as footnotes, additional plans, studies, and reports used for this process include, but are not limited to:

- Pend Oreille County Hazard Mitigation Plan (2011)
- Pend Oreille County Community Wildfire Protect Plan (2011)
- Pend Oreille County Comprehensive Emergency Management Plan (CEMP)
- Pend Oreille County Comprehensive Land Use Management Plan (2005, 2015)
- Flood Insurance Study and Flood Maps (2002)
- Pend Oreille County Critical Areas Protection Ordinance (2012)[1]
- Pend Oreille County Development Regulations (2015)
- Water Resources Inventory Area (WRIA) 62: Pend Oreille Watershed Fact Sheet (2012)[2]
- Washington State Enhanced Hazard Mitigation Plan (2010 and 2013)
- State of Idaho Hazard Mitigation Plan (2013)
- Washington Department of Natural Resources (WDNR) Landslide Report
- Climate change data – various reports and information
- Washington State Department of Ecology Drought Studies/Data (2015, 2016)
- Washington Department of Ecology Hazardous Materials 2017 Annual Report
- Pend Oreille County Comprehensive Emergency Management Plan (2017)

[1] Pend Oreille County Critical Areas Protection Ordinance https://pendoreilleco.org/wp-content/uploads/2015/08/Local-Adoption-Ordinance2012-3.pdf
[2] https://fortress.wa.gov/ecy/publications/documents/1111066.pdf

- Washington State Department of Natural Resources Annual Report (various years)
- Application for Surrender of License – Sullivan Creek Project (FERC No. 2225)

Data obtained from the plan and regulation review was incorporated into various sections of the hazard mitigation plan. The risk assessment in Chapter 5 through Chapter 13 refer to plans and ordinances that affect the management of each hazard. Section 17.2 describes how mitigation can be implemented through existing programs. An assessment of all planning partners' regulatory, technical, and financial capabilities to implement hazard mitigation initiatives is presented in the jurisdiction-specific annexes in Volume 2 and in Chapter 16. Many of these relevant plans, studies and regulations are cited in the capability assessment.

2.7 PUBLIC INVOLVEMENT

Broad public participation in the planning process helps ensure that diverse points of view about the planning area's needs are considered and addressed. The public must have opportunities to comment on disaster mitigation plans during the drafting stages and prior to plan approval (44 CFR Sections 201.6- and 201.7-(b); 201.6- and 201.7-(c)(1)(i); 201.6- and 201.7-(c)(1)(ii)).

The County and its planning partners did extensive outreach and used different methods to increase involvement, such as pairing meetings with existing council and commission meetings, holding web-based meetings, and scheduling conference calls that allowed participation by agencies and individuals. Data and fact-finding discussions with individuals and specialists from outside organizations identified common concerns related to natural and manmade hazards, and key long- and short-term activities to reduce risk. These contacts included public safety personnel, planning department personnel, natural resources personnel, cultural resource personnel, and representatives from other government agencies from surrounding jurisdictions. The public outreach strategy for involving the public in this plan emphasized the following elements:

- Include members of the public on the Planning Team.
- Use a questionnaire to determine general perceptions of risk and support for hazard mitigation and to solicit direction on alternatives. The questionnaire was available to anyone wishing to respond via the website and was distributed by hard copy for those without computer access (hard-copy results were entered by the consultant). The County published a news release in local papers, and identified the survey on the hazard mitigation website. Several Planning Team Members throughout the County also posted the link to the survey on their various Facebook and Twitter accounts.
- Attempt to reach as many citizens as possible using multiple formats. This is important because of the somewhat geographically remote areas in the county.
- Identify and involve planning area stakeholders.
- Provide newsletter articles about mitigation efforts such as the FEMA flood maps, etc.

Other Public Outreach Efforts	
Effort	**Description**
Manned booth	Provided materials of the HMP/CWPP Update process, including hazard identification, planning process, involved partnerships, and provided disaster information. Sought input on the plan development, and how to get involved in the planning update process.
Newspaper	An article was published to make citizens in the county aware of the hazard mitigation plan update process, and invited participation and attendance at

Other Public Outreach Efforts	
Effort	**Description**
	upcoming meetings. Announcement of the draft plan was also made via the local newspaper.
Developed Hazard Mitigation/CWPP Website	Provided information on the plan update process and location of documents, meeting locations, agenda and minutes, risk assessment, risk ranking process, hazard maps, and final plan availability.
Weekly broadcasts	Provided information on the mitigation planning process; announced availability of survey; provided information on the hazards of concern, including public outreach efforts.
Social Media Outreach	Utilized social media accounts to distribute information to existing followers, reaching over 1,400 individuals.
Survey	A public survey was posted on the County's website inviting the public to comment on how prepared both the county and individuals are for a possible natural disaster, including insurance information and repetitive losses resulting from disaster incidents.

2.7.1 Planning Team Input

Most members of the Planning Team live or work in the planning area. Planning team participation by individuals with varied backgrounds and from varied organizations added details and information that were valuable in identifying direction for the plan development process.

The County utilized its Emergency Management webpage, which hosted a mitigation section, wherein all notices and survey links were posted. Figure 2-1 shows a sample from the webpage. Several of the Planning Team members also posted links to the County's website as well, to ensure consistent, accurate information was provided. During meetings within the planning area or attended elsewhere by Planning Team members, individuals were directed to the website to gain better insight of the County's endeavors and to solicit input. The Planning Team identified stakeholders to target through the public involvement strategy. Members of the Planning Team attending conferences or meetings provided updates to those in attendance, asking for input and review of the plan. Some of the outreach sessions are identified in Table 2-3. This list is not all-inclusive, but rather demonstrative of the various efforts of the Planning Team. Planning Team Members also utilized existing social media outlets as well to distribute information.

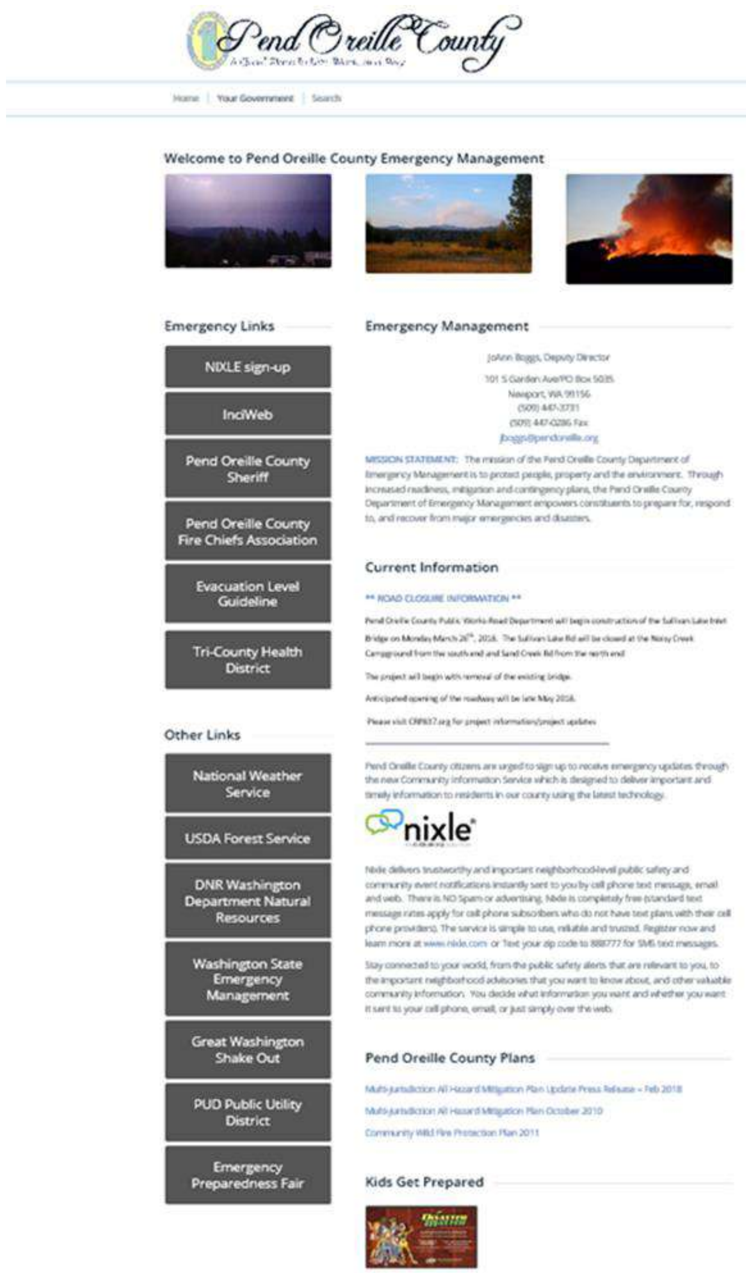


Figure 2-1 Pend Oreille County Web Page

2.7.2 Hazard Questionnaire and Citizen Comments

A hazard mitigation plan questionnaire developed by the Planning Team was used to gauge household preparedness for natural hazards and the level of knowledge of tools and techniques for reducing risk and loss from natural hazards. This questionnaire was designed to help identify areas vulnerable to one or more natural hazards. The answers to its questions helped guide the planning partners in selecting goals, objectives and mitigation strategies. Hard copies were disseminated throughout the planning area, and a web-based version was made available on the hazard mitigation plan website which was distributed and announced during meetings, during public outreach sessions, and announced through twitter and email distributions countywide. During meetings, citizens were queried many similar questions as those posed in the on-line questionnaire.

Over 100 on-line questionnaires were completed. Appendix B presents the questionnaire and a summary of its findings. The Survey also provided an opportunity for citizens to provide comments during the entire process, from the initial drafting stages when the survey was deployed, until the draft plan was available for review.

Comments received during public outreach and from the survey, which were relevant to the planning process and provided applicable information to the various sections of the plan were incorporated as appropriate. The following are some general comments received:

- Review of the hazards of greatest concern very closely mirrors that as identified by the risk assessment completed through this process, with wildfire being the hazard of greatest concern, followed by severe weather, and flood. Landslides were identified not for property destruction, but more in line with impact to transportation routes.
- Hazardous materials were also identified with citizen comments indicating concern over hazmat transportation, especially in light of a potential new smelter facility in the County.
- A failure to the Usk Bridge, which is identified as a critical facility in this planning process, was also referenced by a citizen as a matter of concern due to the bridge as a major tributary for the County.
- The Cusick Bridge was also identified as a critical facility in need of update, replacement or significance enhancement as this bridge, too, is a major tributary for the County.
- Lack of cell coverage in parts of the county was also identified as an issue. Citizens felt that the lack of cell phone coverage, especially during a time of power outages when landlines did not work, severely hampered any response requests regarding calls for services.

All of these items raised as concerns by citizens have been addressed by the County and its planning partners, with strategies identified for improvement for each.

Survey responses from the on-line survey indicate a close match between respondents' hazards of greatest concern and hazards identified through the Planning Team's risk ranking.

- Review of the hazards of greatest concern very closely mirrors that as identified by the risk assessment completed through this process, with wildfire being the hazard of greatest concern (3.85 weighted factor), followed by severe weather (2.98 weighted factor), and flood (2.83 weighted factor). Hazardous materials (not profiled separately) were also identified (2.47 weighted factor) as a hazard of concern.

Additional points of interest and comments from the survey results include:

- The majority of respondents resided in the unincorporated area of the county, the City of Newport, and the Kalispel Reservation.

- 77 percent of respondents have experienced a severe weather disaster/event. Severe weather events are the primary type of declared disasters that have impacted the County in the last 20 years.

- Approximately 50 percent of residents had experienced impact from wildfire. The wildfire hazard was the hazard of greatest concern for the majority of the planning partners.

- 41 percent of residents had experienced impact from a flood incident.

- Of those individuals responding, one individual indicated that they or a family member was injured as a result of the disaster incident. 75 percent indicated that the disaster incident they experienced occurred while living within Pend Oreille County. Approximately 11 percent indicated that the disaster event impacted their ability to utilize their residence, while 15 percent indicate their ability to work was impacted. Comments indicate that road closures due to slides and downed trees made travel difficult. One individual indicated that phone systems have failed at their place of business.

- With respect to insurance coverage, 15 percent indicate that they sustained a financial loss as a result of a hazard incident, with 9 percent indicating they had no type of insurance to assist in recovery of those losses; however, 26 percent of respondents indicate that they have hazard-specific insurance, either flood, landslide, earthquake or wildfire. 89 percent of respondents owned their residence.

- 61 percent of respondents indicate that they are somewhat prepared to be self-sustaining after a disaster incident, with 25 percent adequately prepared and only 4 percent well prepared.

- 51 percent of respondents have prepared a fire escape plan, with 6 percent being involved in FireWise meetings, and 10 percent planting fire resistant landscaping to help reduce wildfire risk. For the fire districts, this is demonstrative of their level of outreach to their local communities, and their participation in developing the CWPP component of this planning effort.

- 51 percent of respondents have stored water and food, with a full 68 percent having stored medical supplies, including medications.

- Three-quarters of the respondents feel that the internet/social media are the best sources to gain information on the hazards of concern and incident information as it evolves, followed by TV news. 35 percent indicate that information exchange through the local fire departments is also a favored means of information exchange. Comments include specific reference to Nixle Alerts being effective, as well as Facebook.

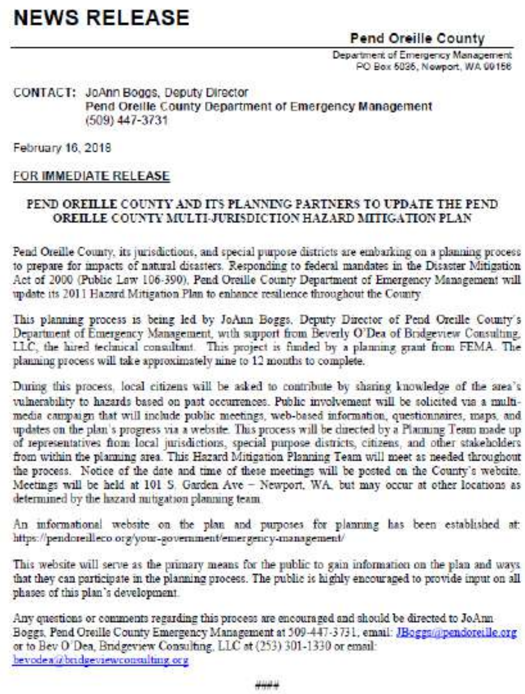
- 24 percent of respondents indicated that Kalispel Tribal meetings are significant in gathering information, referenced by almost 100% of respondents.

- Review of hazard-specific data indicate that for the flood and landslide hazards, citizens in the county are well-informed with respect to the geographic areas of impact; however, when queried about whether their community is a FireWise Community, 72 percent were unsure, and 71 percent indicate that they do not actively participate in FireWise activities in the communities, leaving these an area for potential outreach as the FireWise program continues to grow in the County.

Social vulnerability of a community is based on various factors discussed in detail in Chapters 3 and 14. Those factors include age, race, sex, income (several elements), education, etc.. Of those factors, review of the data from this survey can help identify potential increased vulnerability to the County. Of those individuals responding, the age bracket fell between 51-60 years of age, with 73 percent being female respondents. 68 percent of those individuals had some degree of college, with an additional 12 percent having graduate degrees. Every responding party had a high school or higher degree. 40 percent of respondents had lived in Pend Oreille County for more than 20 years, with an additional 16 percent living in the County within the 11-20 year range. The County appears to be at a higher capacity with lower social vulnerability than when compared to other counties in the state.

2.7.3 News Releases

At the onset of this project, the County published a news release concerning the hazard mitigation plan update, including an invitation to the general public to learn about emergency management as a whole, including presentation of risk data and hazard maps (see Figure 2-2). When the draft plan was available for public review, a press release was again drafted and distributed via the County's media distribution list announcing its availability in an effort to draw in as many comments as possible.



NEWS RELEASE

Pend Oreille County
Department of Emergency Management
PO Box 5036, Newport, WA 99156

CONTACT: JoAnn Boggs, Deputy Director
Pend Oreille County Department of Emergency Management
(509) 447-3731

February 16, 2018

FOR IMMEDIATE RELEASE

PEND OREILLE COUNTY AND ITS PLANNING PARTNERS TO UPDATE THE PEND OREILLE COUNTY MULTI-JURISDICTION HAZARD MITIGATION PLAN

Pend Oreille County, its jurisdictions, and special purpose districts are embarking on a planning process to prepare for impacts of natural disasters. Responding to federal mandates in the Disaster Mitigation Act of 2000 (Public Law 106-390), Pend Oreille County Department of Emergency Management will update its 2011 Hazard Mitigation Plan to enhance resilience throughout the County.

This planning process is being led by JoAnn Boggs, Deputy Director of Pend Oreille County's Department of Emergency Management, with support from Beverly O'Dea of Bridgeview Consulting, LLC, the hired technical consultant. This project is funded by a planning grant from FEMA. The planning process will take approximately nine to 12 months to complete.

During this process, local citizens will be asked to contribute by sharing knowledge of the area's vulnerability to hazards based on past occurrences. Public involvement will be solicited via a multi-media campaign that will include public meetings, web-based information, questionnaires, maps, and updates on the plan's progress via a website. This process will be directed by a Planning Team made up of representatives from local jurisdictions, special purpose districts, citizens, and other stakeholders from within the planning area. This Hazard Mitigation Planning Team will meet as needed throughout the process. Notice of the date and time of these meetings will be posted on the County's website. Meetings will be held at 101 S. Garden Ave – Newport, WA, but may occur at other locations as determined by the hazard mitigation planning team.

An informational website on the plan and purposes for planning has been established at: https://pendoreilleco.org/your-government/emergency-management/

This website will serve as the primary means for the public to gain information on the plan and ways that they can participate in the planning process. The public is highly encouraged to provide input on all phases of this plan's development.

Any questions or comments regarding this process are encouraged and should be directed to JoAnn Boggs, Pend Oreille County Emergency Management at 509-447-3731, email: JBoggs@pendoreille.org or to Bev O'Dea, Bridgeview Consulting, LLC at (253) 301-1330 or email: bevodea@bridgeviewconsulting.org

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Figure 2-2 Pend Oreille County Press Release

2.7.4 Internet

At the beginning of the plan development process, a website was created to keep the public posted on plan development milestones and to solicit input (see Figure 2-4). The plan was provided via a file-transfer site, which allowed for the plan downloading for review. The County intends to keep a website active after the plan's completion to keep the public informed about successful mitigation projects and future plan updates.

The County's website address was publicized in all press releases, mailings, questionnaires and public meetings. Information on the plan development process, the Planning Team, the questionnaire and phased drafts of the plan was made available to the public on the site throughout the process. Hazard maps were published on this site, and were available for download. A link was also made available to the County's survey, available at: https://pendoreilleco.org/your-government/emergency-management/

2.7.5 Social Media

In addition to the County's website, the PUD also has a Facebook account with over 1,400 followers who follow their webpage, and who received notice of the various activities involved in the plan's update. This included distribution of general information concerning the plan's update; information concerning the survey; meeting notices; advising citizens of the availability of the hazard maps for review and comment, and when the final plan was complete, alerting citizens to the draft plan, asking for review and comment during the open public comment period.

2.7.6 Public Meetings

Several public meetings and events which were open to the public were held during this effort, beginning with the drafting stage and carrying through to when the draft plan was presented for public review. All planning meetings were also open to the public, and citizens did attend those meetings. Relevant data received during those meetings were incorporated as the planning team deemed appropriate.

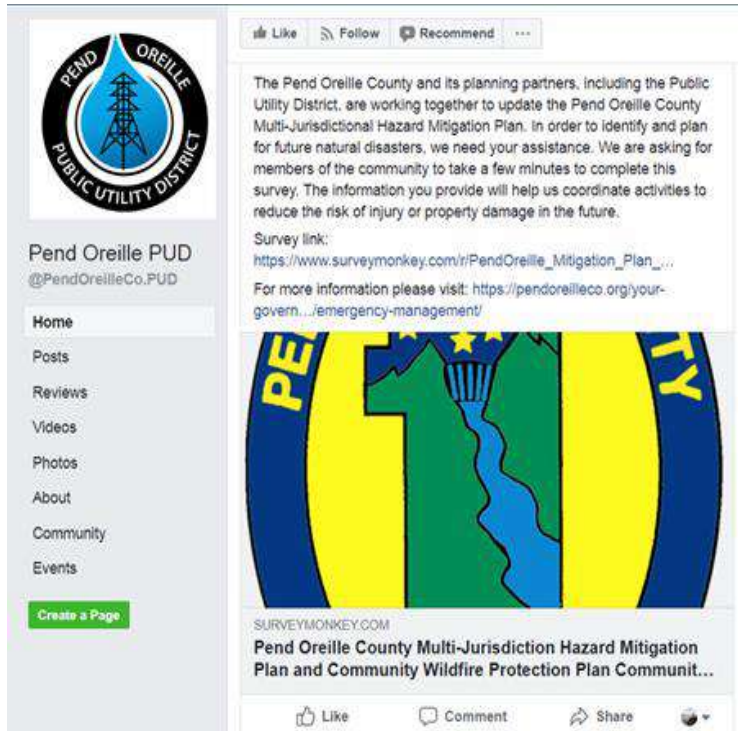


Figure 2-3 PUD Facebook Page

In addition to the regular HMP meetings, occurring simultaneous with the development of the HMP was the update to the County's 2011 CWPP, which was integrated into the HMP process, and now serves as the Wildfire profile. During meetings, citizens were advised of the planning efforts underway and the integration of data from each plan supporting the other document. The County utilized the Wildfire Working Group, Fire Districts Chiefs' Meetings, and the Local Emergency Planning Commission (LEPC) to gain additional outreach and perspective from citizens. All of these meetings are regularly scheduled, advertised meetings which are open to the public.

In addition, during the time this plan was under development, the county and its planning partners were also experiencing a flooding event as a result of the snowmelt exacerbated by increased temperatures. As such, the US Army Corps of Engineers and NOAA, in conjunction with the local communities, hosted several public outreach meetings to provide information and insight. During those meetings, planning team members also discussed the other hazards of concern, as well as how the flooding was impacting the communities, and available mitigation efforts to help reduce the impact of the hazards. Table 2-3 highlights some of the specific public outreach efforts conducted.

Table 2-3
Public Outreach Events

Date	Jurisdiction	Description	Attendance
2018			
February	Countywide	Press release announcing the up-coming project	N/A
February	Countywide	Website developed; announcement of upcoming meeting posted. Agenda posted for upcoming meeting.	
February	Countywide	Frequently asked questions and minutes were posted both for the County and a separate set of FAQs were developed and posted for the Kalispel Tribe of Indians.	N/A

Table 2-3
Public Outreach Events

Date	Jurisdiction	Description	Attendance
March 20	Countywide	Kick-Off Meeting which was advertised via newspaper and via website	26
March 21	LEPC	This served as a second kick-off meeting for those individuals who could not attend the previous day's meeting due to a fire response occurring. This meeting is regularly scheduled, advertised, and open to the public. During the LEPC Meeting, the same items discussed during the March 20th kick-off meeting were discussed and identified. A brief overview of the purpose of the planning process and benefits were discussed, as well as identification of the hazards of concern. The CWPP update was also discussed in detail as a concurring update effort. The risk assessment component of the HMP update for Wildfire will now serve as the CWPP.	~30
March	County Commissioner's Meeting	Deputy Director JoAnn Boggs provided a briefing at the regularly scheduled Commissioner's Meeting, which is advertised and open to the public. The presentation included information concerning the County's current participation in the Countywide Hazard Mitigation Plan Update process, and addressed the HMP FAQ. The briefing included identification of the hazards of concern, and general information on the planning process. The survey was also discussed and attendees were advised that they could locate information on the planning process and the survey on Emergency Management's website.	30
April 19	Countywide, Kalispel Tribe, Town of Cusick	Community meeting concerning potential flooding resulting from the Pend Oreille River, and mitigation efforts which can be administered to help reduce the flooding impact. USGS and the NWS presented information on the flood risk impacting the county. The County Emergency Manager discussed the county's on-going planning efforts (HMP and CWPP). Local officials were also present to answer any questions concerning on-going efforts both for immediate flood reduction efforts, as well as long-term flood reduction efforts through mitigation-related grants. The project's survey was introduced, and citizens were asked to take part in the process by completing the survey. All planning team members in attendance utilized the opportunity to discuss the mitigation plan, and potential mitigation actions which can be taken to reduce the risk of hazards. The FEMA Flood Maps were presented, illustrating the areas of concern.	200+
April, May and July	Port Commissioner's Board Meetings	Provided information on the hazard mitigation planning process; identified hazards of concern and the findings of the risk assessment. Meetings are advertised and open to the public, with question/answer sessions provided at the end of each presentation.	Varied
May	Countywide	Survey deployed	

Table 2-3
Public Outreach Events

Date	Jurisdiction	Description	Attendance
Monthly Meetings	Countywide, Tribal, Local Municipalities, Special Purpose Districts	Discussions and presentation on status of project to various councils, commissions and boards, which included representatives from all local communities, county departments, and local departments.	15-20 monthly
May 9	Countywide Fire Chiefs' Meeting	Hazard Mitigation and Community Wildfire Protection Planning efforts discussed; Dave Marcell from the WSU Conservation District discussed previous projects and offered assistance to attendees to begin identifying potential new strategy data concerning fuels reduction and other efforts. The current plans status and level of effort to complete annex documents were again discussed, with the integration of the CWPP into the HMP being the focus to allow a clear understanding of the process involved.	17
May 9	LEPC Meeting	Members of the planning team discussed the HMP/CWPP process with the local LEPC, providing information on the hazards identified for this 2018 update. The LEPC determined that they would value the opportunity to be part of the planning process. Given that several of the planning team members for the HMP are also LEPC members, such process will help streamline the effort, while also expanding the stakeholder group as there are citizens who also attend the LEPC meeting that did not attend the HMP/CWPP Meeting.	~30
May 11	Countywide, Towns of Cusick, Ione, Kalispel Tribe	Community meeting concerning potential flooding resulting from the Pend Oreille River, and mitigation efforts which can be administered to help reduce the flooding. NWS made a presentation on the flood risk. The County Emergency Manager discussed the county's on-going planning efforts (HMP and CWPP), and asked for citizen involvement. The project's survey was announced, and citizens were asked to take part in the process by completing the survey. Several meetings such as this occurred throughout the County, with all of the municipalities and the Kalispel Tribe utilizing the opportunity to discuss the mitigation plan, and potential mitigation actions which can be taken to reduce the risk of hazards.	Unknown
May	Countywide	Planning Team Members posted a link on Facebook accounts concerning the availability of the County's survey.	N/A
May	Hospital District	Planning Team Member Christina Wagar distributed information concerning the planning process, hazards, and survey to all employees, inviting comments. Once the risk assessment was completed, risk data was also distributed during the Board meeting, as well as provided to employees. The Board meetings are open public meetings, and attendees were provided an opportunity to comment and provide input. While general discussions ensued, no comments which impacted the plan were received.	

Table 2-3
Public Outreach Events

Date	Jurisdiction	Description	Attendance
June (various dates)	Countywide	Additional risk assessment results were provided for review to members of the planning team.	+20
June	City of Newport	The City of Newport gave a presentation of the HMP/CWPP update process. They provided an overview of the risk assessment and planning process during their regularly scheduled Council meeting. An overview of the process was also provided, and handouts of the risk posters identifying impact and areas of concern were provided. Citizen comments were requested, but other than general discussions, no comments were received.	~15
July 11	Countywide Fire Chiefs' Meeting	Hazard Mitigation Planning Effort discussed; current plan status and level of effort to complete annex documents discussed. Risk ranking process discussed.	~15
July 27	PUD, County	Public presentation of countywide maps and risk to PUD during public outreach effort. Handouts of countywide posters and information specific to PUD distributed to all attendees. Meeting regularly held and advertised.	17
July 31	Kalispel Tribe	The Tribal Planning Team Members provided an overview of the risk assessment data and findings at the Tribal Council Meeting, which is open to all tribal members. The various posters and maps were also displayed. Approximately 20 tribal members were in attendance at the Council Meeting. Once the Council Meeting was completed, the posters were erected in the Camas Center. The posters and information remained available for viewing for several weeks, including during the Tribe's annual Pow Wow (Aug. 3-6). The Pow Wow draws additional tribal members who currently do not live on the Reservation, as well as tribal members from various other tribes nationwide.	250+/-
Aug 8	Town of Cusick School Districts Pend Oreille County PUD Port Fire Districts	The Town of Cusick conducted a charette for various planning activities on-going in the Town and County, including, among other things, the hazard mitigation plan, the comprehensive plan, and its five year strategic plan. The planning meeting included citizens, community members, planners, and other planning team members from across the County. During the meeting, the on-going hazard mitigation planning effort was discussed, with a presentation of the risk countywide identified during the effort. Maps and data were erected throughout the facility, and citizens were provided the opportunity to review the data in detail, and provide input and suggestions. The town also prepared packets containing the papers and data which individuals were able to take with them containing the risk information, as well as strategy and other hazard mitigation information.	40

Table 2-3
Public Outreach Events

Date	Jurisdiction	Description	Attendance
Aug 14	Port of Pend Oreille	During a regularly scheduled Board meeting, the Port of Pend Oreille reviewed the risk data and general hazard mitigation planning data. These meetings are regularly held, with notice given in accordance with Port regulations. All meetings are open to the public. Planning team members presented the information on the risk as it relates not only countywide, but also as it relates to Port facilities and infrastructure. Attendees were invited to review the posters, maps and data distributed throughout the meeting room. Attendees expressed their appreciation to the Port for their participation in the countywide efforts, as well as expressing their appreciation for the information which was provided. While questions, comments and a robust discussion ensued, there were no comments which involved new data requiring input within the plan.	15
August 16-19	Countywide	County Fair— During the four days of the fair, in conjunction with other planning partners, the County displayed the hazard maps and provided information and input to the citizens in attendance. Notice of the availability of the maps and opportunity to speak with planning team members was also announced via the County's website. Various handouts were provided, including copies of the hazard maps, posters, and other relevant information. Citizens were also provided hard copies of the surveys, as well as being provided the link to the on-line survey. The booth was manned, and planning partners were available to answer any questions. Attendees were also provided the opportunity to email any comments, concerns or questions they had to planning team members, whose email addresses and phone numbers were provided. While general conversations with viewers ensued, no (significant) comments related to risk, strategies or suggestions for changes were received.	+500
Aug 20	Kalispel Tribe	Presentation open to all tribal members during planned luncheon and meeting. During this presentation, the Planning Team Members provided information on the overall process, the benefits of mitigation planning, presentation of the risk and maps, and advised that the final version of the plan would be available on the Tribe and County's website within the next two weeks.	15
Aug 23	Hospital District #1	Presented risk data and final Hospital District Annex to Board of Commissioners and attendees. Meetings are advertised and regularly attended, with an agenda being developed in advance of the meeting announcing the Hazard Mitigation Plan as an agenda item. The Planning Team Member made a power point presentation containing general data concerning the HMP process, as well as risk data. The Hospital District's Annex was also presented for review and comment. The availability of the Draft HMP on the County's website beginning September 1st was also announced.	24

Table 2-3
Public Outreach Events

Date	Jurisdiction	Description	Attendance
September	Pend Oreille County	Press Release distributed announcing plan availability for review on the County's Website and hard copy available for review at Pend Oreille County Emergency Management.	
September 4	City of Newport	During its regularly scheduled council meeting, the availability of the Draft Hazard Mitigation Plan was announced, with website location information presented. The plan was discussed, with an opportunity for citizens to provide input and comment; however, no comments were received.	
September 6	Newport Hospital and Health Services	The Hospital District posted verbiage on its Facebook site, along with a link to the Draft Hazard Mitigation Plan, requesting comments and input.	
September 11	Pend Oreille County LEPC	JoAnn Boggs, Emergency Management Deputy Director presented an update to the planning process during the LEPC meeting, discussing the process, risk assessment, and again presented the draft plan to the group. Citizens were advised that the draft plan was available for review on the County's mitigation planning website, as well as a hard copy printed and available for review at the County Library. Ms. Boggs further announced that the plan would be available for review until September 17, 2018.	30

The kickoff meeting was open to the public and was publicized in the local paper. Table 2-4 summarizes the review and analysis of the 2011 plan discussed at that meeting. Photo of the kick-off meeting are also provided below.

Table 2-4
Review and Analysis of 2011 Hazard Mitigation Plan

2011 PDM Sections	How Reviewed and Analyzed
Section 1—Introduction and Purpose	Reviewed existing section through discussion at public meeting. No analysis needed.
Section 2—Planning Process	Reviewed and analyzed existing section through discussion at public meeting. Planning process expanded by utilizing project website and scoring hazards using Calculated Priority Risk Index.
Section 3—Hazard Identification and Vulnerability Analysis	Reviewed and analyzed existing section through discussion during public meeting and Planning Partner conference calls. Reviewed and updated hazards, critical facilities and vulnerable populations. Updated section with recent hazard data.
Section 4—Critical Facilities and Infrastructure	CIKR data was reviewed and planning partners were asked to update the data for the 2018 edition. This information, when completed, will be incorporated into the CDMS layer for the Hazus model, and utilized during the risk assessment portion of the planning effort.
Section 5—Mitigation Initiatives	Reviewed by planning partners during conference calls, public meeting and subsequent mitigation workshop. New projects developed, existing projects re-worded and/or deleted, completed projects documented.

Table 2-4
Review and Analysis of 2011 Hazard Mitigation Plan

2011 PDM Sections	How Reviewed and Analyzed
Section 6—Plan Maintenance	Reviewed and analyzed existing section through discussion during Planning Partner conference calls. Determined that plan maintenance procedures outlined in previous plan had not been implemented.

Presentation of Risk

During public outreach events, maps from the various hazards were presented (see Figure 2-5 below for one example). The meeting formats allowed attendees to examine maps and handouts, and have direct conversations with project staff. Risk data was shared with attendees, as were various mitigation strategy efforts developed to help reduce risk. Maps and posters were set up for each primary hazard to which the planning area is most vulnerable. This allowed citizens to see information related to their property. Each citizen attending was also asked to complete a questionnaire, and each was given an opportunity to provide written comments to Planning Team members concerning the hazard maps.

In addition, once completed, the County also posted all of the hazard maps on its website to allow citizens who were unable to attend any of the public outreach sessions to view the maps online, and provide comments. Notice of the availability of the maps on the County's website was distributed via social media and press releases.

Figure 2-4 Kick-Off Meeting

Figure 2-5 Kalispel Tribe Poster Display of Risk Posters as Camas Center

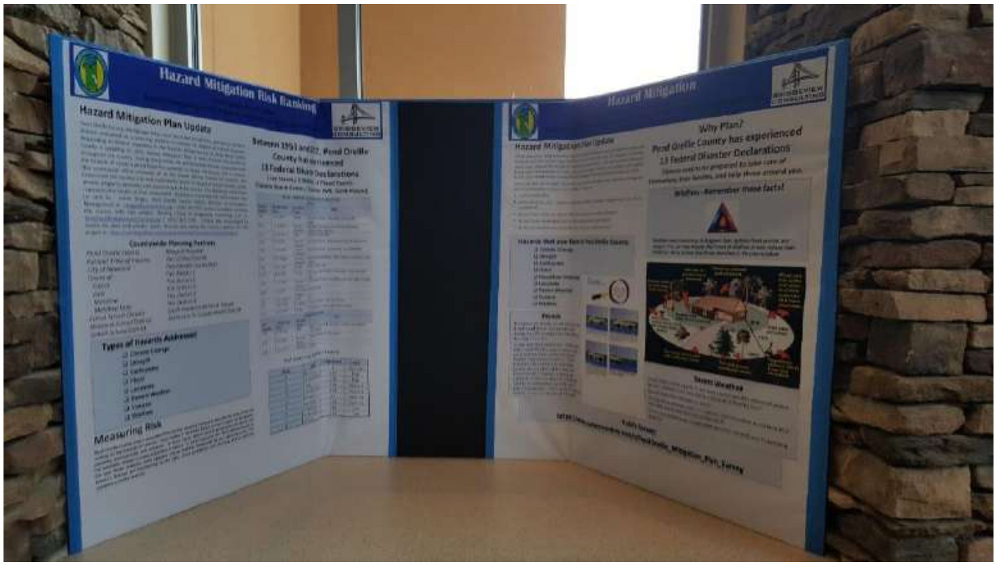


Figure 2-6 Kalispel Tribe Hazard Mitigation Planning General Information Posters

Figure 2-7 PUD Public Outreach Presentation

Figure 2-8 Port of Pend Oreille Public Outreach August 14, 2018

Figure 2-9 Pend Oreille County Fair Public Outreach August 16-19, 2018

Draft Plan Review

Once the draft plan was completed, the public was invited to provide comments on the hazard mitigation plan. The final public review period began August 31, 2018 lasting through September 17, 2018. The County and its planning partners completed the following outreach activities for final plan review:

- During the September 2018 LEPC and Commissioner's Meeting, Emergency Management Deputy Director JoAnn Boggs announced that the draft plan was available for review, and citizens were asked to review the draft plan and provide comments.
- The City of Newport, during its regularly scheduled Council Meeting on September 4th, announced the plan's availability, providing the link to the group in attendance. The City also provided the link on its website.
- The draft plan was posted on the project website and stakeholders were notified through press releases and e-mail messages of its availability, including Twitter and Facebook.
- Planning partners provided notification of the plan's availability for review during their respective council and commission meetings, advising citizens of the plan's availability.
- Each planning partner held their own final public meeting, at which the plan was presented to their commission or council and the approving authority adopting the plan.

Once the review period closed, final comments were addressed and the plan was submitted to FEMA for review. Once pre-adoption approval was received from FEMA, the plan was provided to the Pend Oreille Board of County Commissioners and the incorporated communities for adoption. After adoption, final copies of the plan were submitted to the Washington State Department of Emergency Management and FEMA. Appendix C includes the adoption resolutions.

The final plan will remain on the County's website over the next five years. Future comments on the plan should be addressed to:

JoAnn Boggs, Deputy Director
Pend Oreille County Department of Emergency Management
PO Box 5035
Newport, WA 99156
(509) 447-3731

2.8 PLAN DEVELOPMENT MILESTONES

Table 2-5 summarizes important milestones in the development of the Pend Oreille County Multi-Jurisdiction Hazard Mitigation Plan.

Table 2-5
Plan Development Milestones

Date	Event	Description
2015		
2015	Submit initial grant application	Seek funding for plan development process (due to awards and disaster funding, this was a two year process before award was made)
2017		
2017	Grant award	Funding secured.
Sept	Initiate consultant procurement	Seek a planning expert to facilitate the process.

Table 2-5
Plan Development Milestones

Date	Event	Description
Oct	Contractor secured	Select Bridgeview Consulting to facilitate plan development.
2018		
Jan	Commission Presentation	Identification of Hazard Mitigation Project discussed; vendor selection identified; contract with consultant approved by Commissioners.
Feb	County HMP Team Identified	Formation of the County's HMP planning and core project management team. Continue review of existing plan and existing documentation supporting effort (e.g., studies, other planning documents, etc.)
March	Press Release	Press release announced concerning HMP development process; published in local newspapers and on County website.
March 20 and 21	Planning Team Kick-Off meeting	Presentation on plan process, hazards, goals, objectives and public outreach strategy. Review of 2011 plan, and identification of the CWPP update process. General plan template discussed. Discussed hazards to be addressed in plan update; discussed methodology which would be used to conduct the analysis. Hazards to be addressed were reviewed and confirmed. A second kick-off meeting was held on March 21st with the local LEPC due to a fire response which impacted the ability of several planning partners to attend on March 20th. Both of these meetings are advertised, and open to the public. The survey was also provided for review and comment, with the finalized version made public via Survey Monkey. Notice of the survey's availability and a link to the survey was posted on the County's website.
June	Planning Team	Initial risk maps were presented to the Planning Team members for review and comment.
June/ July	Planning Team Meeting	Risk ranking exercise completed and confirmed; strategy/action items reviewed and discussed; incorporation of risk data into other planning mechanisms discussed (e.g., land use, CEMP, evacuation plans, etc.).
Aug	Draft Plan Internal Review	Draft provided by Planning Team to Planning Team (additional strategies added during review process).
Sept	Public Review	Draft provided on website with press releases inviting citizens to review and comment for 30 day periods.
Dec	Plan Adoption	After receipt from FEMA of the Approval Pending Adoption, the final version of the Pend Oreille County HMP was approved and adopted by the Board of Commissioners.

CHAPTER 3.
COMMUNITY PROFILE – DEFINING THE PLANNING AREA

3.1 PHYSICAL SETTING

Pend Oreille County is a relatively small county that looks like the number “1” set in the northeast corner of the State of Washington. Pend Oreille County is 66 miles long and 22 miles wide. Pend Oreille County is bordered on the east by both Boundary County and Bonner County, Idaho. On the south it is bordered by Spokane County, Washington and on the west by Stevens County, Washington. The international northern border is shared with Central Kootenay Regional District, British Columbia, Canada.

Pend Oreille County is a rural County covering an area of 1,400 square miles and is ranked 25th in size among Washington State’s counties. Not far from where the Selkirk Mountains end, Pend Oreille County begins its association with the Pend Oreille River. There are large areas of forest, mountains, valleys, lakes, and open pastures with widely dispersed homes and ranches within the County. The County consists of beautiful landscapes, rugged wilderness, and outdoor recreation areas. The Pend Oreille River runs the entire length of the County providing electric power and recreational opportunities. Most of Pend Oreille takes the form of a long-forested river valley. This area, known as the Okanogan Highlands, is unique since it is the only area in the country where plant and animal species from both the Rocky Mountain Region and the Cascade Mountain region can be found.

There are 55 lakes, 48 creeks and numerous wetlands dotting the natural meadows, the forested foothills and the mountains. There are seventy mountain peaks within the county borders, the highest of which is Gypsy Peak (7309’). Several of the peaks are the endpoints of interstate hiking trails and offer exceptional vistas into Idaho and Canada. Nestled within these forests and mountains are the Cusick Flats and other sections of the county with areas of specific agricultural land use.

All of the major towns in the county are located along the Pend Oreille River and virtually all agricultural land is part of the Pend Oreille River floodplain or along creek bottoms in the southern third of the county. The Pend Oreille River, the second largest in Washington State, flows through the entire county except for the very southern 10 miles in a northerly direction for about 155 miles from its headwaters at Pend Oreille Lake in Idaho to the Columbia River in British Columbia, Canada. The northward-flowing river, fed by more than twenty-two tributaries, also supports a modest amount of farming as it courses through the county. The southern area is headwaters of the Little Spokane River with the watershed divide running roughly east-west from Newport to the Sacheen Lake area.

Pend Oreille County is named after the Pend d’Oreille Tribe, a local tribe whose name was derived from the French-Canadian fur traders who visited the area. The name Pend Oreille is French and means “hangs in the ear”. It is believed that the fur traders gave the tribe this name because of their ear pendants. Pend Oreille County was formed out of Stevens County on March 1, 1911. Newport was established as the County seat in 1912 after defeating three other contenders. Pend Oreille County is a blend of “pioneer spirit, visitor amenities, and small town hospitality”.

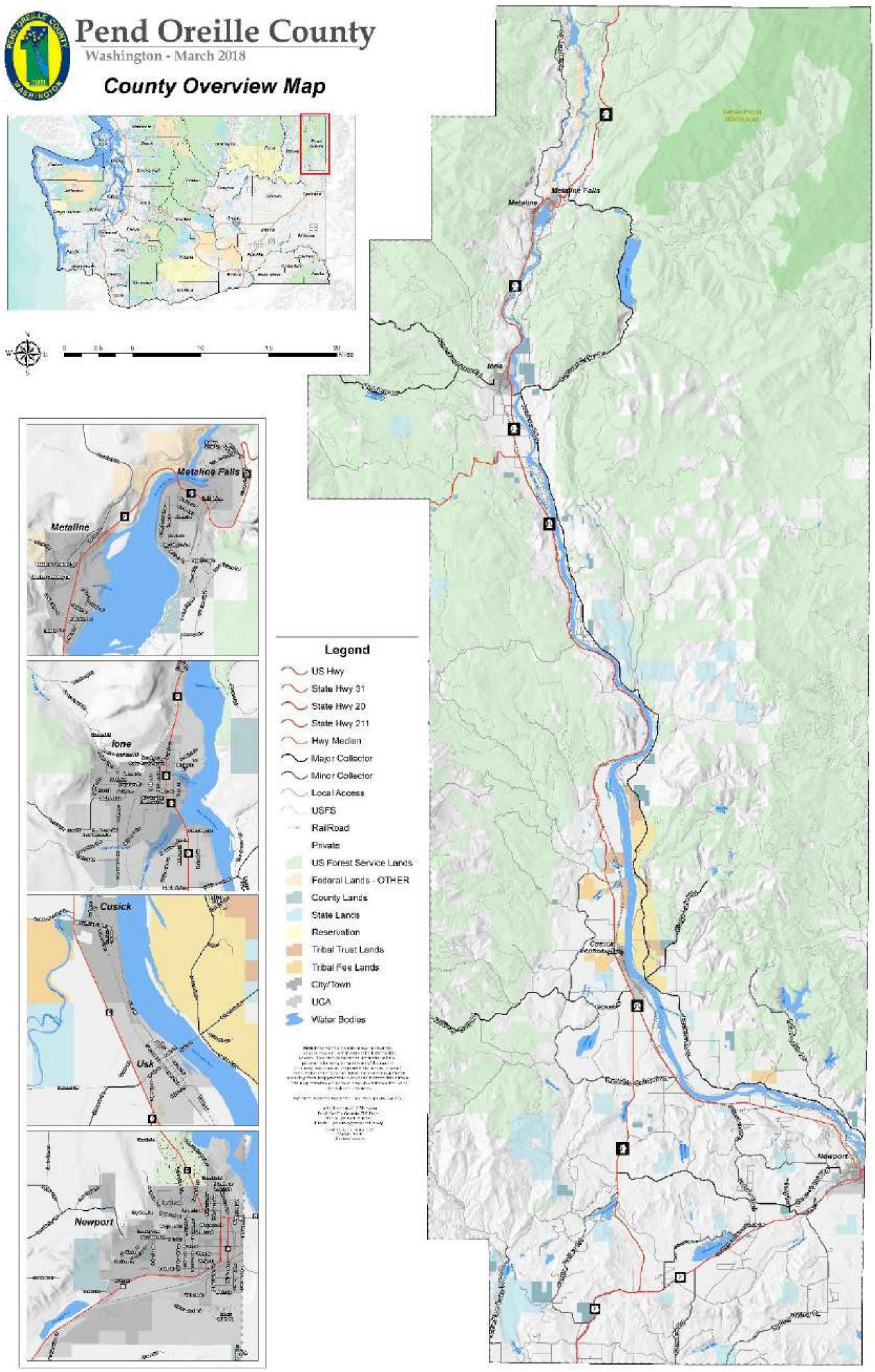


Figure 3-1 Pend Oreille County Map Overview

3.1.1 Topography and Geography

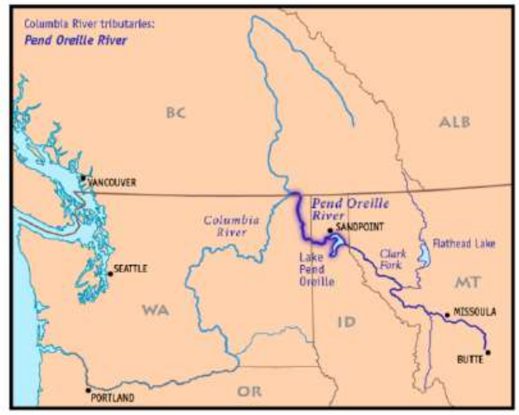


Figure 3-2 Pend Oreille River - North Flowing from Montana to Canada

Pend Oreille County consists of 1,400 square miles of land and 25 square miles of water. The southern portion of the County is made up of rolling hills while the central and northern portions of the County are comprised of high hills and valleys. The most prominent area of the County is the valley along the Pend Oreille River. This valley has areas which stretch for miles and areas which are very narrow. One-half mile north of Newport the Pend Oreille River enters Washington State from Idaho and then flows north to join the Columbia River in British Columbia, Canada. The river runs northwest for 72 miles and is one of only two rivers in the North American hemisphere that runs north. The watershed in the Newport area is very limited which is due to a small depression beginning one-half mile to the southwest of the river. As indicated, there are 55 lakes that are located within the County. Much of the surface water in the County is used for hydroelectric power. Total withdrawal of fresh water for public supply is 0.72 million of gallons per day, 82% of which is from ground water and 18% from surface water.

During the ice age, the Pend Oreille Lobe of the Missoula glacier formed the Pend Oreille River (see Figure 3-2). The Missoula Glacier, part of the Cordillera Ice Sheet, extended south and covered the valley. During the retreat of ice, the formation of recessional lakes and the laying down of materials in still water were widespread. Alluvial sediments deposited on the wide, nearly level undulating lakebeds and low outwash terraces along the river were most prevalent. As the glacier receded, tremendous overflows from lakes hundreds of feet deep carved unique features in the basin. A main artery in the county, the River provides sanctuaries for an abundance of wildlife and pristine forests of Western Larch, Douglas Fir and Ponderosa Pine, interspersed with groves of Aspen, Maple and Poplar. Pend Oreille River valley's sides are comprised of glacial drift, colluvium and rock outcrops. Dolomite bedrock can be seen on both sides of Box Canyon for about .75 miles south of Box Canyon Dam. Granite rocks are exposed between Lost Creek and the east branch of LeClerc Creek. From the upstream end of Box Canyon to Tiger, the river flows through predominantly glacial lake deposits of silt, fine sand and gravel. These deposits are nearly continuous on the river up to Dalkena, where the Newport Fault is exposed along the edge of the river. On the east bank of the river, materials vary from glacial lake deposits to metavolcanic rocks of the Windermere Group.

In some areas benches extend above the river with steep timber-covered mountains. The Selkirk Mountain Range runs parallel to the River and extends from the City of Newport to the Canadian border. The Selkirk Mountain Range is geologically older than the Rocky Mountains, and consists of mellow, rounded peaks rather than the mountainous crags of the Rocky Mountains. The County is also home to two National Forests; the Colville and Kanisku, as well as Little Pend Oreille National Wildlife Refuge.

3.1.2 Geology

The rocks over a considerable portion of the County are metamorphosed sedimentary and consist of shale and dolomite limestone. Large deposits of alluvial clay are found in many areas along the Pend Oreille River. These deposits are usually bluish, grayish, or yellowish in color, and fine grained. Precambrian Phyllite interbedded carbonate rocks, quartzite, volcanic, and gritstone rocks are confined to the northeastern portion of Pend Oreille County. Southeastern portions of the County contain dark-gray diorite sills from 3 to 1200 feet thick. Quartzite sandstone is present in the upper part, with dark-gray argillite mixed with sandstone and limestone in the middle, and sandstone with argillite in the lower part of the County.

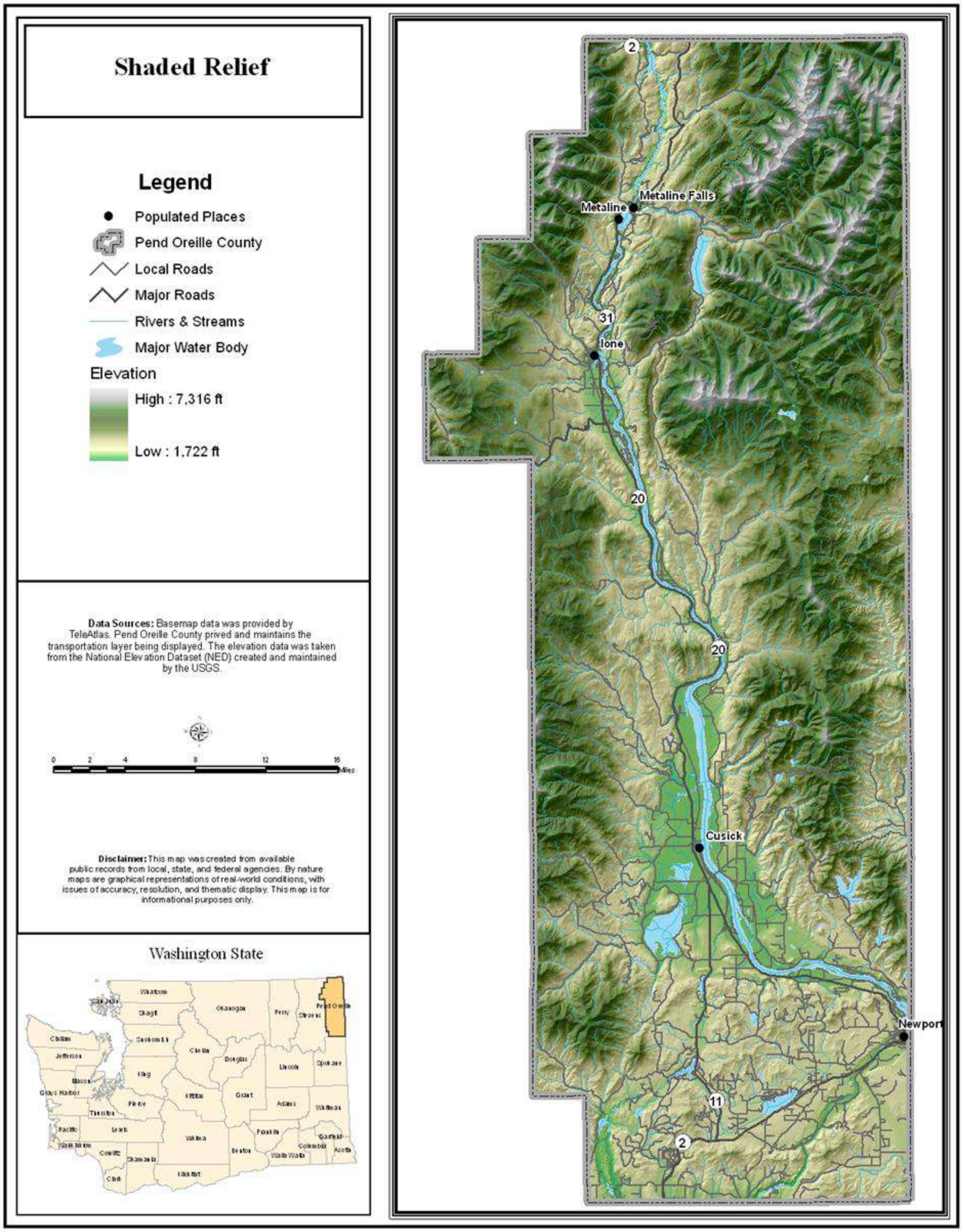


Figure 3-3 Pend Oreille County Elevation

3.1.3 Soils

The soils in the County range in texture, natural drainage and other characteristics. Soils along the major drainage areas are suited to small grain and hay crops, pasture, recreation, and watershed and wildlife habitat. Due to seasonal high water tables and overflow, crop production is limited. Soils on terraces in the County are suited to grain crops, pasture, recreation, timber production, grazeable woodland, as well as watershed and wildlife habitat. The main limitation in these areas is the low availability of water capacity. Soils on the uplands, foothills and mountainous areas, are suited for crops, hay, pasture, timber production, recreation, grazeable woodland, and watershed and wildlife habitat. The soils in this area have few limitations but the growing season varies.

Ahren loam soils are found on slopes of 2 to 20 percent. This is a very deep, well-drained soil and is located on the toe slopes of the foothills and mountains. It formed in a mantle of volcanic ash and loess over calcerous, fine textured glacial till derived from shaly rock and limestone. Also included in the upper parts of the slopes are Blezar silt loam, Boundary silt loam, and Hartill silt loam. Permeability is moderately low in this Ahren soil. Ahren loam also covers the foot slopes of the foothills and mountains on 20 to 40 percent slopes and 40 to 65 percent slopes. Included in the toe slopes is another type of soil, the Aits loam that has a slope of more than 15 percent, with Newbell silt loam, Smackout loam, and Waits loam. Included in this soil mix are Bonner silt loam, and Martell silt loam on terraces, Hartill silt loam on the upper slopes, and Inkler gravely silt loam on south and west facing slopes. Poorly drained soils exist in draws and adjacent to steep slopes and springs.

Aits stony loam is found on toe slopes and foot slopes of foothills and mountains, generally with north or east aspects at the lower elevations and south and west aspects on the higher elevations.

Anglen silt loam is another soil type found in the County on slopes of 0 to 7 and 7 to 40 percent. Dalkena fine sandy loam, Kaniksu sandy loam, Martella silt loam, Sacheen loamy fine sand and Scotia fine sandy loam are also found in this unit in small areas. Also included in the unit are Blueslide silt loam in depressions and adjacent to streams as well as poorly drained areas. Areas included make up about 20 percent of the unit. Permeability is moderately slow in this Anglen soil and available water capacity is high.

Belzar silt loam is a moderately deep, well-drained soil that is found on foot slopes and ridgetops of the foothills and mountains. As with the other soils in the County this soil is formed in a mantle of volcanic ash and loess over residuum and colluviums derived from calcerous rock and limestone.

Blueslide silt loam is a very deep, somewhat poorly drained soil on floodplains. It formed in alluvium derived dominantly from granitic rock, lacustrine sediments, volcanic ash, and loess.

Also present in the County is the Buhrig Rock outcrop complex found on 25 to 40 percent slopes, and Buhrig very stony loam found on 40 to 65 percent slopes, with both of these being convex and generally have north and east aspects. Elevation for these soils is between 3,000 and 6,500 feet. Clayton fine sandy loam is a very deep and well-drained soil found on terraces. It is formed in glaciofluvial material of mixed mineralogy. The elevation for this soil is between 1,800 and 2,200 feet. (See Figures 3-3 and 3-4.)

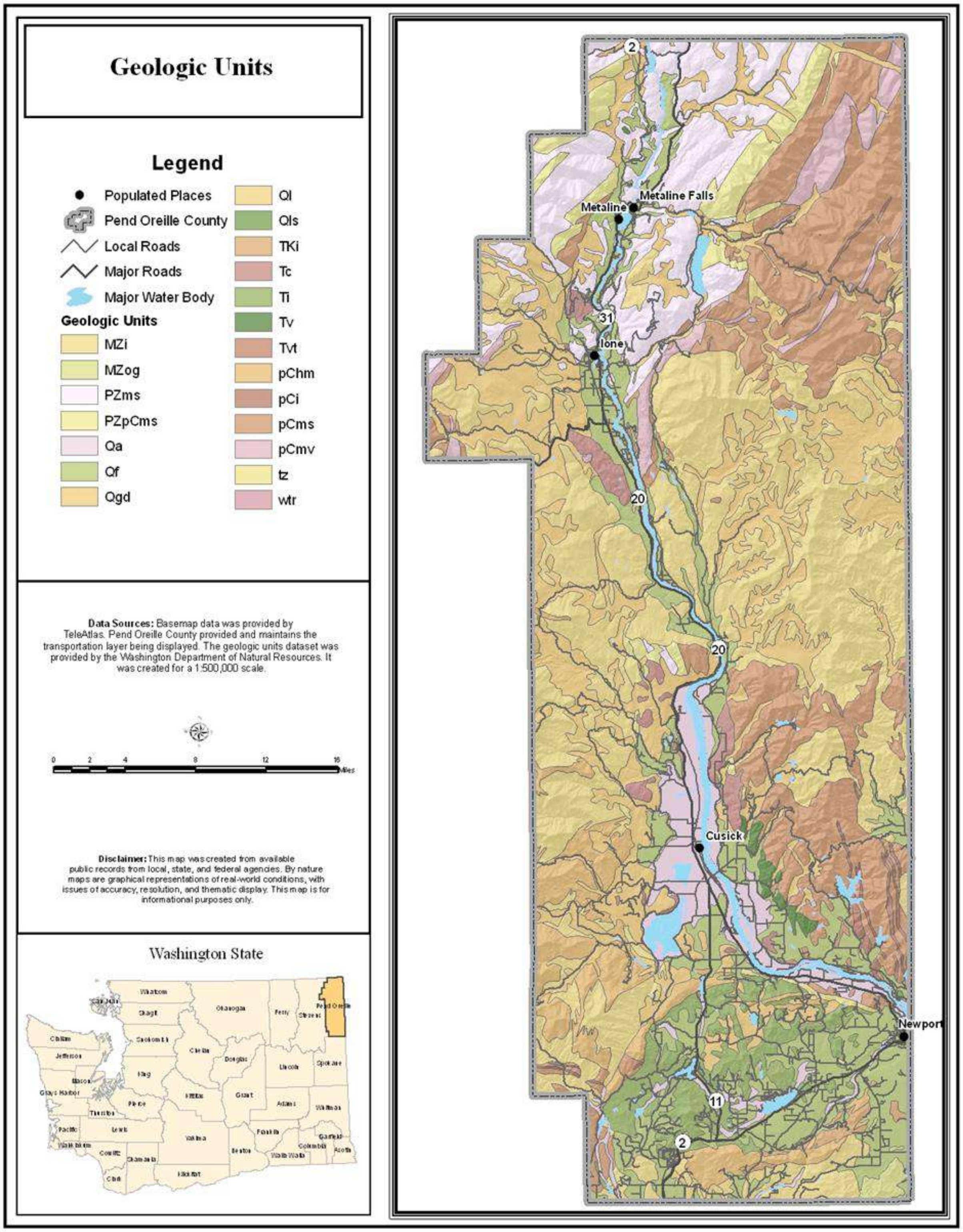


Figure 3-4 Geology of Pend Oreille County

3.1.4 Watershed

Pend Oreille County contains parts of two major watersheds – the Pend Oreille and the Little Spokane, in addition to several other smaller watersheds which traverse the county:

- Pend Oreille (WRIA 62)
- Pend Oreille Lake
- Priest
- Little Spokane (WRIA 55)
- Franklin D. Roosevelt Lake (WRIA 58, and others); and
- Colville (WRIA 59)

The Pend Oreille River Watershed encompasses approximately 26,000 square miles in parts of Washington, Idaho and Canada. The Washington portion of the watershed is referred to as the Water Resource Inventory Area (WRIA) 62 (see Figure 3-5), which encompasses about 795,000 acres, mostly in Pend Oreille County. There are also several sub-basins within WRIA 62, including the Little Calispell Creek, Renshaw Creek, Marshall Creek and Marshall Lake. The availability and yield of groundwater from WRIA 62 is very limited due to climate and geology. As such, the WRIA 62 Planning Unit has administrative restrictions in place for usage and new water appropriations. While the Pend Oreille watershed is not closed to new water uses, at present, the majority of water in the tributaries has been appropriated and new uses can be subject to restrictions, although the Pend Oreille River mainstem is generally open for new appropriations, with low flow limitations used on new irrigation requests. The Pend Oreille Conservation District is the lead agency for the WRIA 62 WPU.

WRIA 55, the Little Spokane River Basin, encompasses about 432,000 acres, mostly in Spokane County. The headwaters of the Little Spokane River and its West Branch drain the southern portion of the County. This watershed includes many of the County's recreational lakes. The main stem of the Little Spokane River begins in the County just west of the City of Newport on the north side of Highway 2. The WRIA 55 Watershed Planning Unit (WPU) was formed in 1999. The WPU tasks include: to develop estimates of current water use, in stream flow, and future water needs; to determine the amount of water allocated for use in the basin; and evaluate the water quality data as related to flow. Spokane County is the lead agency for the WPU.

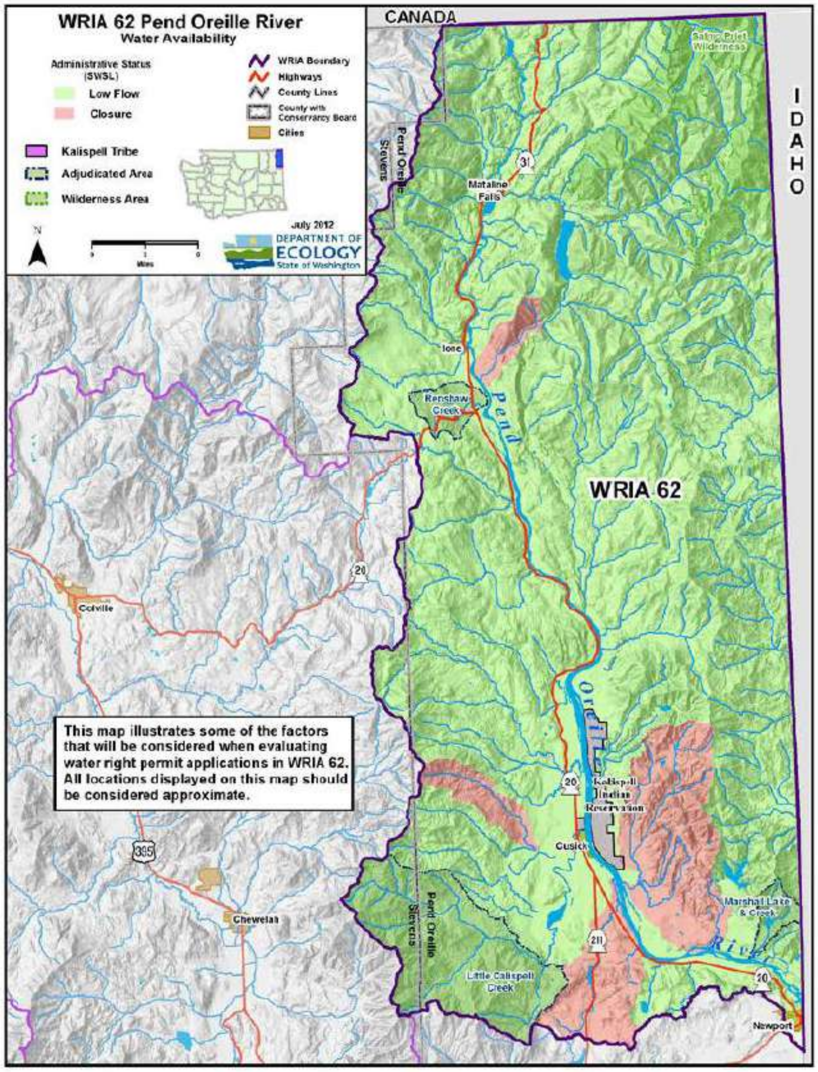


Figure 3-5 WIRA 62

3.1.5 History

Pend Oreille County is in the extreme northeast corner of Washington and was the last County created in the State. Early inhabitants of the County were Native Americans, then fur traders and explorers, missionaries, miners, loggers, and finally homesteaders. The economy was based on timber, mining, and cement manufacture. Most of these businesses profits flowed to outside investors, leaving the local economy little for local development.

In 1809 David Thompson, an English fur trader from the North West Company, made his first trip down the Pend Oreille River. He came upon two tribes of Native Americans: the Kalispels, a tribe known as "camas people" because of the root that was their food staple, and the Pend Oreille, named by French-Canadian trappers due to the large ear pendants they wore. The Kalispels currently live in the County on the Kalispel Reservation while most of the Pend Oreille Tribe now lives in the State of Montana. In 1950, the Bureau of Indian Affairs combined the Kalispel Tribe and the remaining Washington Pend Oreille Tribe tribal members into a single tribe, the Kalispels.

Protestant missionaries came to the area with an austere version of Christianity and little understanding of traditional Native American ways; they were not successful among the Kalispels. The Jesuits fared better, but two Catholic missionaries arrived in 1844 and built the St. Ignatius Mission near Usk on the present day Kalispel Reservation. These missionaries were more successful and introduced gardening and livestock husbandry to the Valley. The Kalispel Tribe raised horses of the Cayuse type, which provided a good market throughout the area during the fur trading and early prospecting period. Perhaps due to the tensions with the different groups of missionaries, settlement by white settlers was discouraged from 1840 to 1870 because of general Native American hostility in the area.

The first major influx of non-Native Americans and fur traders came in 1850 with the discovery of gold and silver in the Metaline area in the northern portion of the County. Many of these miners were those who had failed in the California mines; however, permanent settlement of the Metaline area did not actually begin until 1884. From 1928 to the early 1950's "the real mining bonanza" was in lead and zinc mined in the Metaline Mining District. "During World War II, 'soldier-miners' were deployed to the Metaline mines to help produce lead and zinc for the war effort."[3]

The Lehigh Portland Cement Company of Metaline Falls was one of the State's most successful operations in providing cement for the construction of the Grand Coulee Dam and other such projects in eastern Washington. The cement industry in the County was prosperous until the 1990's; this industry was made possible by the limestone and quartz in the Metaline Falls area.

Timber was the second leading extractive industry in the County. The first sawmill was built by Edwin Winchester to supply settlers in the Calispell (variant spelling of Kalispel) Valley. The most successful local company was named the Panhandle Lumber Company, which was owned by Frederick A. Blackwell, who also owned 65,000 acres in the northern portion of the County by 1909. This sawmill was the first all-electric sawmill in the Inland Northwest and was of particular importance due to the cedar pole industry which was being used to supply poles for the growing electric, telephone and telegraph industry. Logging was a difficult and dangerous lifestyle, as the hours were long and the pay was low. Some loggers lived in the County with their families while others traveled from camp to camp living in bunkhouses. "By the 1920's, efforts by the Industrial Workers of the World (IWW), commonly called the Wobblies, were somewhat successful in bringing about better conditions" for the loggers, including shorter hours and higher wages. Another leading company in the 1920's was the Diamond Match Company, using 80 percent of the counties Pend Oreille White Pine to meet the demand for matches. Throughout the years there have been more than 250 sawmills operating at various times in Pend Oreille County.

The railroad reached Newport in 1892 enabling rail shipments for the logging industry, which until this time had been using the river to transport their shipments. Since the river runs north through the County, shipping of logging materials to the south was not possible. In 1910 Frederick A. Blackwell completed his "Idaho & Washington Northern Railroad running from near Post Falls, Idaho north to Metaline Falls via Newport". This railroad not only benefitted the logging industry but became the main source of transport for lead, zinc, and cement, as well as supplies necessary for the area settlers.

Pend Oreille County homesteaders soon learned that the area was not necessarily conducive to farming; it was found to be better for dairy farming. By 1944 seventy-five commercial dairies had been established in the County. Today there are none. After the completion of the railroad, the area saw new homesteaders and land seekers enter the valley. One of the earliest successful farm products was wild grass hay. Oats also

[3] http://www.pendoreilleco.org/about/history.asp

became an important pioneer crop in the valley. Hay, feed grains, and wheat were the primary crops. Grazing of livestock was also successful.

The construction of the Box Canyon Dam in the 1950's was a major achievement for the Pend Oreille County Public Utility District. It provides hydroelectric power, as well as recreational opportunities. Seattle City Light's Boundary Dam was built in 1967 near the Canadian border; it provides hydroelectric power to Seattle and recreational use to Pend Oreille County.

3.2 CLIMATE

On average, there are 174 sunny days per year in Pend Oreille County. Pend Oreille County's average winter temperature is 28 degrees, with an average low of 21 degrees. The average summer temperature is 63 degrees with an average daily high of 79 degrees. The July high is around 83 degrees. The annual precipitation in the Pend Oreille Watershed ranges from 26 inches per year in the City of Newport to 55 plus inches in the higher elevation mountainous area. The number of days with any measurable precipitation is 54. Only a fraction of this precipitation becomes water available for human and economic uses. Most of the precipitation arrives during the winter months, when water demands are the lowest. Total annual precipitation for the County averages 27 inches with 30-40 percent of the precipitation falling in the months of April through September. Seasonal snowfall averages 62 inches at Boundary Dam and 70 inches in the City of Newport.[4] During the summer, when the snowpack is gone, there is little rain, and naturally low stream flows are dependent on groundwater inflow. This means that groundwater and surface water are least available when water demands are the highest. Much of the water in the Pend Oreille Watershed has already been allocated. Increased demands from population growth, declining groundwater levels, and impacts from climate change are adding to the challenge of finding new water supplies in WRIA 62, especially during the summer months. As a result of this, the Kalispell Indian Reservation, which is located within WRIA 62, has expressed concern about maintaining flows and fish habitat in the watershed with respect to water right applications.

3.3 MAJOR PAST HAZARD EVENTS

Major hazard events are often identified by federal disaster declarations, which are issued for hazard events that cause more damage than state and local governments can handle without assistance. FEMA categorizes disaster declarations as one of three types (FEMA, 2012a):

- **Presidential major disaster declaration**—Major disasters are hurricanes, earthquakes, floods, tornados or major fires that the President determines warrant supplemental federal aid. The event must be clearly more than state or local governments can handle alone. Funding comes from the President's Disaster Relief Fund, managed by FEMA and disaster aid programs of other participating federal agencies. A presidential major disaster declaration puts into motion long-term federal recovery programs, some of which are matched by state programs, to help disaster victims, businesses and public entities.
- **Emergency declaration**—An emergency declaration is more limited in scope and without the long-term federal recovery programs of a presidential major disaster declaration. Generally,

[4] Western Regional Climate Center

federal assistance and funding are provided to meet a specific emergency need or to help prevent a major disaster from occurring.

- **Fire management assistance declaration** (44 CFR 204.21)—FEMA approves declarations for fire management assistance when a fire constitutes a major disaster, based on the following criteria:
  – Threat to lives and improved property, including threats to critical facilities and critical watershed areas
  – Availability of state and local firefighting resources
  – High fire danger conditions, as indicated by nationally accepted indices such as the National Fire Danger Ratings System
  – Potential major economic impact.

Since 1953 until December 31, 2017, 13 federal disaster declarations have affected Pend Oreille County, as listed in Table 3-1 (FEMA, 2012b). Fire and Emergency Management Declarations are also referenced if received. One incident, the Wildfire occurring in August 2015, was an Emergency Management Declaration for both the County and the Kalispel Tribe. Of the incidents listed, the *type* of Presidential Declaration received (as identified by FEMA) is as follows:

– 4 Flood events
– 5 Severe Storms
– 1 Severe Ice Storm
– 2 Fires
– 1 Volcano (Mount Saint Helens)

It should be noted that the *typing* of the incident is sometimes misleading. The *typing* of the incident refers to FEMA's classification of the hazard involved. For instance, of the five Severe Storm events, three also include flooding, but are not listed under the Flood incident type as other hazards were also involved. Therefore, readers should review both the "Incident Type" column and the "Title" column to identify additional hazard impact.

Review of these events helps identify targets for risk reduction and ways to increase a community's capability to avoid large-scale events in the future. Still, many natural hazard events do not trigger federal disaster declaration protocol but have significant impacts on their communities. These events are also important to consider in establishing recurrence intervals for hazards of concern.

Table 3-1
Pend Oreille County Disaster History 1953 – 2017

Disaster Number	Declaration Date	Incident Type	Title	Incident Begin Date	Incident End Date
4309	4/21/2017	Flood	Severe Winter Storms, Flooding, Landslides, Mudslides	1/30/2017	2/22/2017
4249	1/15/2016	Severe Storm(s)	Severe Storms, Straight-line Winds, Flooding, Landslides, and Mudslides	11/12/2015	11/21/2015
4243	10/20/2015	Fire	Wildfires and Mudslides	8/9/2015	9/10/2015
1825	3/2/2009	Severe Storm(s)	Severe Winter Storm, Record and Near Record Snow	12/12/2008	1/5/2009

Table 3-1
Pend Oreille County Disaster History 1953 – 2017

Disaster Number	Declaration Date	Incident Type	Title	Incident Begin Date	Incident End Date
1682	2/14/2007	Severe Storm(s)	Severe Winter Storm, Landslides, and Mudslides	12/14/2006	12/15/2006
1641	5/17/2006	Severe Storm(s)	Severe Storms, Flooding, Tidal Surge, Landslides, and Mudslides	1/27/2006	2/4/2006
1182	7/21/1997	Flood	Flooding, Snow Melt	4/10/1997	6/30/1997
1172	4/2/1997	Flood	Heavy Rains, Snow Melt, Flooding, Land and Mud Slides	3/18/1997	3/28/1997
1159	1/17/1997	Severe Storm(s)	Severe Winter Storms, Land/Mud-slides, and Flooding	12/26/1996	2/10/1997
1152	1/7/1997	Severe Ice Storm	Severe Ice Storm	11/19/1996	12/4/1996
922	11/13/1991	Fire	Fires	10/16/1991	10/24/1991
623	5/21/1980	Volcano	Volcanic Eruption, Mt. St. Helens	5/21/1980	5/21/1980
414	1/25/1974	Flood	Severe Storms, Snowmelt and Flooding	1/25/1974	1/25/1974
Emergency Declarations					
EM Number	**Declaration Date**	**Incident Type**	**Title**	**Incident Begin Date**	**Incident End Date**
3372	8/21/2015	Fire	Wildfires – Declared for both County and Kalispel Tribe of Indians	8/13/2015	9/10/15
3227	9/7/2005	Coastal Storm	Hurricane Katrina Evacuation	8/29/2005	10/1/2005
3037	3/31/1977	Drought	Drought	3/31/1977	3/31/1977

In addition to the natural disaster identified above, since completion of the 2011 plan, the County has experienced two significant hazardous material incidents. While the county has only 12 Tier II Registered Hazmat locations countywide, the Planning Team felt it relevant to address the two incidents, providing a general overview of the incidents as they occurred. For planning purposes, the Tier II facilities have been included in the risk assessment conducted for all of the hazards of concern, and as appropriate, hazardous materials are addressed within each of those profiles. The County also maintains a Threat Hazard Identification and Risk Assessment, which provides a more detailed assessment of the hazardous materials throughout the region. As such, the Planning Team determined it was redundant to profile hazardous materials as a separate hazard.

Figure 3-6 Zodiac Aerospace Plant Explosion

- July 15, 2015, an explosion occurred at the Zodiac Aerospace Plant in Newport (see Figure 3-6). The explosion, which injured five people, one of which had to be airlifted to a Spokane hospital, caused part of the roof to cave in, and doors on the opposite side of the building where the explosion occurred were blown off the hinges. The plant employs 104 people, and is one of the world's largest suppliers of aircraft interiors to airplane manufacturers like Boeing and Airbus. It is also one of the largest suppliers of aerospace materials in the state. It is believed that the explosion occurred as a result of flammable vapors accumulating. Fire suppression systems extinguished the fire quickly.[5]

- November 21, 2016 – a semitruck hauling two trailers of diesel fuel crashed along Highway 211. Approximately 9,300 gallons of diesel fuel leaked out, but did not ignite. Department of Ecology indicated that the diesel fuel did not leak into any standing bodies of water, and it was unlikely that any groundwater was impacted given the location of the spill. However, the soil was saturated and removal was necessary. The accident occurred as a result of a distracted driver overcorrecting his vehicle after drifting onto the shoulder when attempting to reach for a six-week old puppy that was accompanying him in the cab. While the driver sustained minor injuries and was transported to the hospital, the puppy was not injured.[6]

3.4 CRITICAL FACILITIES AND INFRASTRUCTURE

3.4.1 Definition

Critical facilities and infrastructure are those that are essential to the health and welfare of the population. Loss of a critical facility could also result in a severe economic or catastrophic impact. These facilities become especially important after a hazard event. Critical facilities typically include police and fire stations, schools and emergency operations centers. Critical infrastructure can include the roads and bridges that provide ingress and egress and allow emergency vehicles access to those in need, and the utilities that provide water, electricity and communication services to the community. Also included are "Tier II" facilities and railroads, which hold or carry significant amounts of hazardous materials with a potential to impact public health and welfare in a hazard event.

Under the Pend Oreille County hazard mitigation plan definition, during its March 2018 kick-off meeting, the Planning Team adopted its definition of critical facilities for the 2018 update to include the following:

- Police stations, fire stations, vehicle and equipment storage facilities, communication centers and towers, and emergency operations centers needed for disaster response before, during, and after hazard events.
- Public and private utilities and infrastructure vital to maintaining or restoring normal services to areas damaged by hazard events. These include, but are not limited to:
  - Public and private (large scale) water supply infrastructure, water and wastewater treatment facilities and infrastructure, potable water pumping, flow regulation, distribution and storage facilities and infrastructure.
  - Public and private power generation (electrical and non-electrical), regulation and distribution facilities and infrastructure.
  - Communication facilities.

[5] http://www.spokesman.com/stories/2015/jul/15/explosion-rips-through-newport-aerospace-company/#/0
[6] http://www.spokesman.com/stories/2016/nov/21/semitruck-hauling-11000-gallons-of-diesel-fuel-cra/

  - Structures that manage or limit the impacts of natural hazards such as regional flood conveyance systems, potable water trunk main interconnect systems and redundant pipes crossing fault lines and reservoirs.
  - Major road and rail systems including bridges, airports, and water/marine terminal facilities.
- Hospitals, including large medical facilities that provide critical medical services.
- Structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic, and/or water-reactive materials (e.g., hazmat facilities).
- Public gathering places that could be used as evacuation or feeding centers (or suppliers) during large-scale disasters, including those with which the County or its planning partners have MOU's or MOA's for use during disaster incidents.
- Schools (provided by County and School Districts).
- Governmental facilities central to governance and quality of life along with response and recovery actions taken as a result of a hazard event.

3.4.2 Comprehensive Data Management System Update

This process included a partial update of the database contained in FEMA's Hazus software (a hazard-modeling program) to reflect a more accurate representation of the structures and facilities in the County; however, not all data was available for each structure to complete this update. This has been identified as a strategy for future updates. Utilizing the definition of Critical Facilities, the planning partners provided additional information as available which was joined with existing data. Limitations associated with the updated CDMS data and the FEMA dataset are discussed in Chapter 4. While all critical facilities identified are incorporated into this planning process, due to the sensitivity of this information, a detailed list of facilities is not provided. The list is on file with each planning partner.

Figure 3-7 illustrates the location of critical facilities and infrastructure in the planning area. Table 3-2 and Table 3-3 provide summaries of the general types of critical facilities and infrastructure. These tables indicate the location of critical facilities and infrastructure, not jurisdictional ownership. All critical facilities/infrastructure were analyzed to help rank risk and identify mitigation actions. The risk assessment for each hazard discusses critical facilities with regard to that hazard. At the conclusion of the risk assessment, each planning partner is provided an excel spreadsheet of their identified critical facilities on which specific impact data is noted. That spreadsheet, in part, provides the background and serves as the basis for their hazard ranking process.

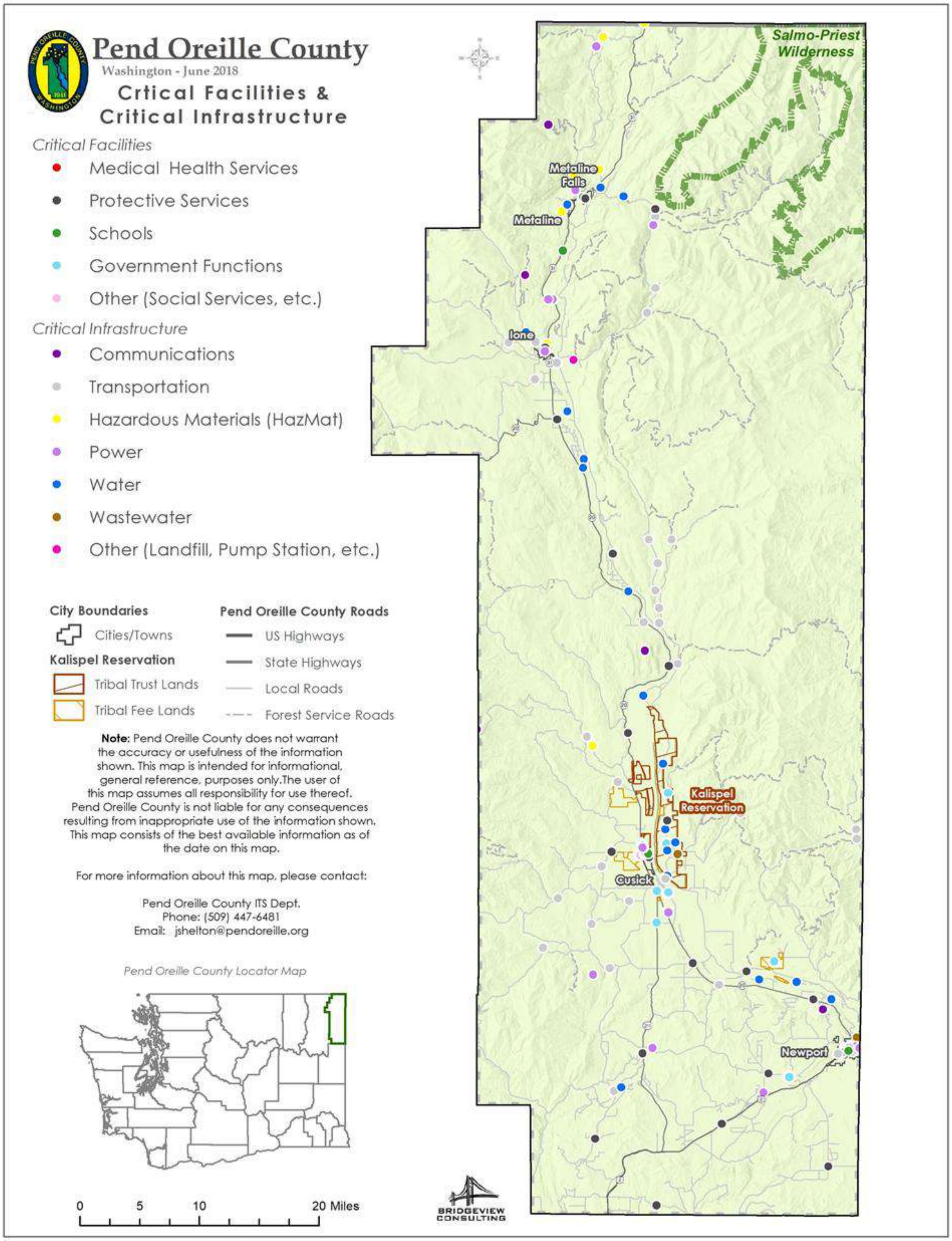


Figure 3-7 Planning Area Critical Facilities and Infrastructure – Bridges Removed

Table 3-2
Pend Oreille Countywide Critical Facilities

Jurisdiction	Medical and Health	Government Functions	Protective Functions*	Schools	Hazmat**	Shelter***	Total
Unincorporated Pend Oreille County	0	5	17	1	10	29	62
Kalispel Tribe of Indians	1	11	1	2	0	4	19
Newport, City of	12	9	4	6	3	0	34
Cusick, Town of	0	1	1	5	0	0	8
Ione, Town of	0	1	2	0	1	0	4
Metaline, Town of	0	0	0	0	0	0	0
Metaline Falls, Town of	1	0	2	2	2	0	5

*Protective Functions include the EOC and backup EOC, as well as police, fire and jail facilities.

**Hazmat also includes disposal and transfer stations for solid waste management, as well as hazardous materials facilities.

***Shelter includes shelter locations identified in addition to facilities which provide food or supportive functions. Pend Oreille County Fairgrounds are also designated as a shelter location, including for pet and agricultural animals' evacuation sites. All facilities on the fairgrounds have a supportive role and are individually identified. For some jurisdictions, parks are also identified as shelter/gathering locations.

Table 3-3
Pend Oreille Countywide Critical Infrastructure

Jurisdiction	Trans-portation	Water Supply	Wastewater	Power	Communica-tions	Other	Total
Unincorporated Pend Oreille County	33	12	2	13	4	1	65
Kalispel Tribe of Indians	1	6	2	0	1	0	10
Newport, City of	2	0	1	3	0	0	6
Cusick, Town of	1	0	0	0	0	0	1
Ione, Town of	0	0		1	0	0	1
Metaline, Town of	0	1	0	0	0	0	1
Metaline Falls, Town of	0	0	0	0	0	0	0

3.4.3 Critical Infrastructure

Electricity

Pend Oreille County Public Utility District is a consumer owned and locally controlled electric, water, and communication utility district. The home office is located in Newport, with service provided in both the north and south portions of the County. Box Canyon Dam is a hydroelectric project which is owned by the people of Pend Oreille County and operated by the Pend Oreille Public Utility District. This Public Utility District (PUD) was the first one in the state to build its own dam.

Power Loss

Downed trees and wind storms continue to be the leading cause of power outages in Pend Oreille County. The Pend Oreille PUD over the course of time since the last plan was approved has completed several large distribution projects, including the LeClerc Road Improvement Project, a 13-mile section on the east side of the Pend Oreille River between Riverbend and Tiger.[7] That area of the distribution system generally sustained longer outage durations due to inaccessible line locations and a lack of alternate feeds. During 2012-2013, the LeClerc project consisted of the installation of approximately 300 wood distribution poles along LeClerc Road North. On those poles, a Northwest Open Access Network fiber optic cable was also installed. Completion of these projects ensured that customers on both the east and west sides of the Pend Oreille River benefited from a more reliable system capable of sustaining projected growth over the next 50 years.

Large maintenance projects included continuance of the District's Pole Testing and Treatment Program, with 2,000 wood distribution poles being tested, as well as ongoing right-of-way clearing projects.

In 2012, the District received a $900,000 Department of Health grant for additional improvements for the Metaline Falls Water System. The project included replacing 13,000 feet of water main transmission lines, which were originally installed more than 50 years ago.

In accordance with the Department of Health's Water Use Efficiency Program, the District established water efficiency goals to reduce water usage by 1% per year through 2013, and reduce leakage. The District is in compliance with these and all other known water regulations.

Telecommunications

The Cusick and Usk areas are served by three Internet Service Providers. The Ione area is also served by three Internet Service Providers. In addition, Frontier Communications provides landline telecommunication service and Verizon Wireless and AT&T provide wireless communication service in Newport. The Pend Oreille Telephone Company serves the County from the Town of Dalkena throughout the rest of northern Pend Oreille County with landline telecommunication service. Metaline and the Metaline Falls area are served by Verizon Wireless and Unicel for wireless telecommunication service. The Northstar Broadband Cable Company serves the Diamond Lake, Ione, Metaline, and Metaline Falls areas; Concept Communications Corporation Cable Company serves the Newport area; and Dish Network, Comcast Cable and DirecTV serve all the other areas with cable and satellite service.

[7] http://www.popud.org/wp-content/uploads/2011/01/2012-Annual-Report.pdf

Sewer and Water

Pend Oreille County residents are served by multiple water and sewer districts. The City of Newport provides water and sewer services to the community of Newport. The West Bonner Sewer District #1 contracts with the City of Newport to utilize up to 30 percent of the sewer system capacity. The Sacheen Lake Water & Sewer District recently installed a new system, which became operational in 2017. The Diamond Lake Water and Sewer District provides services to the residents of the Diamond Lake community and some surrounding areas. Ponderay Shores Water and Sewer District provides service to the small area of Ponderay Shores Road and Open Skies Road, which is on the opposite or east side of the Pend Oreille River from the Dalkena community. The Chippewa Water and Sewer District provides service to the community of Ione. The Lenora Water and Sewer District provides service to the Skookum Rendevous (Camelot) area in the community of Usk. The Town of Cusick provides water service to its residents with in-town user rates as well as outside of town limits user rates. The Pend Oreille Mine Water System serves the Teck Mine and related facilities north of Metaline Falls. Lastly, the Pend Oreille Public Utility District provides water service to all of the following water system communities:

- Granite Sacheen Shore, Newport (Sacheen Lake)
- Greenridge, Newport Area
- Sandy Shores, Newport Area
- Riverview, Newport Area
- River Bend, Cusick Area (Just north of Lost Creek)
- Holiday Shores, Cusick Area (Just north of Ruby)
- Sunvale-Abbie Acres, Cusick Area (Just north of Lost Creek)
- Lazy Acres, Cusick Area (Just north of Tiger)
- Metaline Falls, City of Metaline Falls

Waste Management

Pend Oreille County has three transfer stations in the County. The South County Station is five miles west of Newport off of Highway 2 and Gray Road. The Central County Station is off of Highway 211 at Jared Road in Usk ,and the North County Station is east of Ione. Pend Oreille County Solid Waste Division completed a new Recycling Building in 2009. It is located at the South County Station west of Newport. The County also has developed Electronics Recycling (e-cycling) of electronics equipment at the South County Station; this station is the only site available for e-cycling in the County.

Health Care

Pend Oreille County is part of the Northeast Tri-County Health District. The Health District's Pend Oreille County Office, Newport Community & Environmental Health, is located in Newport.

Newport Hospital and Health Services is owned and operated by the Pend Oreille County Public Hospital District #1. The facility is a 24 bed Acute Care Hospital, with a 50 bed Short Term/Long Term Restorative Care Skilled Nursing Facility and a heliport. The Newport Hospital Long Term Care facility is adjoined to the Newport Hospital and Health Services. The Newport Hospital and Health Services also is associated with two Family Practice Clinics: the Family Health Center Newport located near the hospital location.

The River Mountain Village is an assisted living complex consisting of 42 studio and one-bedroom apartment units located in Newport. The complex is also associated with the Newport Hospital and Health Services.

The Selkirk Family Medical Center in Ione provides medical care to the northern portion of the County, including 911 emergency care, North Pend Oreille Ambulance, Basic Life Support, and Advanced Life Support, with the closest hospitals being located in Colville, WA (40 miles) and Newport, WA (50 miles).

The County's Developmental Disability, Mental Health, Substance Abuse and Prevention Programs offer counseling services in Newport. Outreach services are also available in the Cutter Theater in Metaline Falls and the Selkirk School District. This program also provides a crisis line.

Educational Facilities

The Washington State University Extension Office is located in the Courthouse annex in Newport and offers clinics, consultation, and workshops on agriculture, forestry, horticulture, family living, and community development to residents of the County. The Community Colleges of Spokane has a campus in the City of Newport.

The County has three Head Start facilities, one each located in Cusick, Newport, and Metaline Falls. Head Start is a Federal program that promotes the school readiness of children from birth to age five from low-income families by enhancing their cognitive, social, and emotional development. Head Start programs provide a learning environment that supports children's growth in many areas such as language, literacy, and social and emotional development.

Pend Oreille County has three school districts within its boundaries: the Selkirk, Newport and Cusick School Districts.

The Selkirk School District is in Metaline Falls and consists of a Junior/Senior High School and one elementary school. The Junior/Senior High School provides services to approximately 200 students annually in grades 7 through 12. Selkirk Elementary School is located in Metaline Falls, servicing approximately 100 students annually in grades Pre-K through 6.

The Newport School District in Newport has a total of three schools: The Stratton Elementary School, Sadie Halstead Middle School, and Newport High School. Stratton Elementary School services approximately 400 students annually in grades K through 4. Sadie Halstead Middle School services approximately 250 students annually in grades 5 through 8, and the Newport High School services approximately 400 students annually in grades 9 through 12.

The Cusick School District consists of the Cusick Junior/Senior High School and the Bess Herian Elementary School. Cusick Junior/Senior High School services approximately 150 students annually, covering grades 7 through 12. Bess Herian Elementary School provides service to approximately 150 students annually in grades Pre-K through 6.

Transportation:

Roads

Pend Oreille County roads fall into three types; U.S. Interstate Highway (Highway No. 2), state maintained, and local streets.

Pend Oreille County has five state-maintained routes, and they are: Washington State Route 20; Washington State Route 31, which connects to British Columbia and Washington State Highway 20; Idaho State Highway 41, an Idaho highway that has a 0.41 mile section partially in Washington; Washington State Route 211, which is a short connector route; and State Route 2, also known as U. S. Interstate Highway 2.

Together these five roads total 115 miles of highway system. The longest highway in Washington is State Route 20, which runs 53.76 miles within Pend Oreille County.

Rail

The Port of Pend Oreille is operated by the citizens of Pend Oreille County, who formed together in 1979 to create the Port. The sole purpose of the Port was to save the railroad and two mills, which were dependent on the railroad for service. Due to poor economic times the two mills have since been closed. The only service currently on this rail line is the Ponderay (variation of spelling) Newsprint Company.

The Port of Pend Oreille owns and operates the Pend Oreille Valley Railroad which interchanges with the Burlington Northern Railroad at Newport. Products that are shipped into and out of Pend Oreille County from the Newport interchange are newsprint, wood chips, and lumber. Rail service is provided into Cusick and Usk that serves Ponderay Newsprint Company and Vaagen Brothers Lumber, formerly Ponderay Valley Fibre. There is no passenger rail service in the County. On occasion the Newport/Priest River Rotary runs the Scenic Pend Oreille River Train (SPORT) between Newport and Dalkena. The ride follows the Pend Oreille River and affords views that are only available to train passengers.

Airports

Spokane International Airport is the closest regional commercial and freight airport to Pend Oreille County. Private plane service is operated south of Ione from the Robert Davis Airport. River Bend Airport is a privately owned airport located in Usk. Onserud Airfield is another small airstrip located near Usk in Pend Oreille County. The airport has grassy, uneven surface runways. Sullivan Lake State Airport sits on the shore of Sullivan Lake near the community of Metaline Falls. The approach to the airport is over the lake and the runway is short with a rough field. There is a landing area near Newport as well. These small airports and landing strips are for private plane use only.

The County also has two Heliports, one at the Boundary Substation on the Boundary Dam, and the other at the Newport Community Hospital.

3.5 DEMOGRAPHIC DATA

Review of demographic data helps us determine where vulnerabilities may exist, as some populations are at greater risk from hazard events because of decreased resources or physical abilities. Elderly people, for example, may be more likely to require additional assistance. Research has shown that people living near or below the poverty line, the elderly (especially older single men), the disabled, women, children, ethnic minorities and renters all experience, to some degree, more severe effects from disasters than the general population. These vulnerable populations may vary from the general population in risk perception, living conditions, access to information before, during and after a hazard event, capabilities during an event, and access to resources for post-disaster recovery. Indicators of vulnerability—such as disability, age, poverty, and minority race and ethnicity—often overlap spatially and often in the geographically most vulnerable locations.

3.5.1 Population Trends

Population changes are useful socio-economic indicators. A growing population generally indicates a growing economy, while a decreasing population signifies economic decline. In April of each year, the Washington State Office of Financial Management (OFM) also develops population data.

Knowledge of the composition of the population, how it has or may change in the future is needed for informed planning decisions. Information about population is a critical part of planning because it directly relates to land needs such as housing, industry, stores, public facilities and services, and transportation. Table 3-4 presents County population data as established by the 2010 U.S. Census Data. Kalispel Tribe data is not included in Census Data.

Table 3-4
2010 Population and Housing

Geographic Area	Population	Housing units (2010 Census Data)*
Unincorporated Pend Oreille County	**9,810**	**6,335**
Kalispel Tribe of Indians**	**250**	**168**
Newport, City of	**2,126**	**954**
Cusick, Town of	**207**	**106**
Ione, Town of	**447**	**239**
Metaline, Town of	**173**	**91**
Metaline Falls, Town of	**238**	**192**
Total (Census)	**13,001**	**7,936**
Total (including Tribal data)	**13,251**	**8,104**

* US Census Data (2010) Most current available for type of data

** Kalispel Tribe is not included in US Census Data; data utilized is provided by the Tribe.

Table 3-5 illustrates the population trends from 2010-2017 based on Census and OFM data.[8] Such data indicates a higher population rate than the 2010 Census data; however, due to greater variations of available data from the Census information applicable to this planning effort in a geospatial format which is unavailable through OFM data, in some instances, Census data is utilized for spatial and mapping projections (e.g., social vulnerability tables and maps).

Table 3-5
Countywide Population Changes by Jurisdiction 2010-2017

City or Town	Census 2010	Estimate 2011	Estimate 2012	Estimate 2013	Estimate 2014	Actual 2015	Estimate 2016	Estimate 2017
Unincorporated Pend Oreille County	9,810	9,790	9,890	9,945	9,985	10,030	10,085	10,140
Incorporated Pend Oreille County	3,191	3,210	3,210	3,205	3,225	3,210	3,205	3,230

[8] Office of Financial Management http://www.ofm.wa.gov/pop/april1/

City or Town	Census 2010	Estimate 2011	Estimate 2012	Estimate 2013	Estimate 2014	Actual 2015	Estimate 2016	Estimate 2017
Kalispel Tribe	Not Identified in Census							
Cusick	207	210	210	205	205	200	200	205
Ione	447	445	445	445	445	440	440	445
Metaline	173	175	175	175	185	175	180	170
Metaline Falls	238	240	240	240	240	235	235	240
Newport	2,126	2,140	2,140	2,140	2,150	2,160	2,150	2,170
TOTAL	**13,001**	**13,000**	**13,100**	**13,150**	**13,210**	**13,240**	**13,290**	**13,370**
Source: http://www.ofm.wa.gov/pop/april1/poptrends.pdf								

The Office of Financial Management updates county and state long-range population forecasts every five years to support Growth Management Act planning (discussed in Section 16.1.2). The most recent forecasts, which project out to 2040, were issued in May 2012 and are shown in Table 3-6. OFM considers the medium projection the most likely (RCW 43.62.035) because it is based on assumptions that have been validated with past and current information. The high and low projections represent the range of uncertainty that should be considered when using these projections for planning.

Based on 2012 projections by OFM for 2017, when compared to the actual population, the county is below OFM projected levels; however, the population size has continued to grow. This is further confirmed in OFM's 2016 Annual Report, which indicates that Pend Oreille's population increased (0.38 percent change), with the state, in general, increasing in population size by 1.73 percent, up from 1.34 percent in 2015 (OFM Annual Report, 2016) (see Figure 3-8).

Table 3-6
County and State Population Projections

	Census	Projections					
	2010	2015	2020	2025	2030	2035	2040
Washington	6,724,540	7,022,200	7,411,977	7,793,173	8,154,193	8,483,628	8,790,981
Adams	18,728	20,257	21,640	22,964	24,289	25,690	27,205
Asotin	21,623	21,818	22,033	22,196	22,313	22,358	22,356
Benton	175,177	184,882	197,806	210,803	223,689	236,007	247,856
Chelan	72,453	75,180	78,586	81,885	84,778	87,168	89,246
Clallam	71,404	71,868	73,616	75,022	76,112	76,786	77,224
Clark	425,363	447,201	477,884	508,124	536,717	562,207	585,137
Columbia	4,078	4,047	4,013	3,968	3,895	3,800	3,700
Cowlitz	102,410	105,130	108,588	111,706	114,158	115,798	116,897
Douglas	38,431	40,603	43,619	46,662	49,583	52,256	54,762
Ferry	7,551	7,619	7,706	7,751	7,754	7,740	7,692
Franklin	78,163	87,755	100,926	115,142	130,284	146,103	162,900
Garfield	2,266	2,238	2,220	2,210	2,202	2,175	2,143
Grant	89,120	95,822	104,078	112,525	121,204	129,779	138,337
Grays Harbor	72,797	73,575	74,408	75,529	76,428	76,905	77,070
Island	78,506	80,337	82,735	85,073	87,621	90,239	93,205
Jefferson	29,872	30,469	32,017	33,678	35,657	37,914	40,093
King	1,931,249	2,012,782	2,108,814	2,196,202	2,277,160	2,350,576	2,418,850
Kitsap	251,133	262,032	275,546	289,265	301,642	311,737	320,475
Kittitas	40,915	42,592	45,255	47,949	50,567	53,032	55,436
Klickitat	20,318	20,606	20,943	21,225	21,430	21,492	21,439
Lewis	75,455	77,621	80,385	82,924	85,165	87,092	88,967
Lincoln	10,570	10,616	10,707	10,800	10,865	10,862	10,817
Mason	60,699	63,203	67,545	71,929	76,401	80,784	84,919
Okanogan	41,120	42,230	43,163	43,978	44,619	45,127	45,707
Pacific	20,920	20,860	20,990	21,261	21,495	21,736	22,042
Pend Oreille	13,001	13,289	13,692	13,977	14,129	14,149	14,116
Pierce	795,225	831,944	876,565	923,912	967,601	1,006,614	1,042,341
San Juan	15,769	15,907	16,256	16,606	16,939	17,216	17,443
Skagit	116,901	121,624	128,249	136,410	144,953	153,632	162,738
Skamania	11,066	11,282	11,548	12,014	12,447	12,816	13,082
Snohomish	713,335	750,358	805,015	857,939	908,807	955,281	997,634
Spokane	471,221	489,491	513,910	537,428	558,614	576,763	592,969
Stevens	43,531	44,262	45,212	46,447	47,834	49,340	50,929
Thurston	252,264	266,224	288,265	307,930	326,426	343,019	358,031
Wahkiakum	3,978	3,931	3,877	3,830	3,772	3,716	3,669
Walla Walla	58,781	60,015	61,685	63,368	64,978	66,378	67,655
Whatcom	201,140	210,050	225,307	241,138	256,643	271,142	284,901
Whitman	44,776	46,139	47,826	49,346	50,577	51,563	52,504
Yakima	243,231	256,341	269,347	282,057	294,445	306,636	318,494

Note: OFM Forecasting – May 2012 Differences in 2010 figures compared to other tables due to Census corrections. Data may not add due to rounding; unrounded figures are not meant to imply precision.

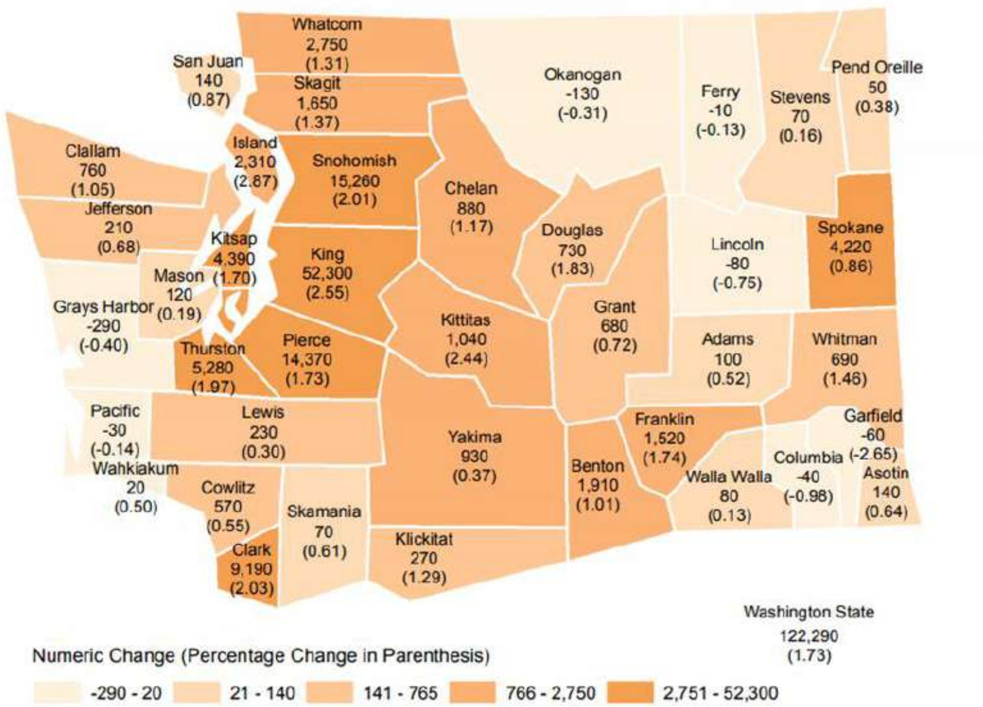


Figure 3-8 Statewide Distribution of 2015-2016 Population Change by County
Source: Office of Financial Management 2016 Population Trends

Elderly people may be more likely to require additional assistance during a disaster incident, or might be less able to provide such care during a crisis, finding the magnitude of the task of providing that care beyond their capability. Research has shown that people living near or below the poverty line, the elderly, the disabled, women, children, ethnic minorities and renters all experience, to some degree, more severe effects from disasters than the general population.

During emergencies, real-time evacuation information may not be provided to people with limited English proficiency, the hearing and visually impaired, and other special needs group. Many low-income people may be stranded because they have no personal transportation, and no mass transit (especially during emergencies) is available.

For the poor, they are less likely to have the income, or assets needed to prepare for a possible disaster, or to recover after a disaster. Although the monetary value of their property may be less than that of other households, it likely represents a larger portion of the total household assets. As such, lost property is proportionately more expensive to replace, especially without insurance. Additionally, unemployed persons do not have employee benefits that provide health cost assistance. High-income populations who suffer higher household losses (absolute terms) find their overall position mitigated by insurance policies and other financial investments not available to lower income households.

These vulnerable populations may vary from the general population in risk perception, living conditions, access to information before, during and after a hazard event, capabilities during an event, and access to resources for post-disaster recovery. Indicators of vulnerability—such as disability, age, poverty, and minority race and ethnicity—often overlap spatially and often in the geographically most vulnerable locations. Figure 3-9 identifies the variables that exist within the five census tracks within Pend Oreille County which can increase vulnerability to the population of the county. Section 14.2, Social Vulnerability, provides a more in-depth spatial analysis, identifying areas where there are higher concentrations of potentially vulnerable community members. Such data helps to extend focused public outreach and education to these most vulnerable citizens.

3.5.2 Age Distribution

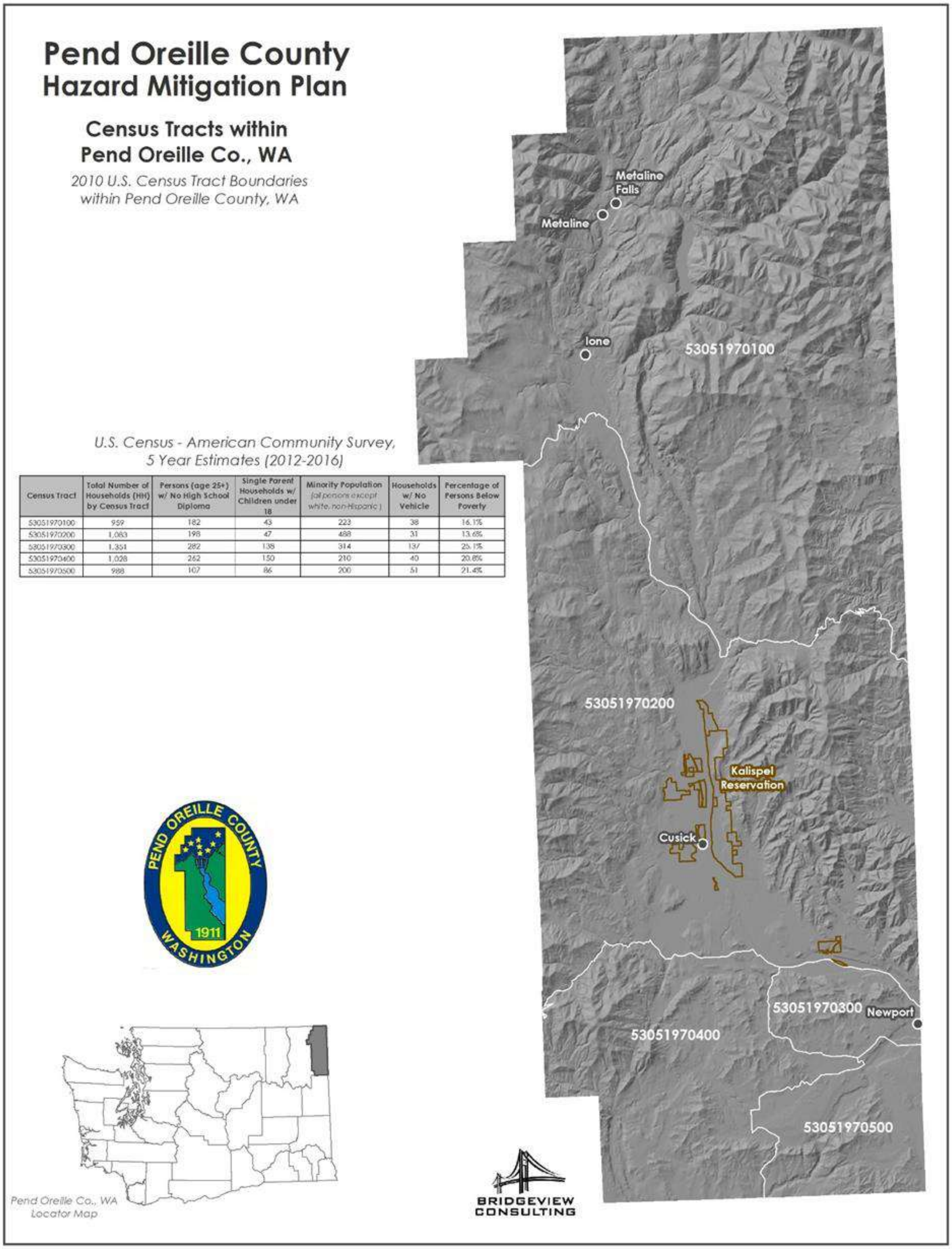
As a group, the elderly are more apt to lack the physical and economic resources necessary for response to hazard events and more likely to suffer health-related consequences making recovery slower. They are more likely to be vision, hearing, and/or mobility impaired, and more likely to experience mental impairment or dementia. Additionally, the elderly are more likely to live in assisted-living facilities where emergency preparedness occurs at the discretion of facility operators. These facilities require extra notice to implement evacuation.

Elderly residents may have more difficulty evacuating their homes and could be stranded in dangerous situations. This population group is more likely to need special medical attention, which may not be readily available during natural disasters due to isolation caused by the event. Specific planning attention for the elderly is an important consideration given the current aging of the American population.

Pend Oreille County is an older community compared to both the State of Washington and the United States. Median age is 49.3 years. As of 2016, an estimated 23.8 percent (3,091 individuals) of county residents were older than 65 (Fact Finder Census).[9] This is higher than the State average of 14.4 percent.[10]

Children under 17, and specifically under 5 are particularly vulnerable to disasters because of their dependence on others for basic necessities. Very young children are additionally vulnerable to injury or sickness; this vulnerability can be worsened during a natural disaster because they may not understand the measures that need to be taken to protect themselves. The 2010 U.S. Census QuickFacts identifies 4.9 percent (633) of the County's population under the age of 5 years. More current projections for 2016 identified 4.4 percent, which is below the state average of 6.2 percent.

[9] https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_16_1YR_S0101&prodType=table
[10] https://fortress.wa.gov/esd/employmentdata/reports-publications/regional-reports/county-profiles/pend-oreille-county-profile



Census Tract	Total Number of Households (HH) by Census Tract	Persons (age 25+) w/ No High School Diploma	Single Parent Households w/ Children under 18	Minority Population (all persons except white, non-Hispanic)	Households w/ No Vehicle	Percentage of Persons Below Poverty
53051970100	959	182	43	223	38	16.1%
53051970200	1,083	198	47	488	31	13.6%
53051970300	1,351	282	138	314	137	25.1%
53051970400	1,028	262	150	210	40	20.8%
53051970500	988	107	86	200	51	21.4%

Figure 3-9 Pend Oreille County Census Tracks and Select Demographic Data

3.5.3 Race, Ethnicity and Language

Research shows that minorities are less likely to be involved in pre-disaster planning and experience higher mortality rates during a disaster event. Post-disaster recovery can be ineffective and is often characterized by cultural insensitivity. Since higher proportions of ethnic minorities live below the poverty line than the majority white population, poverty can compound vulnerability.

Pend Oreille County showed much less diversity in 2015 than the state in all racial/ethnic categories except American Indians and Alaskan Natives. In Pend Oreille, American Indians and Alaskan Natives made up ~4.0 percent of its population compared to 1.9 percent of the state's population.

According to the 2016 U.S. Census Bureau's QuickFacts, racial makeup of the county is: 91.6 percent white; 4 percent American Indian; Black or African American 0.4 percent; Native Hawaiian and other Pacific Islander 0.1 percent; Asian 0.6 percent, and 3.51 percent Hispanic or Latino.[11] Census data also indicates that 2.96 percent of the Pend Oreille County population spoke a language other than English at home (see Figure 3-10). 99 percent are U.S. citizens.[12] Census data also reports 1,597 Veterans residing in Pend Oreille County during the reporting time period 2012-2016.

Washington State Office of Financial Management, Forecasting Division, indicates that as of 2016 (most current report available), the Primary Language in Pend Oreille County is 99.03% English within the school systems.

3.5.4 Disabled Populations

People with disabilities are more likely than the general population to have difficulty responding to a hazard event. As disabled populations are increasingly integrated into society, they are more likely to require assistance during the 72 hours after a hazard event, the period generally reserved for self-help. There is no "typical" disabled person, which can complicate disaster-planning processes that attempt to incorporate them. Disability is likely to be compounded with other vulnerabilities, such as age, economic disadvantage and ethnicity, all of which mean that housing is more likely to be substandard.

Census data identifies 14.5 percent of Pend Oreille's population under age 65 living with a disability during the time period 2011-2016. This represents a higher rate than statewide, which is 8.9 percent for the same time period.

3.5.5 Education

Census data identifies that 90.3 percent of the County age 25 and older have graduated high school, compared to 90.2 percent statewide. Those with a bachelor's degree or higher made up 16.6 percent of residents age 25 and older, compared to 32.3 percent statewide.

3.5.6 Homeless Population

In emergency planning, the needs of homeless people are usually categorized within the needs of all "special populations." People who are homeless have limited resources to evacuate, stockpile food, store medications, and shelter in place. In addition, people who are homeless have limited access to Internet and

[11] https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF
[12] https://datausa.io/profile/geo/pend-oreille-county-wa/

television, and are often the last to know about emergencies. Most do not own vehicles for evacuation purposes, and do not know safe locations to which to evacuate. For these reasons, communities often struggle in their approach to prepare homeless people for disasters. While informational leaflets, coupled with personal trainings, have been effective in helping homeless people prepare for disasters, most jurisdictions are unaware of the number of homeless in their community, and even where they are located. The County currently does not track the homeless population.

3.5.7 Mobility

Census data identifies an average of two vehicles per household. The average commute time to and from work within the County is 30 minutes each way.

3.6 ECONOMY

Knowing the economic characteristics of a community can assist in the analysis of the community's ability to prepare, respond, and rebuild safer after a natural hazard. Categorizing economic vulnerability can encompass many factors, including median household income, poverty rates, employment and unemployment rates, housing tenure, and community building inventory.

Pend Oreille County was largely settled after the discovery of gold in the 1850s in the northern part of the county. This gold strike failed to become a major gold rush. The real mining riches were found in other hard-rock minerals: lead and zinc.

Historically, timber became a major industry once railroad access was developed. A cement manufacturing industry also developed, benefiting from natural deposits of limestone and quartz in the northern part of the county. Much of this resource extraction was first made possible by using the Pend Oreille River for transportation, then by railroad and eventually by state highways.

The employment in Pend Oreille County was affected by the most recent recession, beginning in 2008. The recovery has been long, slow and painful. Growth over the last several years has dropped off, with small pockets of gains, but nowhere near the amount needed to replace the total employment at the peak of the business cycle.

Even with a slow rate of growth, the workforce serving Pend Oreille's major industries presents challenges because current workers have a high average age, increasing the need for replacement workers as they begin retiring.

The largest jobholder age group in Pend Oreille County in 2015 was the 45 to 54 year-olds at 25.1 percent of the workforce. This percentage was closely followed by jobholders aged 55 to 64 with 23.0 percent of the workforce.[13]

In 2015, men held 50.8 percent and women held 49.2 percent of the jobs in Pend Oreille County. There were substantial differences in gender dominance by industry.

[13] *Employment Security Department; Bureau of Labor Statistics; Bureau of Economic Analysis; U.S. Census Bureau; U.S. Census Bureau, American Community Survey)*https://fortress.wa.gov/esd/employmentdata/reports-publications/regional-reports/county-profiles/pend-oreille-county-profile

- Male-dominated industries included agriculture (87.9 percent), manufacturing (88.3 percent), construction (85.3 percent) and mining (89.0 percent).
- Female-dominated industries included healthcare and social assistance (81.1 percent), finance and insurance (79.2 percent) and educational services (70.7 percent).

Pend Oreille County is a rural labor market with 2,959 jobs located in the county. Consequently, a large number (about a third) of the employed residents work in jobs at firms located outside the county. It is likely that the suburban expansion of Spokane into Pend Oreille County explains part of this, but it also reflects a higher level of commuting by residents for jobs outside the county. Major employment sectors in Pend Oreille County are service-providing industries, manufacturing, and government.

- Goods-producing employment averaged 413 jobs in 2015, increasing slightly from the same period in 2014. Manufacturing employment remains weak due to improved technology and efficiencies allowing manufactures to increase production without an increase in employment.
- Government employment accounts for approximately 50 percent of all jobs (in and out of Pend Oreille County boundary), which continues to face budget reductions in 2016/2017.
- Service-providing employment averaged 2,597 jobs in 2015, increasing 146 jobs from 2014, and remain the top industry in the County.[14]
- Principal economic activities in the county are: wood and paper products, seafood processing, food processing, and manufacturing.
- Ten of the top 15 industrial companies in the county are wood-product related; and sustained-yield forestry, reforestation, plywood, paper, pulp and food processing remain the county's industrial base.
- The Kalispel Tribe currently employs approximately 450 people within Pend Oreille County, both tribal and non-tribal. With the construction of the new Casino and RV resort area scheduled to open in August 2018, that number is anticipated to increase to approximately 525 full- and part-time employees by the Tribe. Additionally, when factoring in the development of the Tribe's public utility district, the Northern Quest Casino Resort, and the Kalispel Golf Course, the Kalispel Tribe is one of the largest employers within the Spokane and Pend Oreille areas.

3.6.1 Income and Employment

In the United States, individual households are expected to use private resources to prepare for, respond to, and recover from disasters to some extent. This means that households living in poverty are automatically disadvantaged when confronting hazards. Additionally, the poor typically occupy more poorly built and inadequately maintained housing. Mobile or modular homes, for example, are more susceptible to damage in earthquakes and floods than other types of housing. In urban areas, the poor often live in older houses and apartment complexes, which are more likely to be made of un-reinforced masonry, a building type that is particularly susceptible to damage during earthquakes. Furthermore, residents below the poverty level are less likely to have insurance to compensate for losses incurred from natural disasters. This means that residents below the poverty level have a great deal to lose during an event and are the least prepared to deal with potential losses. Personal household economics also significantly impact people's decisions on

[14] Washington State Employment Security Labor Market and Performance Analysis https://fortress.wa.gov/esd/employmentdata/reports-publications/regional-reports/labor-area-summaries

evacuation. Individuals who cannot afford gas for their cars will likely decide not to evacuate. Per capita income for the county is identified in Table 3-7. Median income for a household in the county is based on OFM data as presented in Table 3-8 (2015 dollars).

Based on Census data, approximately 21.5 percent of the population were below the poverty line; state level was approximately 13 percent of population base.[15] The poverty rate for the county is significantly higher than the national rate (15.5 percent in 2015), and the state rate (13.3 percent in 2015) (see Table 3-9). Washington State OFM data also identifies the families in poverty, which includes children under the age of 18 in poverty, individuals in poverty, and individuals age 65 and older in poverty (see Figure 3-11).[16]

Table 3-7
Per Capita Income Levels 2005-2015

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
U.S.	$35,904	$38,144	$39,821	$41,082	$39,376	$40,277	$42,453	$44,267	$44,462	$46,414	$48,112
State	$37,759	$40,357	$43,192	$44,794	$41,844	$42,195	$44,197	$47,324	$47,778	$50,357	$51,898
Pend Oreille	$23,471	$24,150	$26,321	$29,614	$30,318	$31,082	$31,736	$32,338	$32,628	$34,360	$35,151
Rank	37	38	38	36	30	32	36	36	36	34	36

Table 3-8
Median Household Income Levels 2006-2015

	Median Household Income		Median Family Income	
	2006-10	2011-15	2006-10	2011-15
U.S.	$55,938	$67,864	$53,889	$66,011
State	$61,681	$74,702	$61,062	$74,025
Pend Oreille	$41,911	$50,612	$40,599	$50,036

15 Census Quick Facts https://www.census.gov/quickfacts/fact/table/US/IPE120216#viewtop
16 https://www.ofm.wa.gov/washington-data-research/statewide-data/washington-trends/social-economic-conditions/families-povertyfamilies-children-under-age-18-povertyindividuals-povertyindividuals-age-65-and-older-poverty

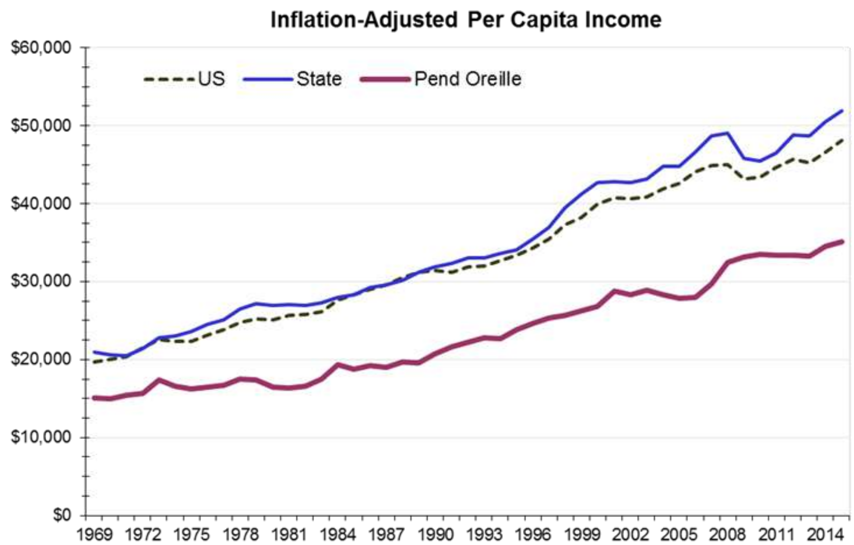


Figure 3-10 Inflation-Adjusted Per Capital Income 2005-2015

Table 3-9
Pend Oreille County Poverty Rates 1999-2015

Poverty Rate	**All individuals**			**Children (<18 years old)**		
	1999	**2006-10**	**2011-15**	**1999**	**2006-10**	**2011-15**
U.S.	9.2%	13.8%	15.5%	13.6%	23.7%	27.8%
State	10.6%	12.1%	13.3%	15.0%	19.0%	21.2%
Pend Oreille	18.1%	18.3%	21.5%	28.5%	33.7%	42.2%

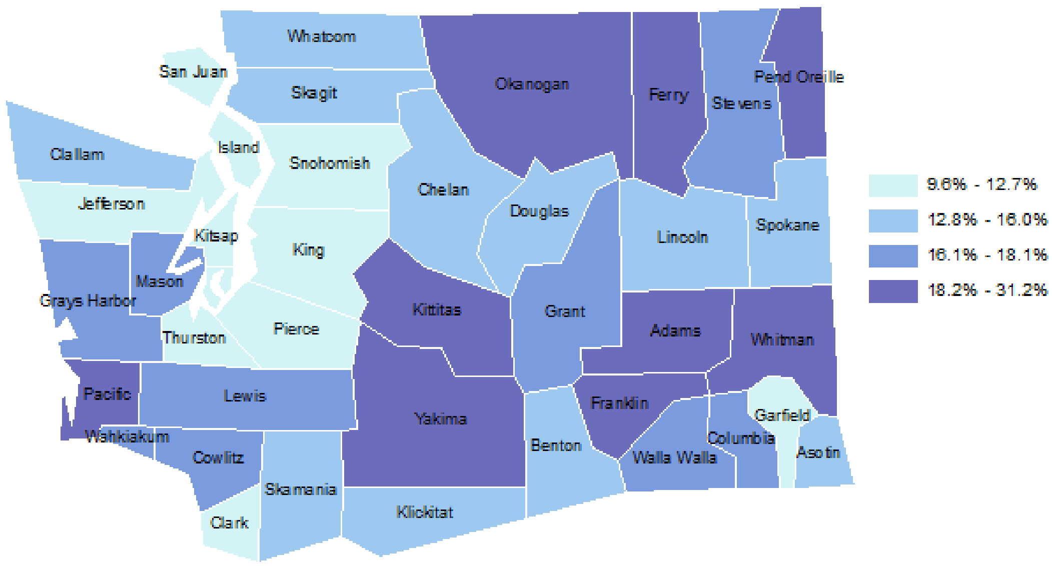


Figure 3-11 Families in Poverty

Economic sustainability is encouraged through employment and job security. The higher the employment rate, the more financial stability is accomplished on an individual level. In addition, a healthy job market brings economic growth to communities.

The civilian labor force increased slightly in the first six months of 2016 to 4,737, from the same period in 2015 of 4,646 The number of employed residents showed an increase in 2016 to 4,276 (99).

The average unemployment rate in the first half of 2016 was 9.7 percent, down from 10.1 percent in 2015. The year-long average unemployment rate in Pend Oreille County in 2016 was 9.1 percent, higher than most other counties in the state. Things are improving, however, as the drop in the unemployment rate was due to an increase in jobs. By June 2017, the average had dropped to 6.0 percent (see Figure 3-12, Table 3-10, and Figure 3-13). Nonetheless, as of April 19, 2017, Pend Oreille County was identified as a distressed area by the Washington State Department of Revenue, meaning that Pend Oreille County's three-year unemployment rate was at least 20 percent higher than the statewide average.[17]

[17] https://esd.wa.gov/labormarketinfo/distressed-areas

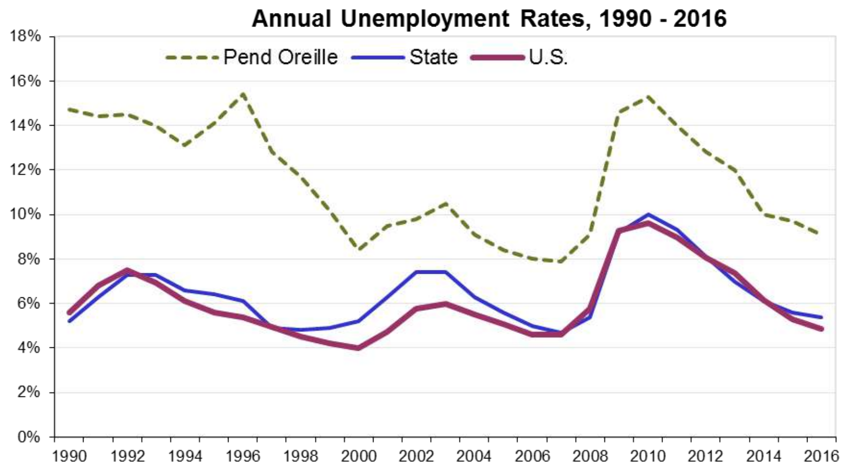


Figure 3-12 Pend Oreille County Unemployment Statistics 1990-2016

Table 3-10
Pend Oreille County Average Yearly Unemployment Rates 2005-2016

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Pend Oreille	8.4%	8.0%	7.9%	9.1%	14.6%	15.3%	14.0%	12.8%	12.0%	10.0%	9.7%	9.1%
Washington State	5.6%	5.0%	4.7%	5.4%	9.2%	10.0%	9.3%	8.1%	7.0%	6.1%	5.6%	5.4%
U.S.	5.1%	4.6%	4.6%	5.8%	9.3%	9.6%	8.9%	8.1%	7.4%	6.2%	5.3%	4.9%

Source: Employment Security Department/WITS; U.S. Bureau of Labor Statistics, Local Area Unemployment Statistics

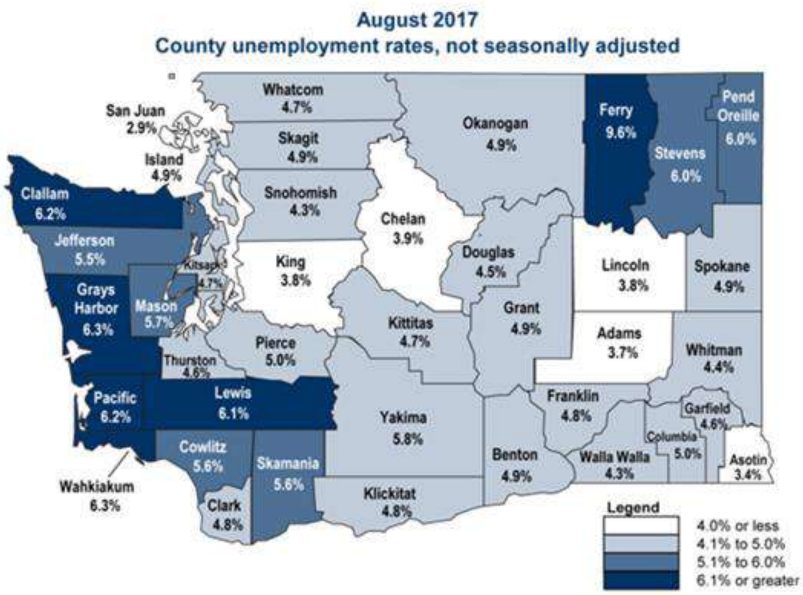


Figure 3-13 Statewide Unemployment Rates August 2017

3.7 LAND USE PLANNING AND FUTURE DEVELOPMENT TRENDS

The County Comprehensive Plan includes components that help to guide the vision for the County: Planning Policies, Future Land Use Analysis, Critical Areas, and Capital Facilities. Within Washington State, the State Growth Management Act (GMA) requires state and local governments to manage Washington's growth by identifying and protecting critical areas and natural resource lands, designating urban growth areas, preparing comprehensive plans and implementing them through capital investments and development regulations.

Over 90 percent of the original forests between the major roads east and west of the Pend Oreille River have been logged or burned at least once, or permanently cleared for agriculture or residential development. A large part of this area is in open fields (pasture, hay fields and fallow land). Seasonally flooded wetlands are extensive. Wetland types include seasonally flooded fields, scrub-shrub and forests; persistently flooded, emergent wetlands; persistently flooded, shallow riverine sloughs; old sloughs that are presently connected to the river only during flood conditions and ponds not evidently connected hydrologically to the river. There are eighteen sloughs, thirteen major tributary mouths and six major islands between Albeni Falls and Box Canyon Dam.

According to the Washington State Department of Revenue, as of 2015 (most current data available) Pend Oreille County had 217,099 acres of Designated Forest Land. This ranks the County 11th in the state with respect to acres with such designation (Washington DOR, 2016).[18] Farm and Agriculture use acres total 26,390, with 6 acres of open space. Only 36 percent of land in the county is privately owned, with about 58 percent owned by the federal government.

[18] Washington State Department of Revenue. https://dor.wa.gov/about-us/statistics-reports/property-tax-current-use-designated-forest-land

The major land owners in the County are the National Forest Service, the State of Washington, the Kalispel Native American Reservation, and the Bureau of Land Management. The chief use of land and natural resources are logging, mining and farming. The lumber industry relies on the federal forests. The major timber species are Douglas-fir, Western Larch, and Ponderosa pine. Only about 25% of the land in the County is used for harvested cropland or livestock grazing. A number of developed and undeveloped recreation sites exist throughout Pend Oreille County. The U.S. Forest Service, Washington State Department of Natural Resources, Washington State Department of Fish and Wildlife, Seattle City Light and the Pend Oreille Public Utility (PUD), have created recreation sites, as have a handful of private enterprises. Approximately 60 percent of Pend Oreille County is in public ownership (Pend Oreille Parks, 2015) (see Figure 3-14).

Pend Oreille County is unique in terms of population density, transportation, industries and infrastructure. It is very rural, with only 9.3 persons per square mile. The County also has a rural economy, with limited transportation routes and dependence on resource extraction, specifically, lead and zinc mining followed by timber and cement manufacturing.

One of Washington’s most important mining areas was the Pend Oreille/Metaline Mining District, which produced lead, zinc and silver from 1911 to 1977. The mine was allowed to flood to the 1350 foot level in 1977. In 1988 the Pend Oreille Mine was pumped out and more reserves were discovered. The mining District was purchased by Teck Cominco American Inc. in 1996, which refitted the buildings and prepared the mine for production to begin again in 2004. The mine was then operated for five years under the name Teck Washington, Inc. In February of 2009, the mine was transitioned to care and maintenance by Teck Washington, Inc.

Average household size for the county and its municipalities is two persons per household, which is the calculation utilized during this planning process to identify potential vulnerability and individuals at risk.[19] Average household size for the Kalispel Reservation is three persons per household, which is the calculation utilized during this planning process as it relates to the Reservation boundaries.

Washington’s Growth Management Act (GMA) requires that jurisdictions select a population projection to use for planning projections. Section 3.5 details the population projections for Pend Oreille County. The Office of Financial Management considers the medium projection the most likely (RCW 43.62.035) because it is based on assumptions that have been validated with past and current information. The high and low projections represent the range of uncertainty that are considered when using these projections for planning purposes. Counties must select a population projection that falls within these ranges to determine their GMA planning projection. Pend Oreille County does not fully participate under the GMA (OFM 2016 Annual Report).

[19] https://www.census.gov/quickfacts/fact/table/pendoreillecountywashington/PST040216?

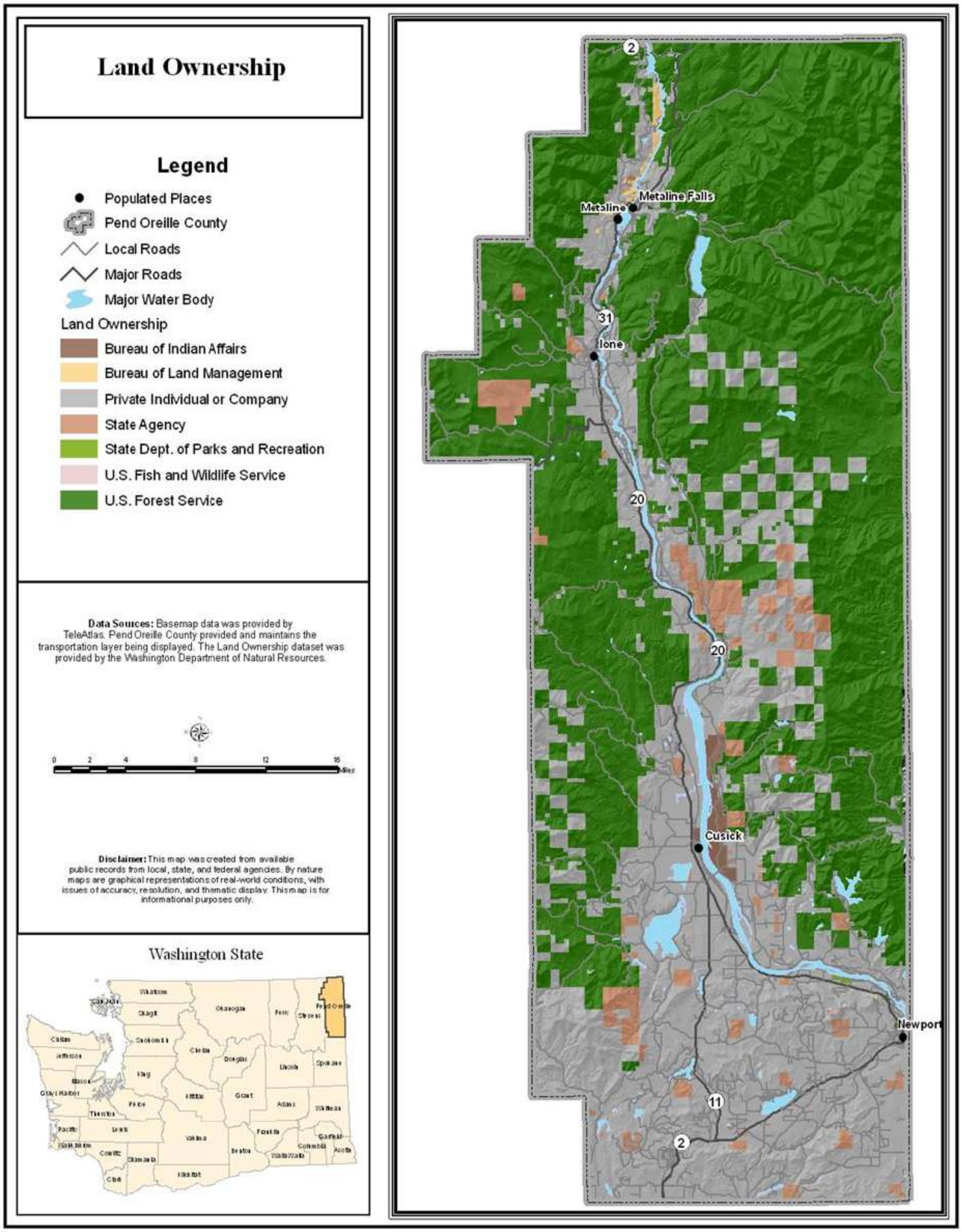


Figure 3-14 Land Ownership Distribution

Critical areas are environmentally sensitive natural resources that have been designated for protection and management in accordance with the requirements of the GMA. Protection and management of these areas is important to the preservation of ecological functions of our natural environment, as well as the protection of the public health, safety and welfare of our community. The County recently updated its Critical Area Protection Ordinance in December 2015 while doing a partial update of its Comprehensive Plan. Information from this mitigation plan will help identify the critical areas throughout the county and its incorporated jurisdictions in future updates as appropriate.

The County has adopted a comprehensive plan that governs its land use decision- and policy-making process in accordance with GMA guidelines. This plan will work together with these programs to support wise land use in the future by providing vital information on the risk associated with natural hazards in Pend Oreille County.

The County's Community Development Department is responsible for updating the Comprehensive Land Use Plan and for overseeing and regulating land use and development in unincorporated Pend Oreille County to protect the health, safety, and welfare of County residents. The department is also responsible for floodplain management in the County. The Planning Department works with other government departments (including emergency management); various agencies and municipalities (including special purpose districts); the general public; land-owners; special interest groups; and businesses to oversee development in unincorporated Pend Oreille County, ensuring land use remains consistent with federal, state and county regulations.

Utilzing estimated population growth statistics, the county has estimated how the future growth in population will be distributed among the different districts created in the Comprehensive Plan. Table 3-11 identifies current land use classifications and acres in the identified classifications within the County. Figure 3-15 is an illustration of the County's most current land use distribution and zoning map.

Research in the area of growth management has demonstrated that communities experiencing economic growth who are able to invest in new development, including mitigation efforts, increase the resilience of both existing and new buildings and infrastructure. Newly constructed buildings and infrastructure are more resilient to hazards of concern and the associated impact by those hazards (e.g., ground shaking, water velocity, etc.) as they are built to higher building code standards. The use of data within plans such as these play a significant role in education with respect to identifying those areas of concern addressed within Growth Management.

Table 3-11 Pend Oreille County Land Use		
Public		**568,040**
Federal		538,759
BLM		1662
BPA		43
USDOE		483
USFS		536,281
USFWS		290
State		21,511
Misc. State/ State Parks		257
WADNR		17,079
WDFW		3,377
WSDOT		798
Other Tax Exempt*		**7,770**
County		4,214
PUD		2,597
School Districts		191
Seattle City Light		768
Rail Road/ Port of Pend Oreille	* Do not have acreage	
Tribal Trust & Reservation Land		**8,273**
Private Land		**317,812**
Natural Resources Land		249,048
Agriculture		20,723
Commercial Timberland		120,818
Other NR Zoned Parcels		107,507
Residential, Commercial, Vacant, other		68,740
Right of way/Water/Other		**18,815**
TOTALS		**912,940**
Source: Pend Oreille County Natural Resource (2016)		

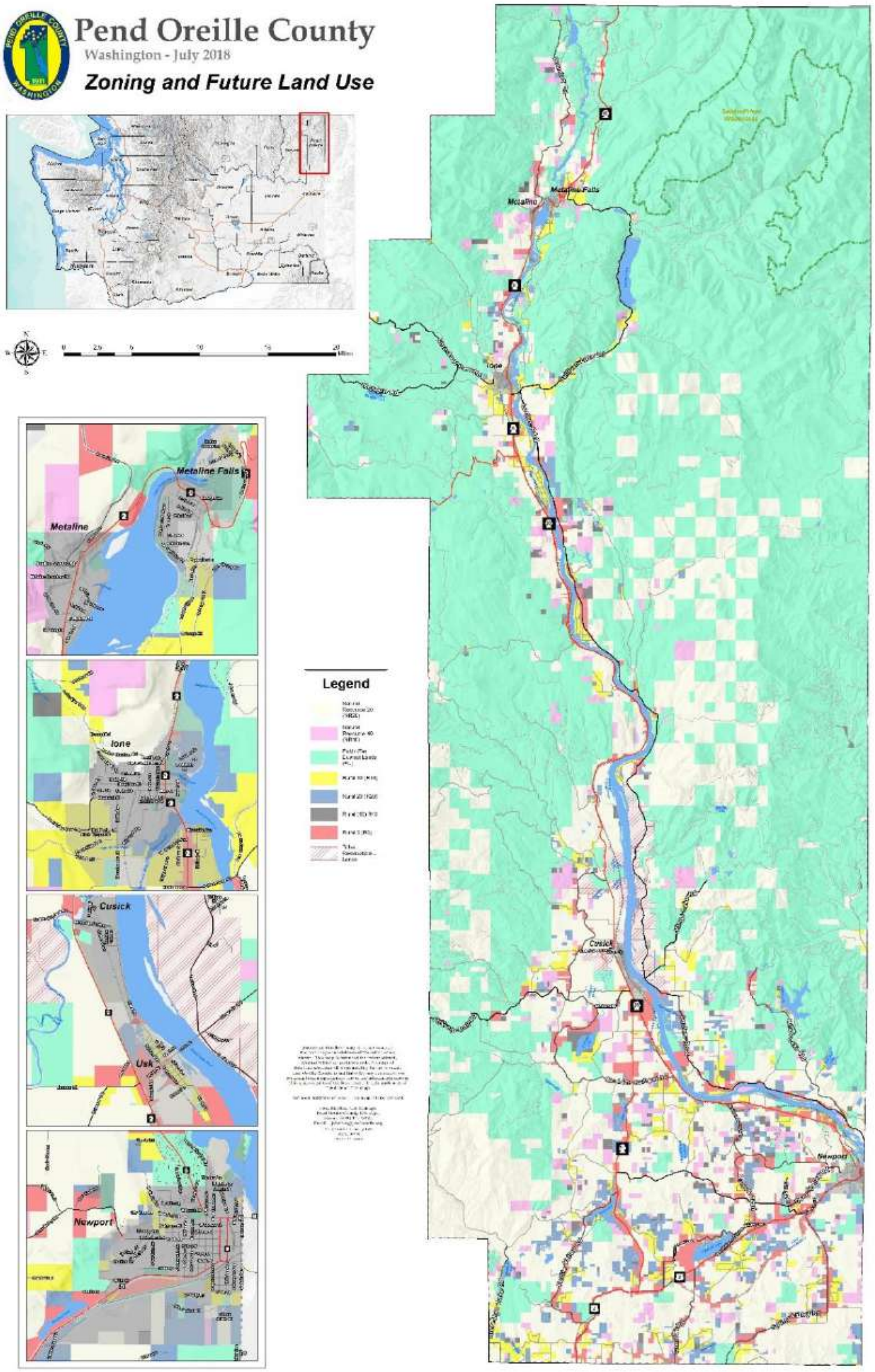


Figure 3-15 Pend Oreille County Land Use and Zoning Map

Table 3-12 indicates that over 1,700 building permits were issued during the time period indicated. That number is reflective of all types of permitting, including for remodels, garages, decks, etc.[20] Figure 3-16 illustrates the distribution of building permits issued during the period 2011-2017.

Table 3-12
Building Permits Issued

Year	Permits for New Residential	All Other Permits	Total
2011	85	183	268
2012	58	158	216
2013	58	223	281
2014	54	218	272
2015	40	186	226
2016	65	170	235
2017	47	174	221
Total	**407**	**1312**	**1719**

Source: Pend Oreille County GIS (3/1/18)

3.7.1 Development Trends and Hazard Impact

The majority of new development has taken place in the unincorporated areas of the county, with the areas of highest concentrations being in the Diamond Lake and Sacheen Lake areas, along the Pend Oreille River, and along some of the major county roadways in the southern portion of the county. Relatively few permits were issued inside the limits of the towns of Cuisck, Ione, Metaline, or Metaline Falls. The City of Newport maintains its own permitting. The majority of the permits were for garages, pole buildings, and utility structures, with only 407 residential structure permits issued.

Development trends since the 2011 plan was completed have not impacted hazard vulnerability with respect to structure impact beyond that customarily expected with growth itself, and an increased number of structures as a whole. All new construction is built to higher standards than most existing buildings, which are of signfiicantly older age (discused below). However, the increase in residential structures would increase the potential population at risk, although many of the residential structures in the area are for seasonal use.

Since completion of the 2011 plan, the Town of Cusick has disbanded its fire department, with Fire District 4 assuming responsibility for the service area. In order to maintain the level of service to the area, the Town of Cusick transferred ownership of the Cusick Fire Station to Fire District 4. Such change in ownership is reflected in the critical infrastructure portion of the planing process. The Town itself has experienced no additional housing unit growth since completion of the last plan.

All municipal planning partners will seek to incorporate by reference the Pend Oreille County Multi-Jurisdiction Hazard Mitigation Plan in their comprehensive plans. This will assure that all future development can be established with the benefits of the information on risk and vulnerability to natural hazards identified in this plan. On next update of its Comprehensive Land Use Plan, this hazard mitigation plan will provide information that will be utilized to support that effort.

[20] https://www.census.gov/quickfacts/fact/table/pendoreillecountywashington/PST040216?

Each planning partner's specific annex to this plan (see Volume 2) includes an assessment of regulatory, technical and financial capability to carry out proactive hazard mitigation. Refer to these annexes for a review of regulatory codes and ordinances applicable to each planning partner. In addition, Chapter 16 of this plan provides a general overview of the municipalities' regulatory authority.

3.7.2 Housing Stock

According to *A Social Vulnerability Index for Disaster Management* (Journal of Homeland Security and Emergency Management, 2011), housing quality is an important factor in assessing disaster vulnerability. It is closely tied to personal wealth: people in lower income brackets often live in more poorly constructed homes that are especially vulnerable to strong storms or earthquakes. Mobile homes are not designed to withstand severe weather or flooding, and typically do not have basements. They are frequently found outside of metropolitan areas and, therefore, may not be readily accessible by interstate highways or public transportation. Also, because mobile homes are often clustered in communities, their overall vulnerability is increased. These issues are further discussed in Chapter 14, Section 14.2 of this plan.

Countywide, as of July 1, 2016 (most recent data available), there were 8,052 housing units available, with a median value of owner-occupied housing units during the time period 2012-2016 of $181,700. The number of housing units is an increase from the 2010 Census data, which reflected 7,936 housing units.

3.7.3 Building Stock Age

The age of a building in determining vulnerability is a significant factor, as it helps identify the building code to which a structure was built. Homes built prior to 1975 are considered pre-code since there was no statewide requirement to include specific standards to address the various hazards of concern (e.g., there were no seismic provisions contained within the building code). Structures built after 1975 are considered of moderate code. It was at that point when all Washington jurisdictions were required to adhere to the provision of the most recently adopted version of the Uniform Building Code (UBC) (Noson et al., 1988).

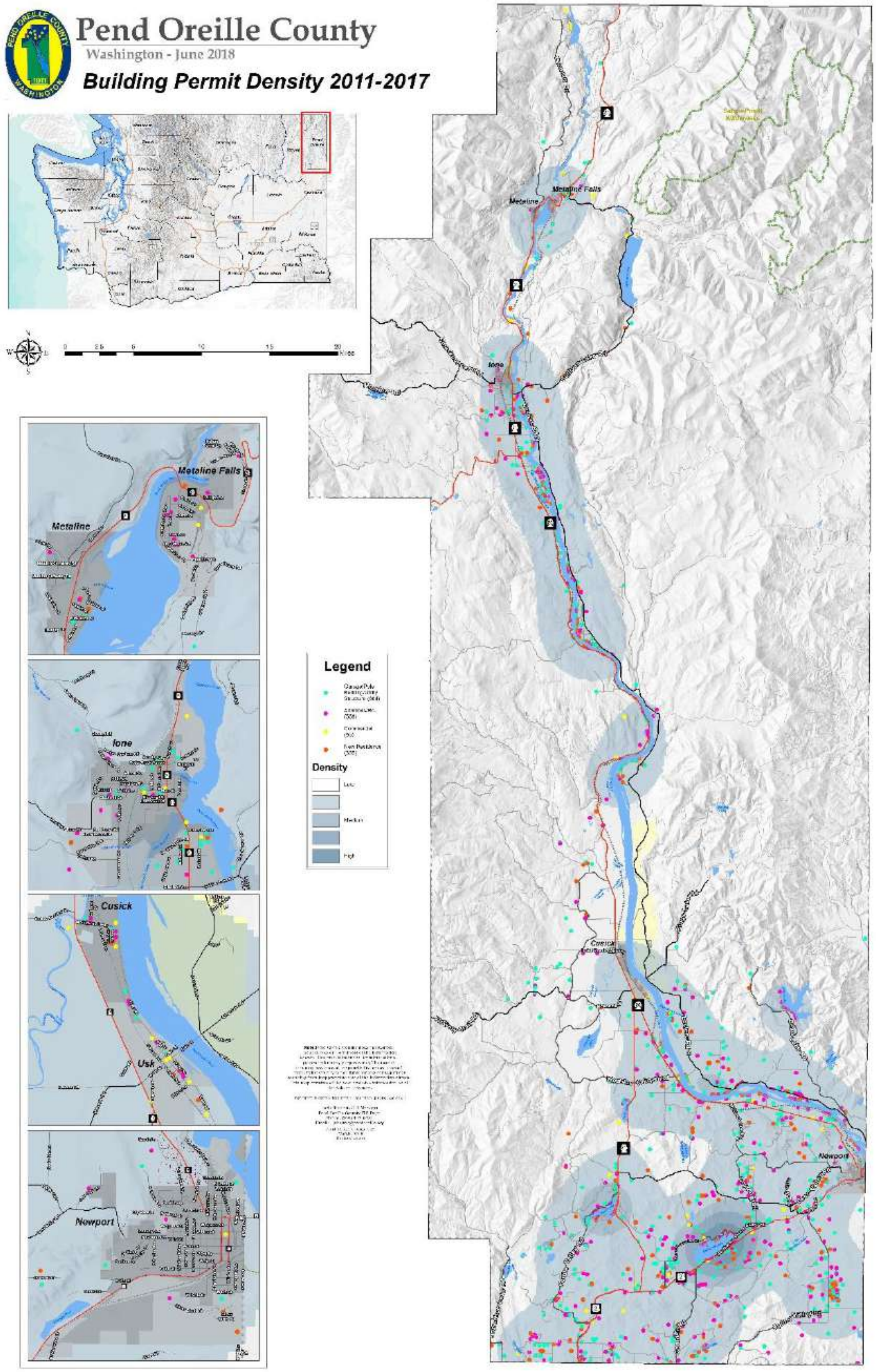


Figure 3-16 2011-2017 Building Permits and Density

The County's Comprehensive Land Use Plan (2005, 2015) identifies that the majority of the housing stock was built since 1970. That data is identified in Table 3-13. Generally, housing is older within the cities of the County, especially in Metaline Falls where 60 percent of the housing stock was built prior to 1939 (ibid). It should be noted that the Census data does not identify building age based on the year of building code, as each state has adopted codes at different times; therefore, the Census designation of year-built is generalized based on 10-year increments, which does not allow us to determine, based on Census date, the number of structures incorporated in the 1970-1979 designation.

For planning purposes, during the risk assessment, FEMA's Hazus program was utilized for a 100-year probabilistic earthquake. That program examines structures based on a specific building code. As FEMA's Hazus tool was utilized, Hazus criteria was also applied. Hazus identifies key changes in earthquake building codes based on year. Homes built prior to 1941 are considered pre-code; they were constructed before any earthquake building codes were put in place. Homes constructed after 1941 are considered moderate code and may include some earthquake building components. It should be noted that the data may be slightly skewed due to the fact that actual building code adoption dates may vary slightly by jurisdiction. Also, structures may have undergone remodel, or improvements which changed the building code classification, increasing the level of code applied. That data may not have been captured or applied in a manner which would reflect a change in the year of construction. Additionally, while building codes may not have been in place, houses may have been constructed to higher standards. Therefore, this data should be used for planning purposes only. Questions concerning actual structural integrity should be determined by appropriate subject matter experts in the field.

Table 3-13
Pend Oreille County Housing Units Pre- and Moderate-Code

Year Structure Built	Housing Units – Unincorporated County	Housing Units – Cities and Towns	Total Units Countywide
1939 or earlier	353	481	834
1940-1959	767	383	1,150
1960-1969	612	117	729
1970-1979	1,181	164	1,345
1980-1989	972	134	1,106
1990-2000*	1,279	165	1,444
Total*	5,164	1,444	6,608
Total 2000-2010*	6,335	1,601	7,936
Total 2010-2016**	6,615	1,615	8,230
*Based on 2000 US Census Data[21] / **2010 and 2016 OFM postcensal estimates provides totals with no breakdown[22]			

[21] U.S. Census: https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk
[22] Office of Financial Management http://www.ofm.wa.gov/pop/april1/

CHAPTER 4.
RISK ASSESSMENT METHODOLOGY

4.1 OVERVIEW

The DMA requires measuring potential losses to critical facilities and property resulting from natural hazards. A hazard is an act or phenomenon that has the potential to produce harm or other undesirable consequences to a person or thing. Natural hazards can exist with or without the presence of people and land development. However, hazards can be exacerbated by societal behavior and practice, such as building in a floodplain, along a sea cliff, or on an earthquake fault. Natural disasters are inevitable, but the impacts of natural hazards can, at a minimum, be mitigated or, in some instances, prevented entirely.

The goal of the risk assessment is to determine which hazards present the greatest risk and what areas are the most vulnerable to hazards. Pend Oreille County and its planning partners are exposed to many hazards. The risk assessment and vulnerability analysis helps identify where mitigation measures could reduce loss of life or damage to property in the planning region. Each hazard-specific risk assessment provides risk-based information to assist Pend Oreille County and its planning partners in determining priorities for implementing mitigation measures.

The risk assessment approach used for this plan entailed using geographic information system (GIS), Hazus hazard-modeling software, and hazard-impact data to develop vulnerability models for people, structures and critical facilities, and evaluating those vulnerabilities in relation to hazard profiles that model where hazards exist. This approach is dependent on the detail and accuracy of the data used. In all instances, this assessment used Best Available Science and data to ensure the highest level of accuracy possible.

The risk assessment is broken down into three phases, as follows:

> The first phase, hazard identification, involves the identification of the geographic extent of a hazard, its intensity, and its probability of occurrence (discussed below). This level of assessment typically involves producing a map. The outputs from this phase can be used for land use planning, management, and development of regulatory authority; public awareness and education; identifying areas which require further study; and identifying properties or structures appropriate for mitigation efforts, such as acquisition or relocation.
>
> The second phase, the vulnerability assessment, combines the information from the hazard identification with an inventory of the existing (or planned) property and population exposed to the hazard. It then attempts to predict how different types of property and population groups will be impacted or affected by the hazard of concern. This step assists in justifying changes to building codes or regulatory authority, property acquisition programs, such as those available through various granting opportunities; developing or modifying policies concerning critical or essential facilities, and public awareness and education.
>
> The third phase, the risk analysis, involves estimating the damage, injuries, and costs likely to be incurred in the geographic area of concern over a period of time. Risk has two measurable components:
>
> 1. The magnitude of the harm that may result, defined through the vulnerability assessment; and
> 2. The likelihood or probability of harm occurring.

Utilizing those three phases of assessment, information was developed which identifies the hazards that affect the planning area, the likely location of natural hazard impact, the severity of the impact, previous occurrences, and the probability of future hazard events. That data, once complete, is utilized to complete the Risk Ranking process described in Chapter 14, which applies all of the data captured to the Calculated Priority Risk Index (CPRI).

The following is provided as the foundation for the standardized risk terminology:

- Hazard: Natural (or human caused) source or cause of harm or damage, demonstrated as actual (deterministic/historical events) or potential (probabilistic) events.
- Risk: The potential for an unwanted outcome resulting from a hazard event, as determined by its likelihood and associated consequences. For this plan, where possible, risk includes potential future losses based on probability, severity and vulnerability, expressed in dollar losses when possible. In some instances, dollar losses are based on actual demonstrated impact, such as through the use of the Hazus model. In other cases, losses are demonstrated through exposure analysis due to the inability to determine the extent to which a structure is impacted.
- Location/Extent: The area of potential or demonstrated impact within the area in which the analysis is being conducted. In some instances, the area of impact is within a geographically defined area, such as a floodplain. In other instances, such as for severe weather, there is no established geographic boundary associated with the hazard, as it can impact the entire area.
- Severity/Magnitude: The extent or magnitude upon which a hazard is ranked, demonstrated in various means, e.g., Richter Scale.
- Vulnerability: The degree of damage, e.g., building damage or the number of people injured.
- Probability of Occurrence and Return Intervals: These terms are used as a synonym for likelihood, or the estimation of the potential of an incident to occur.

4.2 METHODOLOGY

The risk assessment for this hazard mitigation plan evaluates the risk of natural hazards prevalent in Pend Oreille County and meets requirements of the DMA (44 CFR Section 201.6(c)(2) and Section 201.7). The methodology used to complete the risk assessment is described below.

4.2.1 Hazard Identification and Profiles

For this plan, the planning partners and stakeholders considered the full range of natural hazards that could impact the planning area and then listed hazards that present the greatest concern. The process incorporated review of state and local hazard planning documents, as well as information on the frequency, magnitude, and costs associated with hazards that have impacted or could impact the planning area. Anecdotal information regarding natural hazards and the perceived vulnerability of the planning area’s assets to them was also used.

The Planning Team reviewed the hazards considered during the 2011 plan. Based on the review, the Planning Team, at its kick-off meeting, identified the following natural hazards that this plan addresses as the hazards of concern (2018 changes to the hazards of concern are indicated in italics):

- Avalanche
- Climate Change (*New* with qualitative assessment)

- Drought
- Earthquake
- Flood
- Hazardous Materials (Exposure analysis incorporated into the various other hazards of concern where applicable utilizing WDOE's FY2017 Tier II Report)
- Landslide (*Expanded* to include updated DNR data)
- Severe Weather (*Expanded* to include additional related hazard types)
- Volcano
- Wildfire (*Expanded* to the level of a Community Wildfire Protection Plan; risk analysis was completed utilizing Landfire data)

The hazard profiles describe the risks associated with identified hazards of concern. Each chapter describes the hazard, the planning area's vulnerabilities, and, when possible, probable event scenarios. The following steps were used to define the risk of each hazard:

Identify and profile the following information for each hazard:

- General overview and description of hazard;
- Identification of previous occurrences;
- Geographic areas most affected by the hazard;
- Event frequency estimates;
- Severity estimates;
- Warning time likely to be available for response;
- Risk and vulnerability assessment, which includes identification of impact on people, property, economy and the environment.

4.2.2 Risk Assessment Process and Tools

The hazard profiles and risk assessments contained in the hazard chapters describe the risks associated with each identified hazard of concern. Each chapter describes the hazard, previous occurrence, the planning area's vulnerabilities, and, where appropriate, probable event scenarios.

Once the profiles identified above were completed, the following steps were used to define the risk of each hazard:

- Determine exposure to each hazard—Exposure was determined by overlaying hazard maps with an inventory of structures, facilities, and systems to determine which of them would be exposed to each hazard.
- Assess the vulnerability of exposed facilities—Vulnerability of exposed structures and infrastructure was determined by interpreting the probability of occurrence of each event and assessing structures, facilities, and systems that are exposed to each hazard. Tools such as GIS and Hazus (discussed below) were used in this assessment.
- Where specific quantitative assessments could not be completed, vulnerability was measured in general, qualitative term, summarizing the potential impact based on past occurrences,

spatial extent, and subjective damage and casualty potential. Those items were categorized utilizing the criteria established in the CPRI index.

- The final step in the process was to determine the cumulative results of vulnerability based on the risk assessment and Calculated Priority Risk Index (discussed below) scoring, assigning a final qualitative assessment based on the following classifications:
  - Extremely Low—The occurrence and potential cost of damage to life and property is very minimal to nonexistent.
  - Low—Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal.
  - Medium—Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.
  - High—Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread. Hazards in this category may have occurred in the past.
  - Extremely High—Very widespread with catastrophic impact.

4.2.3 Calculated Priority Risk Index Scoring Criteria

Vulnerabilities are described in terms of critical facilities, structures, population, economic values, and functionality of government which can be affected by the hazard event. Hazard impact areas describe the geographic extent a hazard can impact a jurisdiction and are uniquely defined on a hazard-by-hazard basis. Mapping of the hazards, where spatial differences exist, allows for hazard analysis by geographic location. Some hazards can have varying levels of risk based on location. Other hazards cover larger geographic areas and affect the area uniformly. Therefore, a system must be established which addresses all elements (people, property, economy, continuity of government) in order to rate each hazard consistently. The use of the Calculated Priority Risk Index allows such application, based on established criteria of application to determine the risk factor. For identification purposes, the six criteria on which the CPRI is based are probability, magnitude, geographic extent and location, warning time/speed of onset, and duration of the event. Those elements are further defined as follows:

Probability

Probability of a hazard event occurring in the future was assessed based on hazard frequency over a 100-year period (where available). Hazard frequency was based on the number of times the hazard event occurred divided by the period of record. If the hazard lacked a definitive historical record, the probability was assessed qualitatively based on regional history and other contributing factors. Probability of occurrence was assigned a 40% weighting factor, and was broken down as follows:

Rating	Likelihood	Frequency of Occurrence
1	Unlikely	Less than 1% probability in the next 100 years.
2	Possible	Between 1% and 10% probability in the next year, or at least one chance in the next 100 years.
3	Likely	Between 10% and 100% probability in next year, or at least one chance in the next 10 years.
4	Highly Likely	Greater than 1 event per year (frequency greater than 1).

Magnitude

The magnitude of potential hazard events was evaluated for each hazard. Magnitude is a measure of the strength of a hazard event and is usually determined using technical measures specific to the hazard. Magnitude was calculated for each hazard where property damage data was available, and was assigned a 25% weighting factor. (Magnitude calculation was determined using the following mathematical equation: *(Property Damage / Number of Incidents) / $ of Building Stock Exposure = Magnitude.)* Magnitude was broken down as follows:

Rating	Magnitude	Percentage of People and Property Affected
1	Negligible	Less than 5% Very minor impact to people, property, economy, and continuity of government at 90%.
2	Limited	6% to 24% Injuries or illnesses minor in nature, with only slight property damage and minimal loss associated with economic impact; continuity of government only slightly impacted, with 80% functionality.
3	Critical	25% to 49% Injuries result in some permanent disability; 25-49% of population impacted; moderate property damage ; moderate impact to economy, with loss of revenue and facility impact; government at 50% operational capacity with service disruption more than one week, but less than a month.
4	Catastrophic	More than 50% Injuries and illness resulting in permanent disability and death to more than 50% of the population; severe property damage greater than 50%; economy significantly impacted as a result of loss of buildings, content, inventory; government significantly impacted; limited services provided, with disruption anticipated to last beyond one month.

Extent and Location

The measure of the percentage of the people and property within the planning area impacted by the event, and the extent (degree) to which they are impacted. Extent and location was assigned a weighting factor of 20%, and broken down as follows:

Rating	Magnitude	Percentage of People and Property Affected
1	Negligible	Less than 10% Few if any injuries or illness. Minor quality of life lost with little or no property damage. Brief interruption of essential facilities and services for less than four hours.
2	Limited	10% to 24% Minor injuries and illness. Minor, short term property damage that does not threaten structural stability. Shutdown of essential facilities and services for 4 to 24 hours.
3	Critical	25% to 49% Serious injury and illness. Major or long term property damage, that threatens structural stability. Shutdown of essential facilities and services for 24 to 72 hours.
4	Catastrophic	More than 50% Multiple deaths Property destroyed or damaged beyond repair Complete shutdown of essential facilities and services for 3 days or more.

Warning Time/Speed of Onset

The rate at which a hazard occurs, or the time provided in advance of a situation occurring (e.g., notice of a cold front approaching or a potential hurricane, etc.) provides the time necessary to prepare for such an event. Sudden-impact hazards with no advanced warning are of greater concern. Warning Time/Speed of onset was assigned a 10% weighting factor, and broken down as follows:

Rating	Probable amount of warning time
1	More than 24 hours warning time.
2	12-24 hours warning time.
3	5-12 hours warning time.
4	Minimal or no warning time.

Duration

The time span associated with an event was also considered, the concept being the longer an event occurs, the greater the threat or potential for injuries and damages. Duration was assigned a weighting factor of 5%, and was broken down as follows:

Rating	Duration of Event
1	6-24 hours
2	More than 24 hours
3	Less than 1 week
4	More than 1 week

Chapter 14 summarizes all of the analysis conducted by way of completion of the Calculated Priority Risk Index (CPRI) for hazard ranking.

4.3 PROBABILITY OF OCCURRENCE AND RETURN INTERVALS

Natural hazard events with relatively long return periods, such as a 100-year flood or a 500- or 1,000-year earthquake, are often thought to be very unlikely. In reality, the probability that such events occur over the next 30 or 50 years is relatively high, having significant probabilities of occurring during the lifetime of a building:

- Hazard events with return periods of 100 years have probabilities of occurring in the next 30 or 50 years of about 26 percent and about 40 percent, respectively.
- Hazard events with return periods of 500 years have about a 6 percent and about a 10 percent chance of occurring over the next 30 or 50 years, respectively.
- Hazard events with return periods of 1,000 years have about a 3 percent chance and about a 5 percent chance of occurring over the next 30 or 50 years, respectively.

For life safety considerations, even natural hazard events with return periods of more than 1,000 years are often deemed significant if the consequences of the event happening are very severe (extremely high damage and/or substantial loss of life). For example, the seismic design requirements for new construction are based on the level of ground shaking with a return period of 2,475 years (2 percent probability in 50 years). Providing life safety for this level of ground shaking is deemed necessary for seismic design of new buildings to minimize life safety risk. Of course, a hazard event with a relatively long return period may occur tomorrow, next year, or within a few years. Return periods of 100 years, 500 years, or 1,000 years mean that such events have a 1 percent, a 0.2 percent or a 0.1 percent chance of occurring in any given year.

4.4 COMMUNITY VARIATIONS TO THE RISK ASSESSMENT

Each planning partner within their respective annex document describes where or how variations to their risk differs from what is described in the hazard profiles and risk ranking, if appropriate. In some instances, declared disaster events may not have impacted a specific jurisdiction or entity. Similarly, there may have been incidents of significance which did not rise to a level of a disaster declaration, but were nonetheless significant to the jurisdiction or entity. Those events are noted in the disaster history table contained within each annex. Variations in risk from the previous HMP to this update are also discussed throughout the hazard profiles, as well as within specific annex documents.

4.5 LIMITATIONS

This document is intended for planning purposes only. The models and/or information presented in this document do not replace or supersede any official document or product generated to meet the requirements of any state, federal, or local program which may be much more detailed and encompassing beyond the scope of this project.

This document and its contents have been prepared and are intended solely for Pend Oreille County and its planning partners' information and use with respect to hazard mitigation planning. Where appropriate, information contained herein may be utilized to support other planning initiatives, but should not be used for life-safety planning.

While this process utilized best available science and data, no scientific analysis was conducted or performed during this process. The process utilized reproduces existing data (such as the National Flood Insurance Data, national data sets for soils classifications, U.S.G.S. earthquake data, etc.,) in different ways to meet the guidelines and requirements of 44 CFR 201.6 and 44 CFR 201.7 for the Kalispel Tribe. All data layers utilized are identified within the various sections of this document should reviewers wish greater clarification and information.

Loss estimates, exposure assessments, and hazard-specific vulnerability evaluations rely on the best available data and methodologies. However, uncertainties are inherent in any loss estimation methodology and arise in part from incomplete scientific knowledge concerning natural hazards and their potential effects on the built environment. Uncertainties also result from the following:

- Approximations and simplifications necessary to conduct a study
- Incomplete or outdated inventory, demographic or economic parameter data
- The unique nature, geographic extent and severity of each hazard
- Mitigation measures already employed
- The amount of advance notice residents have to prepare for a specific hazard event.

These factors can affect loss estimates by a factor of two or more. Therefore, potential exposure and loss estimates are approximate. The results do not predict precise results and should be used only to understand relative risk. Over the long term, Pend Oreille County and its planning partners will continue to collect additional data to assist in better estimating potential losses associated with other hazards as science increases the validity of data.

Some assumptions were made by the planning partnership in an effort to capture as much data as necessary to supplant any significant data gaps. One example of this is the valuation for structures within the assessed data, most commonly as it relates to the general building stock. For structures for which data was not provided, the missing information was determined using averages of similar types of structures, determining square footage and applying a multiplier. This process is identified in the Hazus User's Guide.

Some hazards, such as earthquake, are pre-loaded with scientifically determined scenarios which are used during the modeling process. This does not allow for manipulation of the data as with other hazards, such as flood. In the case of earthquake, greater reliance existed on the use of the Hazus default data, which is known to be less accurate, most often causing higher loss values. Therefore, while loss estimates are provided, they should be viewed with this flaw in mind. A much more in-depth scientific analysis is necessary to rely on this type of data with a high degree of accuracy. Readers should view this document as a baseline or starting point, and information should be further studied and analyzed by scientists and other subject matter experts in specific hazard fields.

CHAPTER 5.
AVALANCHE

5.1 GENERAL BACKGROUND

Avalanches can occur whenever a sufficient depth of snow is deposited on slopes steeper than about 20 degrees, with the most dangerous coming from slopes in the 35- to 40-degree range; 38 degrees is considered the "ideal" slope for development of avalanche conditions (Pend Oreille HMP, 2011). Avalanche-prone areas can be identified with some accuracy, since they typically follow the same paths year after year, leaving scarring on the paths. However, unusual weather conditions can produce new paths or cause avalanches to extend beyond their normal paths.

Common factors contributing to the avalanche hazard are old snow depth, old snow surface, new snow depth, new snow type, snow density, snowfall intensity, precipitation intensity, settlement, wind direction and speed, temperature, and subsurface snow crystal structure.

In the spring, warming of the snowpack occurs from below (from the warmer ground) and above (from warm air, rain, etc.). Warming can be enhanced near rocks or trees that transfer heat to the snowpack. The effects of a snowpack becoming weak may be enhanced in steeper terrain where the snowpack is shallow, and over smooth rock faces that may focus meltwater and produce "glide cracks." Such slopes may fail during conditions that encourage melt.

Wind can affect the transfer of heat into the snowpack and associated melt rates of near-surface snow. During moderate to strong winds, the moistening near-surface air in contact with the snow is constantly mixed with drier air above through turbulence. As a result, the air is continually drying out, which enhances evaporation from the snow surface rather than melt. Heat loss from the snow necessary to drive the evaporation process cools off near-surface snow and results in substantially less melt than otherwise might occur, even if temperatures are well above freezing.

When the snow surface becomes uneven in spring, air flow favors evaporation at the peaks, while calmer air in the valleys favors condensation there. Once the snow surface is wet, its ability to reflect solar energy drops dramatically; this becomes a self-perpetuating process, so that the valleys deepen (favoring calmer air and more heat transfer), while more evaporation occurs near the peaks, increasing the differential between peaks and valleys. However, a warm wet storm can quickly flatten the peaks as their larger surface area exposed to warm air, rain or condensation hastens their melt over the sheltered valleys.

DEFINITIONS

Avalanche—Any mass of loosened snow or ice and/or earth that suddenly and rapidly breaks loose from a snowfield and slides down a mountain slope, often growing and accumulating additional material as it descends.

Slab avalanches—The most dangerous type of avalanche, occurring when a layer of coherent snow ruptures over a large area of a mountainside as a single mass. Like other avalanches, slab avalanches can be triggered by the wind, by vibration, or even by a loud noise, and will pull in surrounding rock, debris and even trees.

Climax avalanches—An avalanche involving multiple layers of snow,

Loose snow avalanches—An avalanche that occurs when loose, dry snow on a slope becomes unstable and slides. Loose snow avalanches start from a point and gather more snow as they descend, fanning out to fill the topography.

Powder snow avalanches—An avalanche that occurs when sliding snow has been pulverized into powder, either by rapid motion of low-density snow or by vigorous movement over rugged terrain.

Surface avalanches—An avalanche that occurs only in the uppermost snow layers.

Wet snow avalanche—An avalanche in wet snow, also referred to as a wet loose avalanche or a wet slab avalanche. Often the basal shear zone is a water-saturated layer that overlies an ice zone.

5.2 HAZARD PROFILE

5.2.1 Previous Occurrences

The only avalanche death and injury recorded occurred on Saturday, April 5, 1997, when one snowmobiler was killed and another injured on South Baldy Mountain near Newport by an avalanche.[23] Statewide, avalanches in Washington have killed over 119 people since 1951. Since 2011, completion of the last plan, until December 2017, avalanches have killed 25 people statewide (CAIC, 2018).

Within Washington, activity related to climbing and backcountry tourers have sustained the highest number of related avalanche fatalities, followed by hikers (16) and side-country riders and snowmobilers (10 each). December (24), January (18) and June (17) are the months with the highest number of fatalities, while October (1), November (2) and August (3), have the lowest.[24] According to Washington State's Enhanced Hazard Mitigation Plan (2013), "Avalanches have killed more people in Washington than any other hazard during the past century." Avalanches also regularly close access roads at higher elevations.

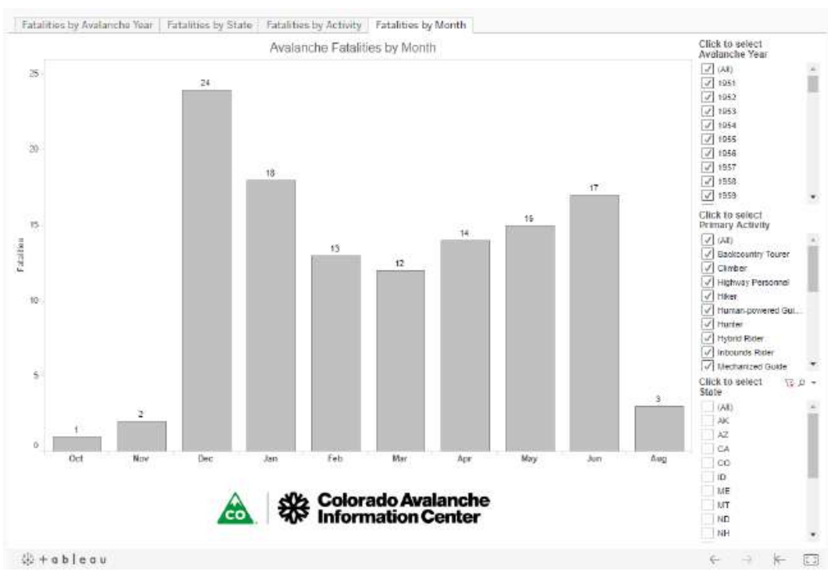


Figure 5-1 Avalanche Fatalities by Month

5.2.2 Extent and Location

The mountainous regions in Pend Oreille County receive extensive precipitation; however, avalanches customarily occur in more remote areas, limiting the extent of the planning area impacted. In the local climate, it is common for air temperatures to fluctuate and for precipitation to change from snow to rain or rain to snow during mid-winter storm cycles. Temperatures can change several degrees within minutes, causing abrupt changes in precipitation type. These conditions frequently cause the release of avalanches. Figure 5-2 shows avalanche hazard areas in Washington, including the Pend Oreille County.

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[23] The Spokesman-Review. April 6, 1997.
[24] http://avalanche.state.co.us/accidents/statistics-and-reporting/

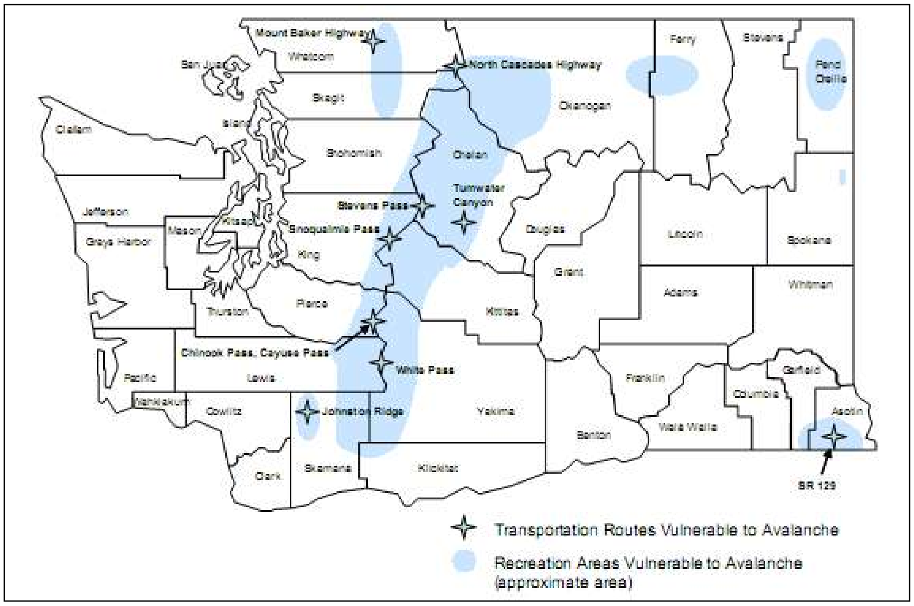


Figure 5-2 Areas Vulnerable to Avalanche

5.2.3 Severity

The severity of the avalanche depends on both the type and the amount of snow involved. Large avalanches have the ability to increase injuries and fatalities because of the area covered. Large external lateral loads can cause significant damage to structures, although building codes specifically address snow load capacities in the County. Table 5-1 indicates the estimated potential damage for a given range of impact pressures.

Table 5-1
Impact Pressures Related to Damage

Impact Pressure (pounds per square foot)	Potential Damage
40-80	Break windows
60-100	Push in doors, damage walls, roofs
200	Severely damage wood frame structures
400-600	Destroy wood-frame structures, break trees
1,000-2,000	Destroy mature forests
>6,000	Move large boulders

Source: www.avalanche.org

Average snowfall accumulations annually are approximately 48 inches per year. The railroad tracks in the area follow essentially the same route as SR-20. The potential for rail service interruption, or for damage to a train carrying hazardous cargo in populated or environmentally sensitive areas, is of concern.

The following weather and terrain factors affect avalanche severity and danger:

- Storms—A large percentage of all snow avalanches occur during and shortly after storms.
- Rate of snowfall—Snow falling at a rate of 1 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.
- 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.

5.2.4 Frequency

The avalanche season begins in November and continues until the last remnants of snow have melted in early summer.

5.2.5 Warning Time

The Northwest Weather and Avalanche Center provides daily forecasts as well as information regarding significantly increased avalanche danger that may serve as advanced warning for individuals participating in activities where avalanches may occur. These warning are generalized and simply alert exposed individuals to an increased risk of occurrence.

The time of an avalanche release depends on the condition of the snow pack; which can change rapidly during a day and particularly during rainfall. Research has shown that most natural avalanches occurred less than 1 hour after the onset of rain; in these cases, the snow pack was initially weak (Washington Emergency Management Division, 1996). In cases where the snow pack was stronger, avalanche activity was delayed or did not occur. Nonetheless an avalanche can occur with little or no warning time, which makes them particularly deadly.

5.3 SECONDARY HAZARDS

Avalanches can cause blocked roads, which can isolate residents and businesses and delay commercial, public, and private transportation. This could result in economic losses for businesses. Other potential problems resulting from avalanches are power and communication failures. Avalanches also can damage rivers or streams, potentially harming water quality, fisheries, and spawning habitat.

5.4 VULNERABILITY

While there is currently minimal development in areas subject to avalanches, in general, everything that is exposed to an avalanche event is vulnerable. Most mountainous areas in the county are part of the Colville National Forest and other protected forests. More and more people are building in or using the high mountain areas in which avalanche can occur. In many instances, these individuals often have little experience with, caution regarding, or preparation for, avalanche conditions. The increasing development of recreational sites in the mountains brings added exposure to the people using these sites and the access routes to them. The risk to human life is especially great at times of the year when rapid warming follows heavy, wet snowfall.

5.5 IMPACT TO LIFE, HEALTH, AND SAFETY

As indicated, the only avalanche death and injury recorded occurred on Saturday, April 5, 1997, when one snowmobiler was killed and another injured on South Baldy Mountain near Newport by an avalanche.[25] There are no major population hubs exposed to avalanches in the county. Most of the avalanche hazard area is uninhabited or has minimal development but are used extensively for recreational purposes. The exact numbers of tourist-related individuals are unknown. The last fatality which occurred was to a snowmobiler. People working in the mountains, public works and/or maintenance personnel working to control avalanche situations, and others such as miners and loggers are exposed, as are recreational users, such as hikers and cross-country skiers. Travelers moving through avalanche-prone areas, especially along the major transportation routes, are also exposed, although snow tunnel do exist.

Of those who die in avalanches, approximately one third of the deaths are as a result of trauma, while the remaining two thirds are from suffocation. Trauma may be the result of being carried into obstructions such as boulders and trees or over cliffs, or from rocks, trees, or large chunks of snow being carried downward at high speed.

5.6 IMPACT ON PROPERTY

There is little property exposed to avalanches within the County. Property and buildings exposed include National Forest huts and temporary structures belonging to mining and forestry operations. However, avalanches may also damage or destroy power lines, block roadways and railroads, and damage trees and vegetation.

5.7 IMPACT ON CRITICAL FACILITIES AND INFRASTRUCTURE

There are no critical facilities exposed to avalanches. There is a small amount of infrastructure that could be blocked by avalanches, including hiking trails, fire roads and logging roads. SR-20 is exposed to avalanches, as are several stretches of SR 2, 31, 41, 211, and the International Selkirk Loop. The railroad lines could also be exposed. Previous avalanches have closed roadways for extended periods of time until the snow could be removed. Crews cannot be sent in to clear avalanche debris until such time as the avalanche danger has passed.

5.8 IMPACT ON ECONOMY

Depending on the location and size of the avalanche, there very likely would be an impact on the planning area’s economy as a result of the avalanche hazard. The timber industry, power companies, recreational resorts, homeowners, and recreational groups depend on relatively free access to wildland areas that may be restricted during periods of high avalanche threat.

[25] The Spokesman-Review. April 6, 1997.

5.9 IMPACT ON ENVIRONMENT

Avalanches are a natural event, but they can negatively affect the environment. This includes trees located on steep slopes. A large avalanche can knock down many trees and kill the wildlife that lives in them. In spring, this loss of vegetation on the mountains may weaken the soil, causing landslides and mudflows.

5.10 FUTURE TRENDS IN DEVELOPMENT

Given the likely location and density of future development based on current land use regulations, there is a small amount of housing and employment capacity that has the potential to be developed in avalanche hazard areas. Most of the land area in the avalanche hazard zone is resource or protected land. Building codes currently in place do provide protection from issues like snow load for weight purposes, and do increase wind-load capacity as well, but little is done to restrict building in avalanche-prone areas.

5.11 ISSUES

Avalanches pose a threat to recreational users and property and can disrupt both the north-south and east-west transportation networks. Specially trained Washington Department of Transportation avalanche-control teams use active and passive means to reduce the avalanche hazard each year. Their efforts limit the number and duration of highway closures. The state posts warning signs in key locations warning recreation users of avalanche dangers, although these signs are commonly ignored. There is no effective way to keep the public out of avalanche-prone recreational areas, even during times of highest risk. A coordinated effort is needed among state, county and local law enforcement, fire, emergency management and public works agencies and media to provide better avalanche risk information.

The Northwest Weather and Avalanche Center provides a source of information to recreational users regarding current conditions and danger levels as well as incident summaries by date and location and additional resources. Measures that have been used in other jurisdictions to reduce avalanche threat include monitoring timber harvest practices in slide-prone areas to ensure that snow cover is stabilized as well as possible, and encouraging reforestation in areas near highways, buildings, power lines and other improvements. The development of a standard avalanche report form, and the maintenance of a database of potential avalanche hazards likely to affect proposed developments in mountain wilderness areas, would be of significant value to permitting agencies.

A national program to rate avalanche risk has been developed to standardize terminology and provide a common basis for recognizing and describing hazardous conditions. This United States Avalanche Danger Scale relates degree of avalanche danger (low, moderate, considerable, high, extreme) to descriptors of avalanche probability and triggering mechanism, degree and distribution of avalanche hazard, and recommended action in back country. Figure 5-3 shows key elements of the danger scale. This information, updated daily, is available during avalanche season from the joint NOAA/U.S. Forest Service Northwest Weather and Avalanche Center and can be obtained from Internet, NOAA weather wire, and Department of Transportation sources. Avalanche danger scale information should be explained to the public and made available through appropriate county and local agencies and the media.

Avalanche Safety Basics

Avalanches don't happen by accident *and most human involvement is a matter of* ***choice*** *not chance. Slab avalanches, which are triggered by the victim or a member of the victim's party, cause most avalanche accidents. However, any avalanche may cause injury or death and even small slides may be dangerous. Hence, always practice safe route finding skills, be aware of changing conditions, and carry avalanche rescue gear. Learn and apply avalanche terrain analysis and snow stability evaluation techniques to help minimize your risk. Remember that avalanche danger rating levels are only general guidelines. Distinctions between geographic areas, elevations, slope aspect and slope angle are approximate, and transition zones between dangers exist. No matter what the current avalanche danger is, there are avalanche-safe areas in the mountains.*

UNITED STATES AVALANCHE DANGER DESCRIPTORS

Danger Level (Color)	Avalanche Probability and Avalanche Trigger	Degree and Distribution of Avalanche Danger	Recommended Action in the Back Country
Low (Green)	Natural Avalanches very unlikely. Human avalanches unlikely.	Generally stable snow. Isolated areas of instability.	Travel is generally safe. Normal caution advised.
Moderate (yellow)	Natural avalanches unlikely. Human triggered avalanches possible.	Unstable slabs possible on steep terrain.	Use caution on steeper terrain on certain aspects
Moderate to High (orange)	Natural avalanches possible. Human triggered avalanches possible.	Unstable slabs possible on steep terrain.	Be increasingly cautious in steep terrain.
High (red)	Natural and human triggered avalanches likely.	Unstable slabs likely on a variety of aspects and slope angles	Travel in avalanche terrain is not recommended. Safest travel on windward ridges of lower angle slopes without steeper terrain above.
Extreme (red with black border)	Widespread natural or human triggered avalanches are certain	Extremely unstable slabs are certain on most aspects and slope angles. Large destructive avalanches possible.	Travel in avalanche terrain should be avoided and travel confined to low angle terrain well away from avalanche path run-outs.

Figure 5-3 United States Avalanche Danger Scale

5.12 RESULTS

Based on review and analysis of the data, the Planning Team has determined that the probability for impact from an avalanche in portions of the County is possible, although not all areas of the county are directly impacted. The area has experienced avalanche conditions annually, the degree varying dependent on snowfall. One death has previously occurred. Secondary impacts would be commodity flow and transportation interruptions, which could impact the entire county to some degree, impacting the region's economy. In a worst-case scenario, an avalanche would occur after a series of storms. 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. Based on the potential impact, the Planning Team determined the CPRI score to be 1.95 with overall vulnerability determined to be a medium level.

CHAPTER 6.
CLIMATE CHANGE

6.1 WHAT IS CLIMATE CHANGE?

Climate, consisting of patterns of temperature, precipitation, humidity, wind and seasons, plays a fundamental role in shaping natural ecosystems and the human economies and cultures that depend on them. “Climate change” refers to changes over a long period of time. Worldwide, average temperatures have increased more than 1.4ºF over the last 100 years (NRC, 2010). Although this change may seem small, it can lead to large changes in climate and weather.

The warming trend and its related impacts are caused by increasing concentrations of carbon dioxide and other greenhouse gases in the earth’s atmosphere. Greenhouse gases are gases that trap heat in the atmosphere, resulting in a warming effect. Carbon dioxide is the most commonly known greenhouse gas; however, methane, nitrous oxide and fluorinated gases also contribute to warming. Emissions of these gases come from a variety of sources, such as the combustion of fossil fuels, agricultural production, and changes in land use. According to the U.S. Environmental Protection Agency (EPA), carbon dioxide concentrations measured about 280 parts per million (ppm) before the industrial era began in the late 1700s and have risen 41 percent since then, reaching 394 ppm in 2012 (see Figure 6-1). The EPA attributes almost all of this increase to human activities (U.S. EPA, 2013f).

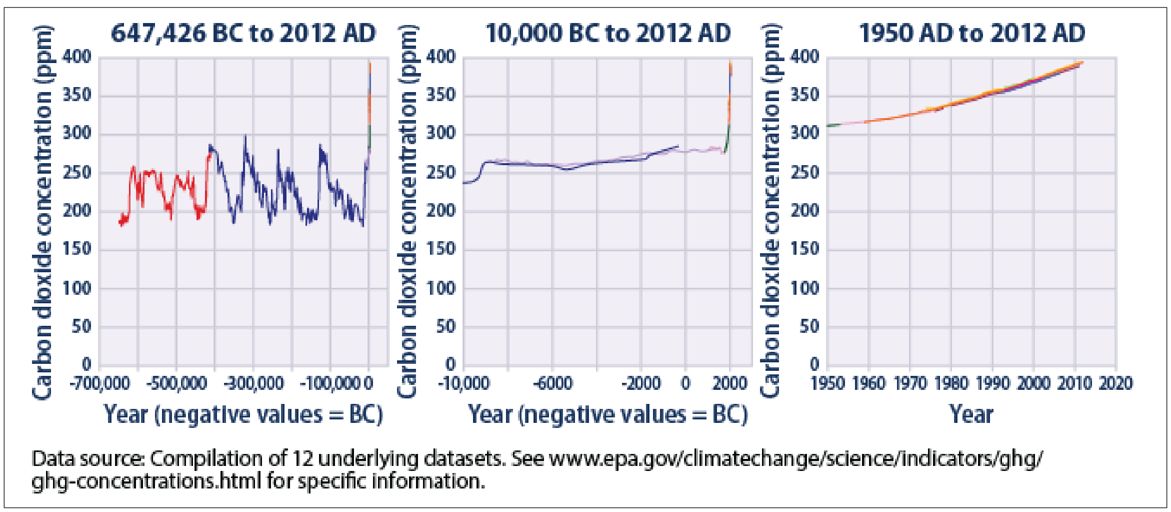


Figure 6-1 Global Carbon Dioxide Concentrations Over Time

Climate change will affect the people, property, economy, and ecosystems of Pend Oreille County in a variety of ways. Some impacts will have negative consequences for the region and others may present opportunities. The most important effect for the development of this plan is that climate change will have a measurable impact on the occurrence and severity of natural hazards.

6.2 HOW CLIMATE CHANGE AFFECTS HAZARD MITIGATION

An essential aspect of hazard mitigation is predicting the likelihood of hazard events in a planning area. Typically, predictions are based on statistical projections from records of past events. This approach assumes that the likelihood of hazard events remains essentially unchanged over time. Thus, averages based on the past frequencies of, for example, floods are used to estimate future frequencies: if a river has flooded an average of once every five years for the past 100 years, then it can be expected to continue to flood an average of once every five years.

For hazards that are affected by climate conditions, the assumption that future behavior will be equivalent to past behavior is not valid if climate conditions are changing. As flooding is generally associated with precipitation frequency and quantity, for example, the frequency of flooding will not remain constant if broad precipitation patterns change over time. The risks of avalanche, landslide, severe weather, severe winter weather and wildfire are all affected by climate patterns as well.

For this reason, an understanding of climate change is pertinent to efforts to mitigate natural hazards. Information about how climate patterns are changing provides insight on the reliability of future hazard projections used in mitigation analysis. This chapter summarizes current understandings about climate change to provide a context for the recommendation and implementation of hazard mitigation measures.

Table 6-1 identifies the relationship between climate change risk and its influence on the various hazards of concern within the planning region. When reviewing the Table, the downward leftmost column identifies the climate risks. Column headings across the table identify the natural hazards identified in the County's Plan. Cells with an X or P show which climate risks will affect the frequency, intensity, magnitude, or duration of each natural hazards. The "P" identifies the primary relationship between the risk and the identified hazard. The "X" identifies a secondary relationship. The blue cells in the body of the table show where climate change risk and a natural hazard are essentially the same thing. The first two highlighted risks rows—increased temperatures and changes in hydrology—are two of the primary climate drivers for many of the natural hazards. The other climate risks represent known environmental or ecosystem responses to one or both of the primary drivers. With respect to Volcanic activity, the impact from climate change on a volcano is unknown; however, volcanic activity itself can influence climate change with respect to absorption of terrestrial radiation by volcanic clouds, lowering temperatures in the lower atmosphere and changing atmospheric circulation patterns.

Table 6-1
Relationship Between Climate Change and Identified County Hazards

							Severe Weather				
CLIMATE RISKS	Avalanche	Climate Change	Drought	Earthquake	Flood	Landslide	Cold	Heat	Winter storms	Wildfire	Volcano*
Increased temperatures	X	P	P		X	X	X	X	X	P	
Changes in Hydrology	X	P	P	X	P	P			X	X	
Increased Wildfires		P	X		X	X				P	
Increase in ocean temperatures and changes in ocean chemistry	n/a										
Increased Drought		P	P								
Changes in Habitat	X	X	X		X	X				X	

Table 6-1
Relationship Between Climate Change and Identified County Hazards

							Severe Weather				
CLIMATE RISKS	Avalanche	Climate Change	Drought	Earthquake	Flood	Landslide	Cold	Heat	Winter storms	Wildfire	Volcano*
Increase in Invasive Species and Pests			X		X	X		X		P	
Decrease in natural vegetation	X		X		P	P	X		X	P	
Loss of Wetland ecosystems and services	X	P	P		P	X				X	
Increased frequency of extreme precipitation events (snow, flooding)	P				P	P			X		
Increased Landslides / Avalanche	P		X		X	P			X	X	

6.3 CURRENT INDICATIONS OF CLIMATE CHANGE

6.3.1 Global Indicators

The major scientific agencies of the United States—including the National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA)—agree that climate change is occurring (NOAA Technical Report, 2012; U.S. EPA, 2013). Multiple temperature records from all over the world have shown a warming trend (U.S. EPA, 2011). According to NOAA, the decade from 2000 to 2010 was the warmest on record, and 2010 was tied with 2005 as the warmest year on record (NOAA, 2011). Worldwide, average temperatures have increased more than 1.4ºF over the last 100 years (NRC, 2010). Many of the extreme precipitation and heat events of recent years are consistent with projections based on that amount of warming (USGCRP, 2009).

Rising global temperatures have been accompanied by other changes in weather and climate. Many places have experienced changes in rainfall resulting in more intense rain, as well as more frequent and severe heat waves. The planet's oceans and glaciers have also experienced changes: oceans are warming and becoming more acidic, ice caps are melting, and sea levels are rising (U.S. EPA, 2010). Global sea level has risen approximately nine (9) inches, on average, in the last 140 years (U.S. EPA, 2010). This has already put some coastal homes, beaches, roads, bridges, and wildlife at risk (USGCRP, 2009).

6.4 PROJECTED FUTURE IMPACTS

6.4.1 Global Projections

Scientists project that Earth's average temperatures will rise between 2ºF and 12ºF by 2100 (NRC, 2011a). Some research has concluded that every increase of 2ºF in average global average temperature can have the following impacts (NRC, 2011b):

- 3 to 10 percent increases in the amount of rain falling during the heaviest precipitation events, which can increase flooding risks

- 200 to 400 percent increases in the area burned by wildfire in parts of the western United States
- 5 to 10 percent decreases in stream flow in some river basins
- 5 to 15 percent reductions in the yields of crops as currently grown.

According to the 2012 report, review of historical Sea Level Rise rate derived from tide gauge records beginning in 1900, global sea level has risen 0.2 meters (8 inches). By 2100, sea level is expected to rise another 1.5 to 3 feet (NRC, 2011b). There is a highly significant correlation between observations of global mean SLR and increasing global mean temperature, and the IPCC and more recent studies anticipate that global mean sea level will continue to rise even if warming ceases. As such, continually rising seas will make coastal storms and the associated storm surges more frequent and destructive. What is currently termed a once-in-a-century coastal flooding event could occur as frequently as once per decade (USGCRP, 2009).

6.4.2 Projections for Washington State

The Climate Impacts Group (CIG, 2009) at the University of Washington used multiple climate models to evaluate potential climate change in Washington State and the Pacific Northwest region. Likewise, NOAA (2012) also completed various studies and technical reports. The following are key findings of those studies that are relevant for hazard mitigation planning:

- Climate models project increases in annual temperature (compared to 1970 – 1999 and averaged across all models) of 2.0°F by the 2020s, 3.2°F by the 2040s, and 5.3°F by the 2080s.
- Projected changes in annual precipitation, averaged over all models, are small (+1 to +2 percent), but some models project an enhanced seasonal precipitation cycle with changes toward wetter autumns and winters and drier summers.
- Regional climate models generally predict increases in extreme high precipitation over the next half-century, particularly around Puget Sound. Sea level risk by the year 2100 is projected to be in the range of 5-33cm (2-13 inches) under the moderate models for Washington state (2009 Climate Impact Group).
- April 1 snowpack is projected to decrease (compared with the 1916 – 2006 historical average) by 28 percent across the state by the 2020s, 40 percent by the 2040s, and 59 percent by the 2080s (Littell et al., 2009). However, the increased snowfall could "more than make up for" the shorter snow season and yield increased snow accumulations in some regions (Christensen, et al 2007, as cited in Sandell, 2013).
- Due to increased summer temperature and decreased summer precipitation, the area burned by fire in the U.S. portion of the Columbia River basin is projected to double by the 2040s and triple by the 2080s. The probability that more than 2 million acres in that area will burn in a given year is projected to increase from 5 percent today to 33 percent by the 2080s.
- Projected warming would likely result in 101 additional deaths during heat events in the greater Seattle area among persons 45 and older in 2025 and 156 additional deaths in 2045.
- Most recently in Washington, the summer of 2017 was one of the driest on record, dating back over 30 years. Area weather records were set for two 90-degree days, tying 1967 and 1988 with the highest number of 90-degree days in September on record.
- Averaged over Washington State, the June through August average temperatures ranked as the 4th warmest in the historical record with temperatures 2.6°F above the 1981-2010 normal. Total June through August precipitation also ranked in the top 10, coming in as the 7th driest for Washington State with over a 2" rainfall deficit compared to normal.

6.5 RESPONSES TO CLIMATE CHANGE

6.5.1 Mitigation and Adaptation

Communities and governments worldwide are working to address, evaluate, and prepare for climate changes that are likely to impact communities in coming decades. Generally, climate change discussions encompass two separate but inter-related considerations: mitigation and adaptation. The term "mitigation" can be confusing, because its meaning changes across disciplines:

- Mitigation in restoration ecology and related fields generally refers to policies, programs or actions that are intended to reduce or to offset the negative impacts of human activities on natural systems. Generally, mitigation can be understood as avoiding, minimizing, rectifying, reducing, or eliminating, or compensating for known impacts (CEQ, 1978).
- Mitigation in climate change discussions is defined as "a human intervention to reduce the impact on the climate system." It includes strategies to reduce greenhouse gas sources and emissions and enhance greenhouse gas sinks (U.S. EPA, 2013g).
- Mitigation in emergency management is typically defined as the effort to reduce loss of life and property by lessening the impact of disasters (FEMA, 2013).

In this chapter, mitigation is used as defined by the climate change community. In the other chapters of this plan, mitigation is primarily used in an emergency management context.

Adaptation refers to adjustments in natural or human systems in response to the actual or anticipated effects of climate change and associated impacts. These adjustments may moderate harm or exploit beneficial opportunities (U.S. EPA, 2013g).

Mitigation and adaptation are related, as the world's ability to reduce greenhouse gas emissions will affect the degree of adaptation that will be necessary. Some initiatives and actions can both reduce greenhouse gas emissions and support adaptation to likely future conditions. Likewise, assessing mitigation efforts to include impact from climate change is a logical approach to enhance resilience of a community.

Societies across the world are facing the need to adapt to changing conditions associated with natural disasters and climate change. Farmers are altering crops and agricultural methods to deal with changing rainfall and rising temperature; architects and engineers are redesigning buildings; planners are looking at managing water supplies to deal with droughts or flooding.

Most ecosystems show a remarkable ability to adapt to change and to buffer surrounding areas from the impacts of change. Forests can bind soils and hold large volumes of water during times of plenty, releasing it through the year; floodplains can absorb vast volumes of water during peak flows; coastal ecosystems can hold out against storms, attenuating waves, and reducing erosion. Other ecosystem services—such as food provision, timber, materials, medicines, and recreation—can provide a buffer to societies in the face of changing conditions.

Ecosystem-based adaptation is the use of biodiversity and ecosystem services as part of an overall strategy to help people adapt to the adverse effects of climate change. This includes the sustainable management, conservation and restoration of specific ecosystems that provide key services.

6.5.2 Response to Climate Change in the Northwest

The State of Washington has adopted greenhouse gas reduction requirements that aim to reduce emissions to 1990 levels by 2020, to 25 percent below 1990 levels by 2035 and to 50 percent below 1990 levels by 2050 (RCW 47.01.440). Scientists have known for more than a decade that carbon pollution is the primary cause of climate change. Recognizing the need to take action, in 2015 Gov. Jay Inslee directed Ecology to cap and reduce carbon pollution under Washington's Clean Air Act. Under the new rule, businesses that are responsible for 100,000 metric tons of carbon pollution annually will be required to cap and then gradually reduce their emissions. Natural gas distributors, petroleum fuel producers and importers, power plants, metal manufacturers, waste facilities, and state and federal facilities need to show their emissions are declining by an average of 1.7 percent a year starting in 2017.

6.6 POTENTIAL CLIMATE CHANGE IMPACT ON HAZARDS

An understanding of the basic features of climate change allows for a qualitative assessment of impacts on hazards of concern addressed in this hazard mitigation plan. This overview serves as a basis for evaluating how risk will change as a result of future climate change impacts. The vulnerabilities identified in this plan update will ultimately be used to inform other aspects of emergency management planning, such as the Comprehensive Emergency Management Plan.

6.6.1 Avalanche

Snow avalanches are rarely used as indicators of climate change. The effects of climate change on avalanche frequency and magnitude are uncertain and will likely be dependent on local climate change impacts, such as changes in snowfall events and temperature series. Some studies have indicated that the types of avalanche events (wet or dry) may shift as a result of changes in snow cover (Martin et al., 2001). Avalanches, however, are not influenced by snow cover alone, but by several interrelated factors including forest structure, surface energy balance, melt water routing, precipitation, air temperature and wind (Teich et al., 2012; Lazar and Williams, 2008).

Secondary and tertiary impacts of climate change may also alter avalanche events. For example, climate change may modify the distribution of tree species across mountain landscapes. Some case studies in the Swiss and French Alps indicate that climate change impacts may reduce the frequency or severity of such events, while other assessments indicate that events may occur more frequently in other mountain regions (Kohler, 2009; Teich et al. 2012). No studies assessing the relative frequency and severity of avalanches in the region were located, but an analysis of wet avalanche hazards in an Aspen ski area indicated that such effects may occur more frequently under high-emission scenarios (Lazar and Williams, 2008). Feedback loops affecting snow cover, forest structure, meteorological averages, and land use planning decisions are all likely to influence the future frequency and severity of impacts from avalanche events.

6.6.2 Dam Failure

Dams are designed partly based on assumptions about a river's flow behavior, expressed as hydrographs. Changes in weather patterns can have significant effects on the hydrograph used for the design of a dam. If the hygrograph changes, it is conceivable that the dam can lose some or all of its designed margin of safety, also known as freeboard. If freeboard is reduced, dam operators may be forced to release increased volumes earlier in a storm cycle in order to maintain the required margins of safety. Such early releases of increased volumes can increase flood potential downstream. Throughout the west, communities downstream of dams are already experiencing increases in stream flows from earlier releases from dams.

Dams are constructed with safety features known as "spillways." Spillways are put in place on dams as a safety measure in the event of the reservoir filling too quickly. Spillway overflow events, often referred to as "design failures," result in increased discharges downstream and increased flooding potential. Although climate change will not increase the probability of catastrophic dam failure, it may increase the probability of design failures.

6.6.3 Earthquake

The impacts of global climate change on earthquake probability are unknown. Some scientists say that melting glaciers could induce tectonic activity. As ice melts and water runs off, tremendous amounts of weight are shifted on the earth's crust. As newly freed crust returns to its original, pre-glacier shape, it could cause seismic plates to slip and stimulate volcanic activity, according to research into prehistoric earthquakes and volcanic activity. NASA and USGS scientists found that retreating glaciers in southern Alaska may be opening the way for future earthquakes (NASA, 2004).

Climate change could magnify secondary impacts of earthquakes. Soils saturated by repetitive storms could experience liquefaction or an increased propensity for slides during seismic activity due to the increased saturation. Dams storing increased volumes of water due to changes in the hydrograph could fail during seismic events. There are currently no models available to estimate these impacts.

6.6.4 Flood

According to University of Washington scientists, global climate changes resulting in warmer, wetter winters are projected to increase flooding frequency. Future floods are expected to exceed the capacity and protective abilities of existing flood protection facilities, threatening lives, property, major transportation corridors, communities, and regional economic centers.

Changes in Hydrology

Use of historical hydrologic data has long been the standard of practice for designing and operating water supply and flood protection projects. For example, historical data are used for flood forecasting models and to forecast snowmelt runoff for water supply. This method of forecasting assumes that the climate of the future will be similar to that of the period of historical record. However, the hydrologic record cannot be used to predict changes in frequency and severity of extreme climate events such as floods. Going forward, model calibration or statistical relation development must happen more frequently, new forecast-based tools must be developed, and a standard of practice that explicitly considers climate change must be adopted. Climate change is already impacting water resources, and resource managers have observed the following:

- Historical hydrologic patterns can no longer be solely relied upon to forecast the water future.
- Precipitation and runoff patterns are changing, increasing the uncertainty for water supply and quality, flood management and ecosystem functions.
- Extreme climatic events will become more frequent, necessitating improvement in flood protection, drought preparedness and emergency response.

The amount of snow is critical for water supply and environmental needs, but so is the timing of snowmelt runoff into rivers and streams. Rising snowlines caused by climate change will allow more mountain area to contribute to peak storm runoff. High frequency flood events (e.g. 10-year floods) in particular will likely increase with a changing climate. Along with reductions in the amount of the snowpack and accelerated snowmelt, scientists project greater storm intensity, resulting in more direct runoff and flooding. Changes in watershed vegetation and soil moisture conditions will likewise change runoff and recharge patterns. As stream flows and velocities change, erosion patterns will also change, altering channel shapes and depths, possibly increasing sedimentation behind dams, and affecting habitat and water quality. With potential increases in the frequency and intensity of wildfires due to climate change, there is potential for more floods following fire, which increase sediment loads and water quality impacts.

As hydrology changes, what is currently considered a 100-year flood may strike more often, leaving many communities at greater risk. Planners will need to factor a new level of safety into the design, operation, and regulation of flood protection facilities such as dams, bypass channels and levees, as well as the design of local sewers and storm drains.

Sea Level Rise

While not a coastal community, the impacts from Seal Level Rise (SLR) could nonetheless impact Pend Oreille County. Sea level and temperature are interrelated (U.S. EPA, 2013e). Warmer temperatures result in the melting of glaciers and ice sheets. This melting means that less water is stored on land and, thus, there is a greater volume of water in the oceans. Water also expands as it warms, and the heat content of the world's oceans has been increasing over the last several decades. According to the EPA, there is likely to be 13 inches of sea level rise in the Puget Sound basin by 2100. According to the Washington State Department of Ecology, the impacts of sea level rise could include the following: increased coastal community flooding, coastal erosion and landslides, seawater well intrusion, acidification of waters, and lost wetlands and estuaries (see Figure 6-2). In addition, sea level risk may also be impacted by vertical land deformation caused by tectonic movement, isostatic rebound, which is the rising of compressed earth after removal of a heavy load mass, such as glaciers, and seasonal ocean elevation changes due to atmospheric impact and effects.

6.6.5 Landslide and Erosion

Climate change may impact storm patterns, increasing the probability of more frequent, intense storms with varying duration. Increase in global temperature could affect the snowpack and its ability to hold and store water. Warming temperatures also could increase the occurrence and duration of droughts, which would increase the probability of wildfire, reducing the vegetation that helps to support steep slopes. All of these factors would increase the probability for landslide occurrences. Likewise, although erosion on beaches and bluffs is a naturally occurring, on-going process, major episodes of erosion often occur during storm events, particularly when storms coincide with high tides. Such events will exacerbate episodic erosion events, accelerating bluff and beach erosion.

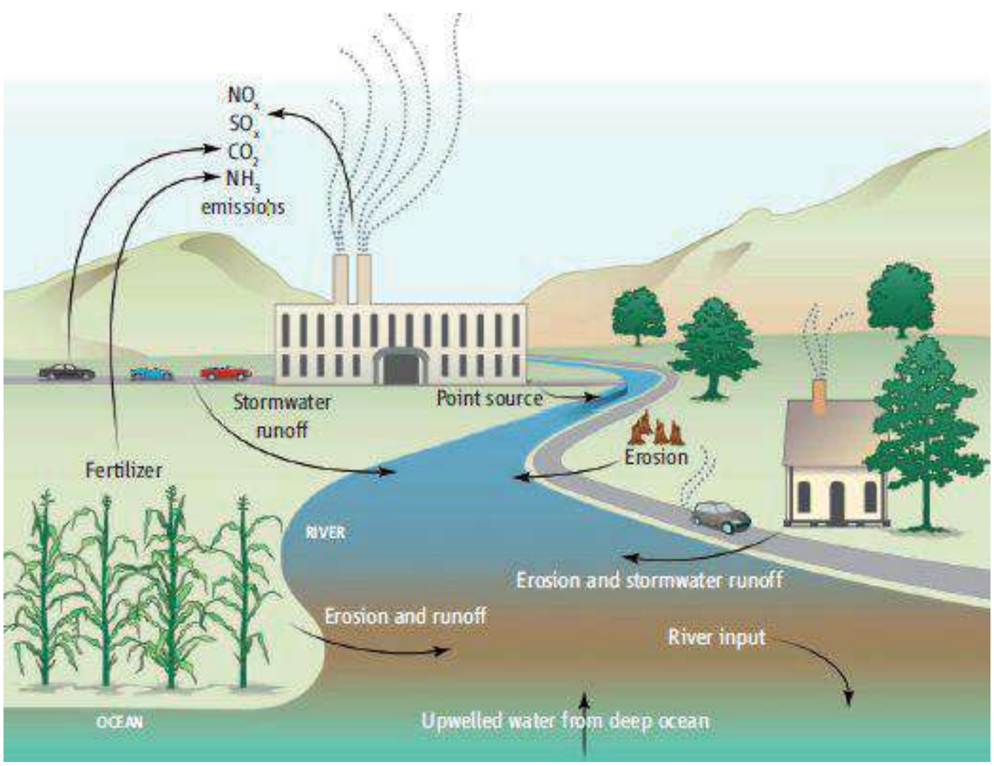


Figure 6-2 Contributors to acidification

6.6.6 Severe Weather

Climate change presents a challenge for risk management associated with severe weather. The frequency of severe weather events has increased steadily over the last century. The number of weather-related disasters during the 1990s was four times that of the 1950s, and cost 14 times as much in economic losses. Historical data shows that the probability for severe weather events increases in a warmer climate (see Figure 6-3). According to the EPA, "Since 1901, the average surface temperature across the contiguous 48 states has risen at an average rate of 0.14°F per decade. Average temperatures have risen more quickly since the late 1970s (0.36 to 0.55°F per decade). Seven of the top 10 warmest years on record for the contiguous 48 states have occurred since 1998, and 2012 was the warmest year on record (U.S. EPA, 2013b)." This increase in average surface temperatures can also lead to more intense heat waves that can be exacerbated in urbanized areas by what is known as urban heat island effect. Additionally, the changing hydrograph caused by climate change could have a significant impact on the intensity, duration, and frequency of storm events. All of these impacts could have significant economic consequences.

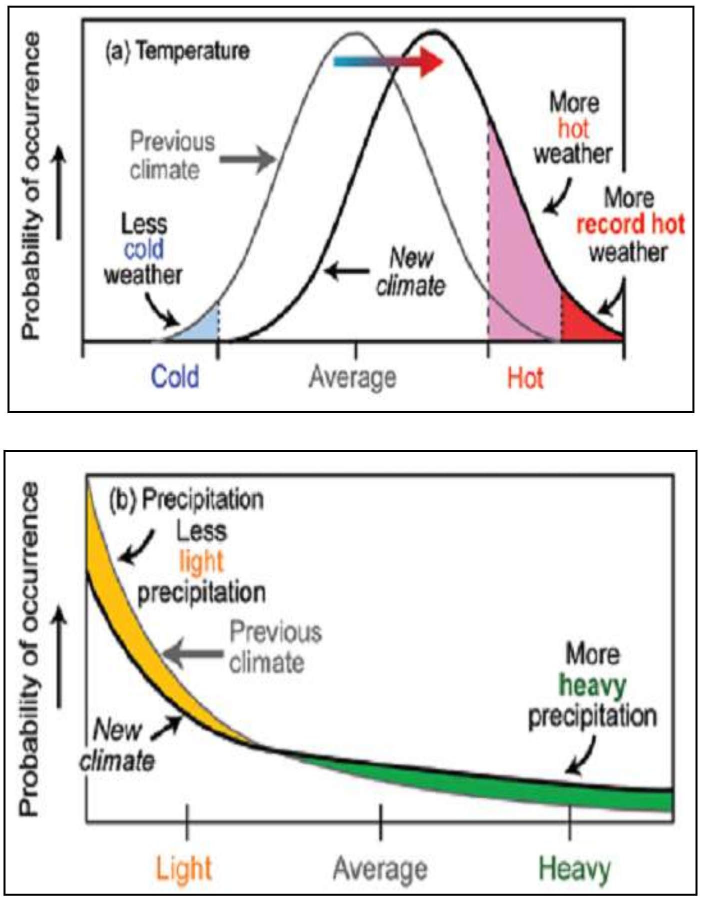


Figure 6-3 Severe Weather Probabilities in Warmer Climates

6.6.7 Severe Winter Weather

One impact of climate change is an increase in average ambient temperatures. Since the 1980s, unusually cold temperatures have become less common in the contiguous 48 states (U.S. EPA, 2013c). This trend is expected to continue, and the frequency of winter cold spells will likely decrease.

As ambient temperatures increase, more water evaporates from land and water sources. The timing, frequency, duration, and type of precipitation events will be affected by these changes. In general, more precipitation will fall as rain rather than snow; however, the amount of snowfall may increase where temperatures remain below freezing (U.S. EPA, 2013d). Snowfall may also change if typical storm track patterns are altered. Snowfall is already changing in the United States. According to the EPA (see Figure 6-4; U.S. EPA, 2014d):

- Total snowfall has decreased in most parts of the country since widespread observations became available in 1930, with 57 percent of stations showing a decline.
- More than three-fourths of the stations across the contiguous 48 states have experienced a decrease in the proportion of precipitation falling as snow.
- Snowfall trends vary by region. The Pacific Northwest has seen a decline in both total snowfall and the proportion of precipitation falling as snow.[26]

[26] https://www.epa.gov/climate-indicators/climate-change-indicators-snowfall

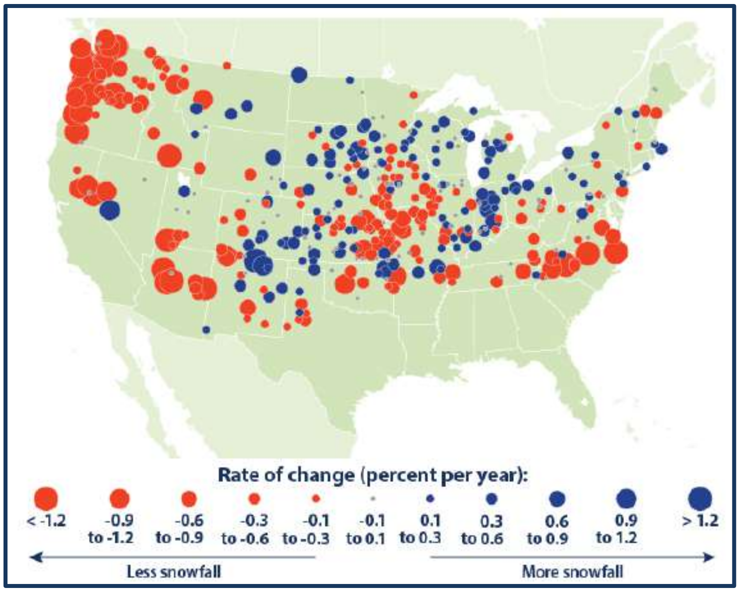


Figure 6-4 Change in Snowfall, 1930-2007

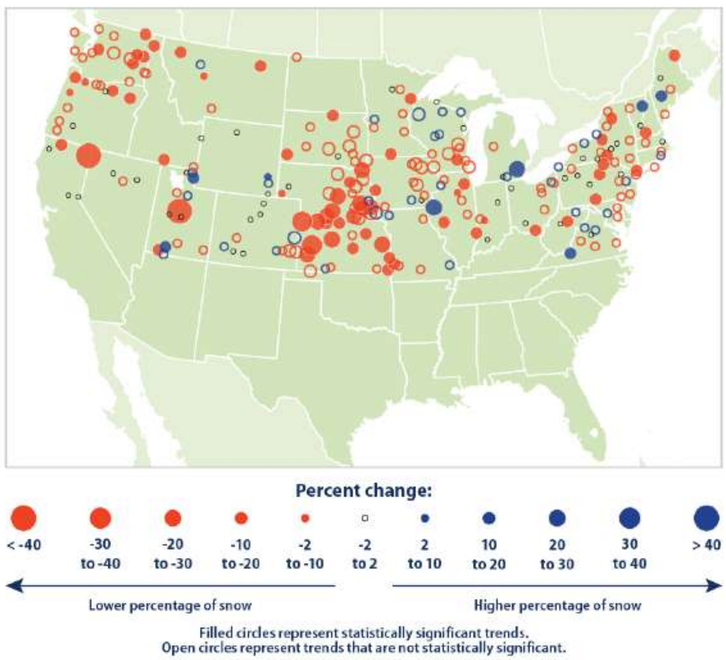


Figure 6-5 Change in Snow-to-Precipitation Ration in Contiguous 48 States, 1949-2016

From 1949 to 2016, snow-to-precipitation ratios have declined in most of the western United States, compared to historical averages. Western Washington, western Oregon and northern California have seen the greatest declines (see Figure 6-5; U.S. EPA, 2017). These changes will impact ecosystems, recreation opportunities, the hydroelectric power supply, and drinking water systems. The timing and magnitude of flooding may also be impacted by changes in the region's hydrograph, due to a greater percentage of precipitation falling as rain and earlier spring melt times.[27]

6.6.8 Volcano

While there are no volcanoes in Pend Oreille County, the accumulation of ash from an eruption could occur. Climate change is not likely to affect the risk associated with volcanoes; however, volcanic activity can affect climate change. Volcanic clouds absorb terrestrial radiation and scatter a significant amount of incoming solar radiation. By reducing the amount of solar radiation reaching the Earth's surface, large-scale volcanic eruptions can lower temperatures in the lower atmosphere and change atmospheric circulation patterns. Such effects can last from two to three years following a volcanic eruption. The massive outpouring of gases and ash can influence climate patterns for years following a volcanic eruption as sulfuric gases convert to sub-micron droplets containing about 75 percent sulfuric acid. These particles can linger three to four years in the stratosphere.

6.6.9 Wildfire

Climate change has the potential to affect multiple elements of the wildfire system: fire behavior, ignitions, fire management, and vegetation fuels. Hot dry spells create the highest fire risk. Increased temperatures may intensify wildfire danger by warming and drying out vegetation. Climate change also may increase winds that spread fires. Forest response to increased atmospheric carbon dioxide could contribute to more tree growth and thus more fuel for fires, although the effects of carbon dioxide on mature forests are still largely unknown. In turn, increased high-elevation wildfires could release stores of carbon and further contribute to the buildup of greenhouse gases.

The extent of area burned by wildfires each year appears to have increased since the 1980s. According to National Interagency Fire Center (2018) data, the number of fires reported were well above the five-year average and slightly higher than the 10-year national average. With respect to acreage burned, 2017 fell slightly below the 2015, which represented the highest number of acres burned over the last 10 years (see Figure 6-6 below). This period coincides with many of the warmest years on record nationwide.[28]

[27] https://www.epa.gov/climate-indicators

[28] https://www.epa.gov/climate-indicators/climate-change-indicators-wildfires Accessed 18 March 2018.

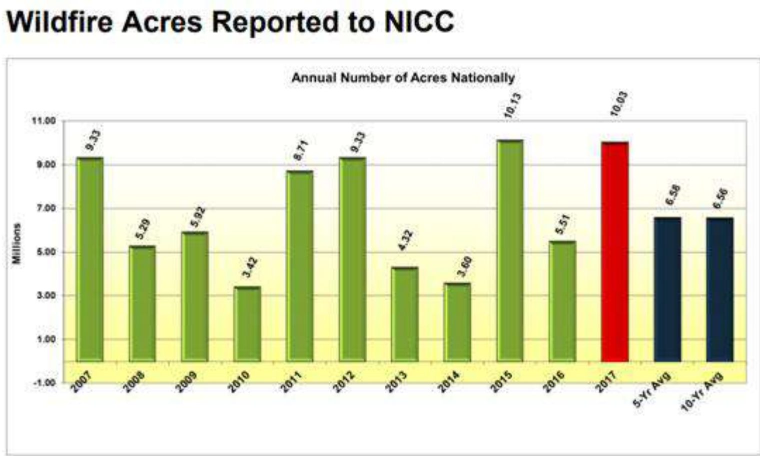


Figure 6-6 Wildfire Acres Burned 2007-2017

Wildfire in western ecosystems is determined by climate variability, local topography, and human intervention. Climate change has the potential to affect multiple elements of the wildfire system: fire behavior, ignitions, fire management, and vegetation fuels. Hot dry spells create the highest fire risk. Increased temperatures may intensify wildfire danger by warming and drying out vegetation. When climate alters fuel loads and fuel moisture, forest susceptibility to wildfires changes. Climate change also may increase winds that spread fires. Faster fires are harder to contain, and thus are more likely to expand into residential neighborhoods.

Historically, drought patterns in the West are related to large-scale climate patterns in the Pacific and Atlantic oceans. The El Niño–Southern Oscillation in the Pacific varies on a 5- to 7-year cycle, the Pacific Decadal Oscillation varies on a 20- to 30-year cycle, and the Atlantic Multidecadal Oscillation varies on a 65- to 80-year cycle. As these large-scale ocean climate patterns vary in relation to each other, drought conditions in the U.S. shift from region to region. El Niño years bring drier conditions to the Pacific Northwest and more fires.

Climate scenarios project summer temperature increases between 2ºC and 5°C and precipitation decreases of up to 15 percent. Such conditions would exacerbate summer drought and further promote high-elevation wildfires, releasing stores of carbon, and further contributing to the buildup of greenhouse gases. Forest response to increased atmospheric carbon dioxide could also contribute to more tree growth and thus more fuel for fires, but the effects of carbon dioxide on mature forests are still largely unknown. High carbon dioxide levels should enhance tree recovery after fire and young forest regrowth, as long as sufficient nutrients and soil moisture are available, although the latter is in question for many parts of the western United States because of climate change.

6.7 PEND OREILLE COUNTY IMPACT

Climate change is likely to have an impact on future water resources in the County. Over the next decades, increased regional temperatures are anticipated to lead to a reduction in snowpack. Since many of the tributary streams in County’s WRIA areas depend upon snowmelt and glacier melt waters, these streams may be affected over time. Anticipated effects include decreased summer baseflows as snowpack and glaciers are reduced. Spring peak flows are also predicted to occur two to six weeks earlier than they do normally (CIG, 2009). Further, streams without snowmelt or headwaters in the mountains will also be affected, perhaps more strongly, as streams currently have low in-stream flows.

For rain-dominated watersheds, studies indicate that there will be an increase in the magnitude and frequency of extreme winter precipitation events, which will "increase winter stream flows and may increase flooding" (Sandell, 2013). Within transient watersheds (mixed rain and snow) or snowmelt-dominated watersheds, projected climate change influences could vary as those are snow-dependent. As in the 2018 season, the snow pack was higher than normal, as were temperatures warmer than normal. This resulted in flooding from the snowpack melting beginning in March, with predictions that such events will continue to last.

6.8 RESULTS

Based on review and analysis of the data, the Planning Team has determined that the probability for impact from Climate Change throughout the area is likely. While there are still many uncertainties associated with climate change, indicators of impact already exist. The area has previously experienced drought conditions, with a drought incident occurring only a short period ago (2015). During the summer of 2017, the State experienced one of its driest summers on record. With anticipated increase in temperatures as a result of climate change, drought situations will only intensify. The impact of Climate Change on Earthquake, while relatively unknown, could be exacerbated as a result of increased liquefaction, due to increased flooding issues. However, the area has very limited impact due to earthquake. Historical hydrologic patterns of weather events would become increasingly inaccurate, increasing potential vulnerability due to uncertainty for water supplies, flood management, and ecological functions. Increased temperatures would also impact snow levels, decreasing water supplies in the various watersheds falling as precipitation, but increasing runoff as a result of snowmelt. Higher temperatures anticipated with climate change would increase vulnerability of the population due to excessive heat. Based on the potential impact, the Planning Team determined the CPRI score to be 2.35, with overall vulnerability determined to be a medium level.

CHAPTER 7.
DROUGHT

7.1 GENERAL BACKGROUND

> **DEFINITIONS**
> **Drought**—The cumulative impacts of several dry years on water users and agricultural producers. It can include deficiencies in surface and subsurface water supplies and cause impacts to health, well-being, and quality of life.
> **Hydrological Drought**—Deficiencies in surface and subsurface water supplies.
> **Socioeconomic Drought**—Drought impacts on health, well-being, and quality of life.

Droughts originate from a deficiency of precipitation resulting from an unusual weather pattern. If the weather pattern lasts a short time (a few weeks or a couple of months), the drought is considered short-term. If the weather pattern becomes entrenched and the precipitation deficits last for several months or years, the drought is considered to be long-term. It is possible for a region to experience a long-term circulation pattern that produces drought, and to have short-term changes in this long-term pattern that result in short-term wet spells. Likewise, it is possible for a long-term wet circulation pattern to be interrupted by short-term weather spells that result in short-term drought.

Drought is a prolonged period of dryness severe enough to reduce soil moisture, water, and snow levels below the minimum necessary for sustaining plant, animal, and economic systems. Droughts are a natural part of the climate cycle. For this plan, the County has elected to use Washington's statutory definition of drought (RCW Chapter 43.83B.400), which is based on both of the following conditions occurring:

- The water supply for the area is below 75 percent of normal.
- Water uses and users in the area will likely incur undue hardships because of the water shortage.

7.2 HAZARD PROFILE

7.2.1 Extent and Location

Drought can have a widespread impact on the environment and the economy, depending upon its severity, although it typically does not result in loss of life or damage to property, as do other natural disasters. The National Drought Mitigation Center uses three categories to describe likely drought impacts:

- Agricultural—Drought threatens crops that rely on natural precipitation, while also increasing the potential for infestation.
- Water supply—Drought threatens supplies of water for irrigated crops, for communities and for fish and salmon and other species of wildlife.
- Fire hazard—Drought increases the threat of wildfires from dry conditions in forest and rangelands.

In Washington, where hydroelectric power plants generate nearly three-quarters of the electricity produced, drought also threatens the supply of electricity. Unlike most disasters, droughts normally occur slowly but last a long time. Drought conditions occur every few years in Washington. The droughts of 1977 and 2001 (discussed below), the worst and second worst in state history, provide good examples of how drought can affect the state.

On average, the nationwide annual impacts of drought are greater than the impacts of any other natural hazard. They are estimated to be between $6 billion and $8 billion annually in the United States and occur primarily in 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.

Drought affects groundwater sources, but generally not as quickly as surface water supplies, although groundwater supplies generally take longer to recover. Reduced precipitation during a drought means that groundwater supplies are not replenished at a 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. About 16,000 drinking water systems in Washington get water from the ground; these systems serve about 5.2 million people. Reduced replenishment of groundwater affects streams. Much of the flow in streams comes from groundwater, especially during the summer when there is less precipitation and after snowmelt ends. Reduced groundwater levels mean that even less water will enter streams when steam flows are lowest.

Much of the area depends on well water, which currently supplies a large portion of Pend Oreille County residents with their drinking water. Drought conditions within the planning area increase pressure on local aquifers. This, in turn, could cause restrictions on economic growth and development.

A drought directly or indirectly impacts all people in affected areas. A drought can result in farmers not being able to plant crops or the failure of planted crops. It can impact the availability of food sources (hay or grain) for cattle and livestock, reducing the carrying capacity for farmers. This ultimately could result in loss of work for farm workers and those in related food processing jobs, things which are a primary source of the economy in the County.

Other water- or electricity-dependent industries are commonly forced to shut down all or a portion of their facilities, resulting in further layoffs. A drought can also harm recreational companies that use water (e.g., swimming pools, water parks, river rafting companies, landscape and nursery businesses) because people will not invest in new plants if water is not available to sustain them. With much of Washington's energy coming from hydroelectric plants, a drought means less inexpensive electricity coming from dams and potentially higher electric bills. This is especially true for Pend Oreille County, as the PUD owns its own dam from which it generates power for the county. All people could pay more for power and water if utilities increase their rates. This has become an issue within Washington State as a whole previously when a lack of snow pack has decreased hydroelectric generating capacity, and raised the prices for power, impacting residents.

7.2.2 Previous Occurrences

In the past century, Washington has experienced a number of drought episodes, including several that lasted for more than a single season—1928 to 1932, 1992 to 1994, and 1996 to 1997. Table 7-1 identifies additional drought occurrences in the state. The 1977 drought was the worst on record, but the 2001 drought came close to surpassing it in some respects. Table 7-2 has data on how the two droughts affected Washington by late September of their respective years.

Table 7-1 Drought Occurrences	
July-August 1902	No measurable rainfall in Western Washington
August 1919	Drought and hot weather occurred in Western Washington
July – August 1921	Drought in all agricultural sections.
June-August 1922	The statewide precipitation averaged 0.10 inches.
March – August 1924	Lack of soil moisture retarded germination of spring wheat.
July 1925	Drought occurred in Washington
July 21-August 25, 1926	Little or no rainfall was reported.
June 1928-March 1929	Most stations averaged less than 20 percent of normal rainfall for August and September and less than 60 percent for nine months.
July – August 1930	Drought affected the entire state. Most weather stations averaged 10 percent or less of normal precipitation.
April 1934-March 1937	The longest drought in the region's history – the driest periods were April-August 1934, September-December 1935, and July-January 1936-1937.
May – September 1938	Driest growing season in Western Washington.
1952	Every month was below normal precipitation except June. The hardest hit areas were Puget Sound and the central Cascades.
January – May 1964	Drought covered the southwestern part of the state. Precipitation was less than 40 percent of normal.
Spring 1966	Drought throughout Washington
June – August 1967	Drought throughout Washington
January – August 1973	Dry in the Cascades.
October 1976 – September 1977	Worst drought in Pacific Northwest history. Below normal precipitation in Olympia, Seattle, and Yakima. Crop yields were below normal and ski resorts closed for much of the 1976-77 season.
2001	Governor declared statewide Stage 2 drought in response to severe dry spell.
June – September 2003	Federal disaster number 1499 assigned to 15 counties. The original disaster was for flooding, but several jurisdictions were included because of previous drought conditions.
March 10, 2005 Governor Declared Drought	Precipitation levels was below or much below the average from November through February, with extremely warm fall and winter months, adversely affecting the state's mountain snow pack. A warm mid-January removed much of the remaining snow pack, with March projections at 66 percent of normal, indicating that Washington might be facing a drought as bad as, or worse, than the 1977 drought. Late March rains filled reservoirs to about 95 percent. State legislature approved $12 million supplemental budget that provided funds to buy water, improve wells, and implement other emergency water supply projects. Wildfires numbers was about 75 percent of previous five years, but acreage burned was three times greater.

Table 7-1 **Drought Occurrences**	
2015	2015 was the year of the “snowpack drought.” Washington State had normal or near-normal precipitation over the 2014-2015 winter season. However, October through March the average statewide temperature was 40.5 degrees Fahrenheit, 4.7 degrees above the 20th century long-term average and ranking as the warmest October through March on record. Washington experienced record low snowpack because mountain precipitation that normally fell as snow instead fell as rain. The snowpack deficit then was compounded as precipitation began to lag behind normal levels in early spring and into the summer. With record spring and summer temperatures, and little to no precipitation over many parts of the state, the snowpack drought morphed into a traditional precipitation drought, causing injury to crops and aquatic species. Many rivers and streams experienced record low flows. (See Figure 7-1.)

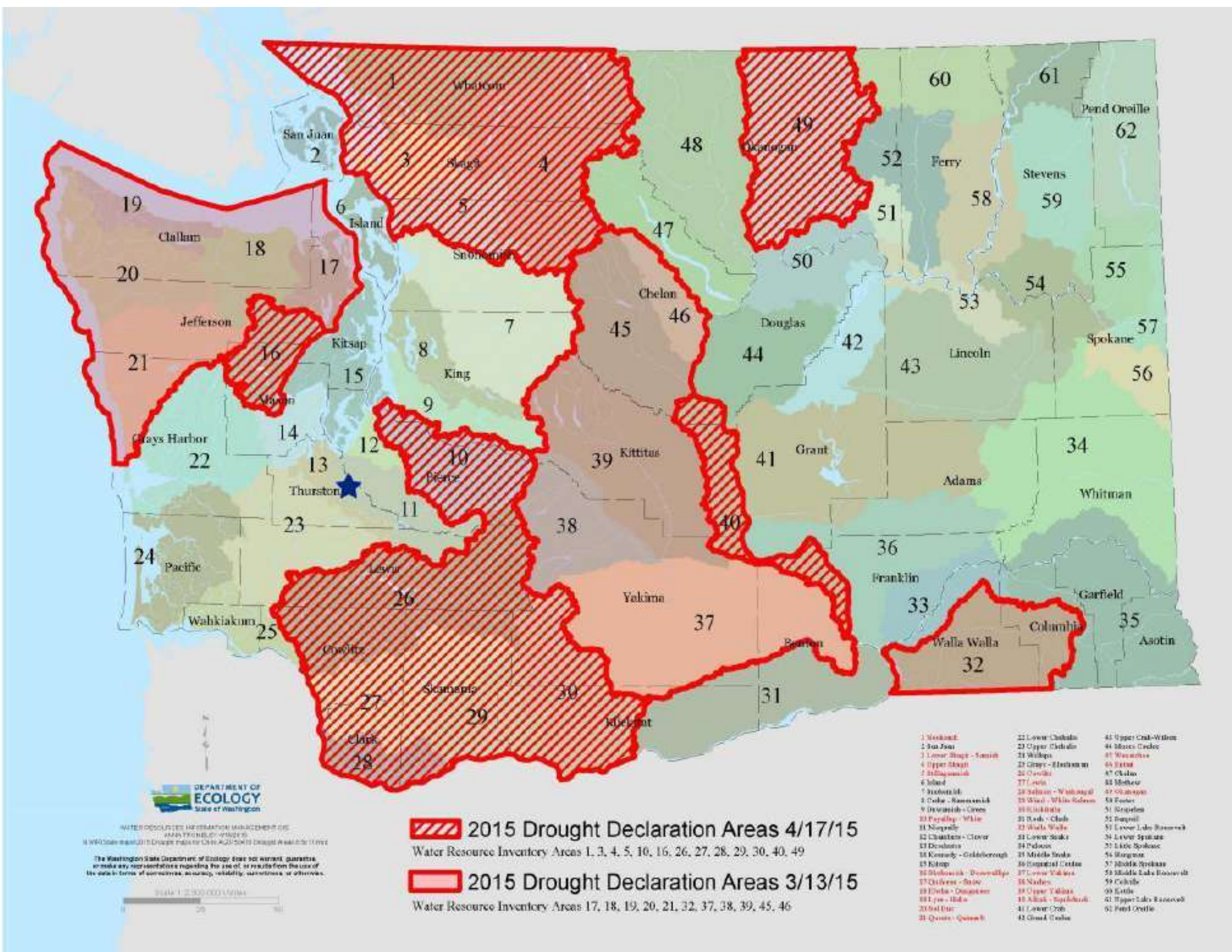


Figure 7-1 Washington State Department of Ecology 2015 Drought Map

Table 7-2
Comparison of Impacts of 1977 Drought to 2001 Drought

Impact	1977 Drought	2001 Drought
Precipitation	Precipitation at most locations ranged from 50 to 75% of normal levels, and in parts of Eastern Washington as low as 42 to 45% of normal.	Precipitation was 56 to 74% of normal. U.S. Bureau of Reclamation – Yakima Project irrigators received only 37% of their normal entitlements. At the end of the irrigation season, the Bureau of Reclamation's five reservoirs stored only 50,000 acre-feet of water compared with 300,000 acre-feet typically in storage.
Wildland Fire	1,319 wildland fires burned 10,800 acres. State fire-fighting activities involved more than 7,000 man-hours and cost more than $1.5 million.	1,162 wildland fires burned 223,857 acres. Firefighting efforts cost the state $38 million and various local, regional, and federal agencies another $100 million.
Fish	In August and September 1977, water levels at the Goldendale and Spokane trout hatcheries were down. Fish had difficulties passing through Kendall Creek, a tributary to the north fork of the Nooksack River in Whatcom County.	A dozen state hatcheries took a series of drought-related measures, including installing equipment at North Toutle and Puyallup hatcheries to address low water flow problems.
Emergency Water Permits	Department of Ecology issued 517 temporary groundwater permits to help farmers and communities drill more wells.	Department of Ecology issued 172 temporary emergency water-right permits and changes to existing water rights.
Economic Impacts	The state's economy lost an estimated $410 million over a two-year period. The drought hit the aluminum industry hardest. Major losses in agriculture and service industries included a $5 million loss in the ski industry. 13,000 jobs were lost because of layoffs in the aluminum industry and in agriculture.	The Bonneville Power Administration paid more than $400 million to electricity-intensive industries to shut down and remain closed for the duration of the drought. Thousands lost their jobs for months, including 2,000-3,000 workers at the Kaiser and Vanalco plants. Federal agencies provided more than $10.1 million in disaster aid to growers. More than $7.9 million in state funds paid for drought-related projects; these projects enabled the state to provide irrigation water to farmers with junior water rights and to increase water in fish-bearing streams.

The following information relates to statewide drought issues (inclusive of impact to Pend Oreille County), which include years of low precipitation and snow pack, as well as impact to sources of power, drinking water, and the fishing/tourism industry:

- Three energy curtailments resulted from drought periods prior to 1977, which caused temporary unemployment within various industry sectors.
- In the summer of 2001, the governor declared a statewide Stage 2 drought in response to the worst dry spell since records began in 1929.

- In 2003, the state was in another drought when areas of the state went for over 60 days without substantial rain. The Office of the State Climatologist stated that the summer of 2003 was the driest summer (at that time) since records were officially kept.
- In March 2005, Washington Department of Ecology declared a statewide drought. The state legislature approved a $12 million supplemental budget request for buying water, improving wells, implementing other emergency water-supply projects, and hiring temporary state staff to respond to the drought emergency, conduct public workshops and undertake drought-related studies. In March, the water supply forecast was 66 percent of normal, signaling an extremely poor water year and a possible reduction in electricity production. By late spring, due to record precipitation in March and April, water filled reservoirs to about 95 percent of capacity, more than enough to meet projected electricity demands. Despite projected drought impacts of up to $300 million, unexpected spring rains combined with reallocation of water and conservation measures by farmers largely mitigated the drought's impacts. Harvest of most crops was near normal levels. While statewide harvests were near normal, local farmers who did not receive the spotty rains experienced poor harvests. Statewide, the number of wildfires was about 75 percent of average for the previous five years, but the acreage burned was three times greater. This was true within Pend Oreille County, which experienced fewer wildfires than the years previous, but more acreage was burned.
- One of the largest fires of the 2015 season – the School fire – burned 52,000 acres of state-protected lands, 109 homes and 106 other buildings in central Columbia and Garfield Counties, and cost more than $15 million to extinguish. The fire also destroyed half of the elk and bighorn sheep and a third of the deer in the Tucannon Game Management Unit. The fire's origin was traced to a dead pine tree falling over power lines, causing the lines to arc and send sparks to the ground, which ignited dry grass.
- Unlike classic droughts characterized by extended precipitation deficits, 2015 was the year of the "snowpack drought," with statewide averages of snow water equivalent being 25 percent of the norm. Washington State had normal or near-normal precipitation over the 2014-2015 winter season. However, October through March the average statewide temperature was 40.5 degrees Fahrenheit, 4.7 degrees above the 20th century long-term average and ranking as the warmest October through March on record. Washington experienced record low snowpack because mountain precipitation that normally fell as snow instead fell as rain. The snowpack deficit then was compounded as precipitation began to lag behind normal levels in early spring and into the summer. With record spring and summer temperatures, and little to no precipitation over many parts of the state, the snowpack drought morphed into a traditional precipitation drought, causing injury to crops and aquatic species, with some crops reporting as much as a 22 percent deficiency in yield (known losses for the five year average of wheat crops alone was in excess of $212 million). Many rivers and streams experienced record low flows where there was low water availability - one of six similar events on record since 1992, the others being 1992, 1993, 1994, 2001, and 2005. Many pro-ratable water districts curtailed water supplies during those years (WA Department of Agriculture, 2015). The Governor declared a drought on March 13, 2015 for three regions of the state—the Olympic Peninsula, the east slopes of the central Cascades and the Walla Walla Basin. In May, the Water Supply Availability and Emergency Water Executive committees determined that 48

Figure 7-2 USDA Drought Monitor Map August 25, 2015

of the 62 watersheds had water supply conditions below 75 percent of normal, an area representing 85 percent of the state's geographic area (see Figure 7-2)[29]. The peak of the drought occurred during the last week in August, when 85 percent of the state was categorized in an "extreme drought."

7.2.3 Severity

Droughts impact individuals (farm owners, tenants, and farm laborers), the agricultural industry, and other agriculture-related sectors. Lack of snow pack has forced ski resorts into bankruptcy. There is increased danger of forest and wildland fires. Millions of board feet of timber have been lost. 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.

The severity of a drought depends on the degree of moisture deficiency, the duration, and the size and location of the affected area. The longer the duration of the drought and the larger the area impacted, the more severe the potential impacts. Droughts are not usually associated with direct impacts on people or property, but they can have significant impacts on agriculture, wildlife, and fishing, which can impact people indirectly. When measuring the severity of droughts, analysts typically look at economic impacts. This was the case with the 2015 drought conditions, which were being felt locally. Both private and public water systems experienced lower water yields. While Pend Oreille County fared better than other surrounding counties, the County did experience lower well water production. In areas most heavily impacted, the County developed a list of public water supplies that could be utilized to supply water to the public whose wells are dry. The County also compiled a list of companies that could haul potable water in accordance with DOH guidelines for water haulers. The County also participated in conversations with several public water systems about funding opportunities through DOE or DOH grant/loan programs with the aim of improving sources or extending services from existing water supplies. (from Matt 3/27/18)

The National Oceanic and Atmospheric Administration (NOAA) has developed several indices to measure drought impacts and severity to map their extent and locations:

- The ***Palmer Crop Moisture Index*** measures short-term drought on a weekly scale and is used to quantify drought's impacts on agriculture during the growing season. Weekly data can be gained from http://www.cpc.ncep.noaa.gov/products/monitoring_and_data/drought.shtml
- The ***Palmer Z Index*** measures short-term drought on a monthly scale. Figure 7-3 shows this index for February 2018.

[29] https://agr.wa.gov/FP/Pubs/docs/104-495InterimDroughtReport2015.pdf

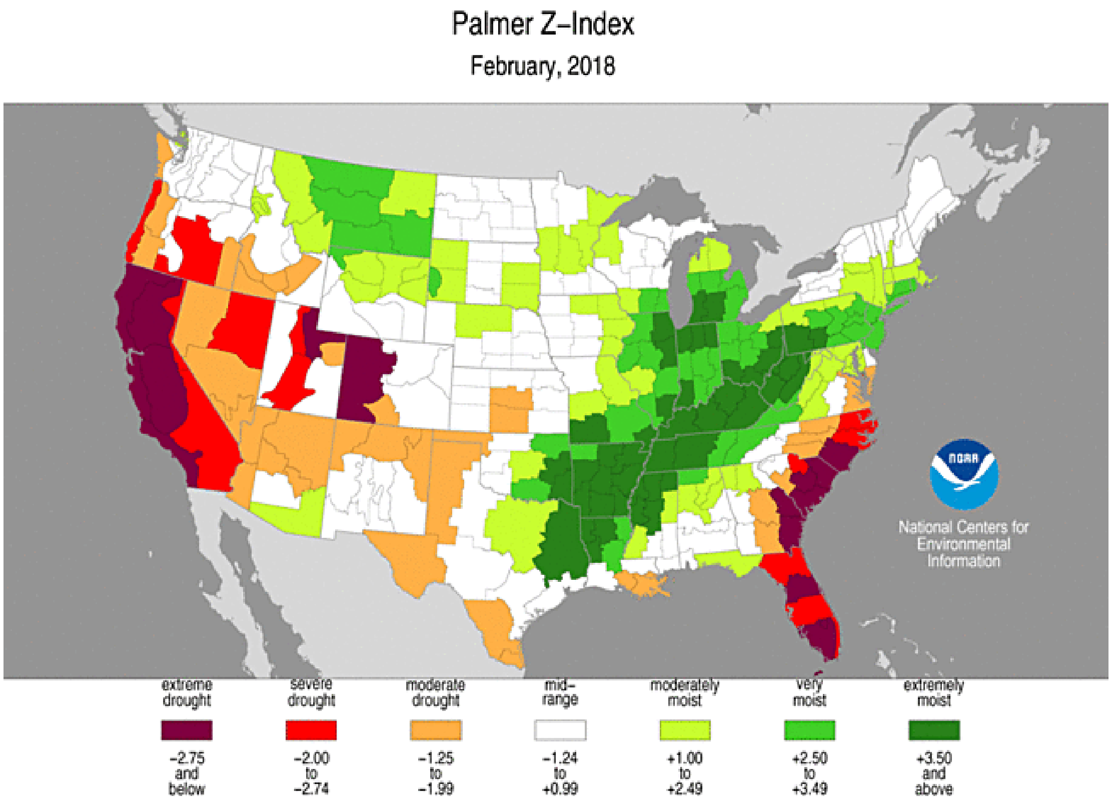


Figure 7-3 Palmer Z Index Short-Term (monthly) Drought Conditions (February 2018)

- The ***Palmer Drought Index*** measures the duration and intensity of long-term drought-inducing circulation patterns. Long-term drought is cumulative, so the intensity of drought during a given month is dependent on the current weather patterns plus the cumulative patterns of previous months. Weather patterns can change quickly from a long-term drought pattern to a long-term wet pattern, and this index can respond fairly rapidly.
- The hydrological impacts of drought (e.g., reservoir levels, groundwater levels, etc.) take longer to develop and it takes longer to recover from them. The ***Palmer Hydrological Drought Index***, another long-term index, was developed to quantify hydrological effects. This index responds more slowly to changing conditions than the Palmer Drought Index.
- While the Palmer indices consider precipitation, evapotranspiration and runoff, the ***Standardized Precipitation Index*** considers only precipitation. In this index, a value of zero indicates the median precipitation amount; the index is negative for drought and positive for wet conditions. The Standardized Precipitation Index is computed for time scales ranging from one month to 24 months.

Additional information and current monthly data are available from the NOAA website.

7.2.4 Frequency

Empirical studies conducted over the past century have shown that meteorological drought is never the result of a single cause. It is the result of many causes, often synergistic in nature; these include global weather patterns that produce persistent, upper-level high-pressure systems along the West Coast with warm, dry air resulting in less precipitation.

In temperate regions, including Washington, long-range forecasts of drought have limited reliability. In the tropics, empirical relationships have been demonstrated between precipitation and El Niño events, but few such relationships have been demonstrated above 30º north latitude. Meteorologists do not believe that reliable forecasts are attainable at this time a season or more in advance for temperate regions.

A great deal of research has been conducted in recent years on the role of interacting systems in explaining regional and even global patterns of climatic variability. These patterns tend to recur periodically with enough frequency and with similar characteristics over a sufficient length of time that they offer opportunities to improve the ability for long-range climate prediction. However, too many variables exist in determining the frequency with which a drought will occur.

According to the Washington State Hazard Mitigation Plan data (2013) "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, with most of eastern Washington experiencing severe or extreme drought about 10 to 15 percent of the time." (EMD, 2013).

The potential for improved drought predictions in the near future differs by region, season, and climatic regime. Based on Palmer Z Short-Term predictions (Figure 7-3), the planning area is currently experiencing no drought situation within the area, with only portions of the coastal areas in Western Washington experiencing a "moderate" level of drought.

7.3 VULNERABILITY ASSESSMENT

7.3.1 Overview

Drought produces a complex web of impacts that spans many sectors of the economy and reaches well beyond the area experiencing physical drought. This complexity exists because water is integral to the ability to produce goods and provide services. Drought can affect a wide range of economic, environmental, and social activities. The vulnerability of an activity associated with the effects of drought usually depends on its water demand, how the demand is met, and what water supplies are available to meet the demand.

All people, property and environments in the planning area could be exposed to some degree to the impacts of moderate to extreme drought. Areas densely wooded, especially areas in parks throughout the County which host campers, increase the exposure to forest fires. Additional exposure comes in the form of economic impact should a prolonged drought occur that would impact fishing, recreation, agriculture, and timber harvesting—primary sources of income in the planning area. Prolonged drought would also decrease capacity within the watersheds, thereby reducing fish runs and, potentially, spawning areas.

Methodology

The Washington State Enhanced Hazard Mitigation plan defines jurisdictions as being vulnerable to drought if they meet at least five of the following criteria:

- History of severe or extreme drought conditions:
    - The jurisdiction must have been in serious or extreme drought at least 10-15 percent of the time from 1895 to 1995.
- Demand on water resources based on:
    - Acreage of irrigated cropland. The acreage of the jurisdiction's irrigated cropland must be in the top 20 in the state.

  - Percentage of harvested cropland that is irrigated. The percentage of the jurisdiction's harvested cropland that is irrigated must be in the top 20 in the state.
  - Value of agricultural products. The value of the jurisdiction's crops must be in the top 20 in the state.
  - Population growth greater than the state average. The population growth from 2000 to 2006 must be greater than state average of 8.17 percent.
- A County's inability to endure the economic conditions of a drought, based on:
  - The jurisdiction's median household income being less than 75 percent of the state median income of $51,749 in 2005.
  - The jurisdiction's being classified as economically distressed in 2005 because its unemployment rate was 20 percent greater than the state average from January 2002 through December 2004.

Presently, Pend Oreille County is not among the nine counties referenced as vulnerable to drought in the Washington State Enhanced Hazard Mitigation Plan. The County does not meet at least five of the State's criteria to be considered vulnerable to drought.[30]

Warning Time

A drought is not a sudden-onset hazard. Droughts are climatic patterns that occur over long periods, providing for some advance notice. In many instances, annual situations of low water levels are identified months in advance (e.g., snow pack at lower levels are identified during winter months), allowing for advanced planning for water conservation.

Meteorological drought is the result of many causes, including global weather patterns that produce persistent, upper-level high-pressure systems along the West Coast resulting in less precipitation. Only general warning can take place, due to the numerous variables that scientists have not pieced together well enough to make accurate and precise predictions. 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.

Scientists do not know how to predict drought more than a month in advance for most locations. Predicting drought depends on the ability to forecast precipitation and temperature. Weather anomalies may last from several months to several decades. How long they last depend on interactions between the atmosphere and the oceans, soil moisture and land surface processes, topography, internal dynamics, and the accumulated influence of weather systems on the global scale. In temperate regions such as Washington, long-range forecasts of drought have limited reliability. Meteorologists do not believe that reliable forecasts are attainable at this time a season or more in advance for temperate regions.

7.3.2 Impact on Life, Health, and Safety

The County and its jurisdictions have the ability to minimize impacts on residents and water consumers within the planning area should several consecutive dry years occur. However, the increased wildfire danger threatens all of the communities throughout the county, thereby increasing the level of injury to its citizens.

[30] Washington State Enhanced Hazard Mitigation Plan Drought Profile Accessed 19 March 2018. Available at: https://mil.wa.gov/uploads/pdf/HAZ-MIT-PLAN/drought_hazard_profile.pdf

A prolonged lack of precipitation dries out vegetation, which becomes increasingly susceptible to ignition as the duration of the drought extends. This increases the risk to the health and safety of the residents within the planning area, especially those in wildland-urban interface areas. Smoke and particles embedded within the smoke are of significant concern for the elderly and very young, especially those with breathing problems.

Within the County, each Group A water system (those with 15 or more connections or serve at least 25 individuals/day) must comply with the Water Use Efficiency Rule that requires them to:

- Set goals for water conservation; and
- Evaluate or implement specific water saving measures.

Such pre-planning helps reduce the impact on individuals by helping to ensure drinking water availability.

7.3.3 Impact on Property

No structures will be directly affected by drought conditions, though many will become vulnerable to wildfires, which are more likely following years of drought. Droughts can also have significant impacts on landscapes, which could cause a financial burden to property owners. However, these impacts are not considered critical in planning for impacts from the drought hazard.

7.3.4 Impact on Critical Facilities and Infrastructure

Critical facilities will continue to be operational during a drought unless impacted by fire. Critical facility elements such as landscaping may not be maintained due to limited resources, but the risk to the planning area's critical facilities inventory will be largely aesthetic. For example, when water conservation measures are in place, landscaped areas will not be watered and may die. These aesthetic impacts are not considered significant.

7.3.5 Impact on Economy

Economic impact from a drought is associated with different aspects, including potential loss of agricultural production. Market value of Pend Oreille County's crop sales was $2.3 million sold based on the 2012 Census of Agriculture released in May 2014. Livestock sales were $1.64 million, with 288 farms being registered in 2012, down from 316 farms in 2007. The census also indicates that 38% of Pend Oreille County is in woodlands, 35.1% croplands, 21.7% pastureland, and 5.2% for other uses (See Figure 7-3).[31] According to the Washington Department of Ecology Report 2015 Drought Response Summary Report (DOE, 2016), the impacts of the 2015 drought "were not limited to certain crops, or certain regions, or even certain times of the year. Every farmer in the state felt some type of impact in 2015, whether it was yield or quality reduction, crop rotation related, a shortened harvest period (due to fast ripening during extreme heat), or some other effect" (DOE 2016). In addition, the full impact of the 2015 drought will not be known for up to four years as a result of several factors, including reduced production of seeds and seedlings, and pasture grazing reduction impacting the carrying capacity for cattle and other livestock.[32]

[32] https://agr.wa.gov/FP/Pubs/docs/104-495InterimDroughtReport2015.pdf

Additional economic impact stems from the potential loss of critical infrastructure due to fire damage and impacts on industries that depend on water for their business, such as fishing industries, water-based recreational activities, and public facilities and recreational areas.

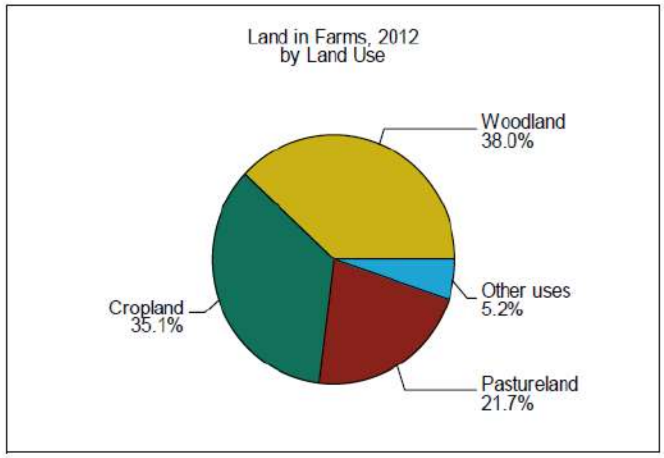


Figure 7-4 USDA Land in Farms by Land Use Type (2012)

Problems of domestic and municipal water supplies have historically been corrected by building another reservoir, a larger pipeline, new well, or some other facility. With drought conditions increasing pressure on aquifers and increased pumping, which can result in saltwater intrusion into fresh water aquifers, resultant reductions or restrictions on economic growth and development could occur. Given potential political issues, a drought situation, if prolonged, could restrict building within specific areas due to lack of supporting infrastructure, thereby impacting the tax base and economy of the region by limiting growth. In addition, impact to or the lack of hydroelectric generating capacity associated with drought conditions as a result of reduced precipitation levels could raise electric prices throughout the region.

7.3.6 Impact on Environment

Environmental losses from drought are associated with aquatic life, plants, animals, wildlife habitat, air and water quality, forest fires, landscape quality, biodiversity, and soil erosion. Some effects are short-term, and conditions quickly return to normal after the drought. Other effects linger or even become permanent. Wildlife habitat, for example, may be degraded through the loss of wetlands, lakes, and vegetation, but many species will eventually recover from this effect. Degraded landscape quality, including soil erosion, may lead to a more permanent loss of biological productivity. Life-cycles for fish spawning in the area would have environmental impacts years into the future.

Public awareness and concern for environmental quality has led to greater attention to these effects. Drought conditions within the planning area could increase the demand for water supplies. Water shortages would have an adverse impact on the environment, relied upon by the planning partnership, causing social and political conflicts. If such conditions persisted for several years, the economy of Pend Oreille County could experience setbacks, especially in water dependent industries.

7.4 FUTURE DEVELOPMENT TRENDS

While Pend Oreille County has a high amount of land available (see Figure 7-3), the U.S. Department of Agriculture has indicated that not only has the number of farms decreased, but the size, or average size of farm, has also decreased from 174 acres in 2007 to 151 acres in 2012, representing a 13% decrease.

With an increase in population, the potential rezoning of land from agricultural or woodland to residential would have the propensity to increase water demands, as well as increase demands on other infrastructure, and increase the potential for wildfires.

The County and some of its cities have established plans or water regulations that include policies directing land use and dealing with issues of water supply and the protection of water resources, as well as fire regulations. Specifically, each Group A water system must comply with the Water Use Efficiency Rule that requires them to establish goals for water conservation, and to evaluate or implement specific water saving measures.

Plans such as these provide the capability at the local municipal level to protect future development from the impacts of drought. All planning partners reviewed their general plans under the capability assessments performed for this effort. Deficiencies identified by these reviews can be identified as mitigation actions to increase the capability to deal with future trends in development.

The planning area continues to move forward in developing policies directing land use and dealing with zoning, density and permitting for any new development. This will provide the capability to protect future development from the impacts of drought.

7.5 ISSUES

Combinations of low precipitation and unusually high temperatures could occur over several consecutive years, especially in response to climate change. Intensified by such conditions, extreme wildfires could break out throughout the area, increasing the need for water. Surrounding communities, also in drought conditions, could increase their demand for water, causing social and political conflicts. Low water tables could increase issues of life, safety, and health, while also impacting the economy both for loss of potential agricultural income, but also with respect to decreased ability to construct new housing due to lack of ability to provide water. If such conditions persisted for several years, the economy of the region could experience setbacks, especially in water dependent industries.

The planning team has identified the following drought-related issues:

- The need for alternative water sources should a prolonged drought occur;
- Use of groundwater recharge to stabilize the groundwater supply;
- The probability of increased drought frequencies and durations due to climate change;
- The promotion of active water conservation even during non-drought periods;
- The potential impact on businesses in the area;
- The potential impact on the livelihood of those employed in industries that could be impacted by drought, such as agriculture, fishing, forestry, and tourism.

7.6 RESULTS

Based on review and analysis of the data, the Planning Team has determined that the probability for impact from Drought throughout the area is possible. The area has experienced drought conditions, with a drought incident occurring only a short period ago (2015). During the summer of 2017, the State experienced one of its driest summers on record for the last 30 years. With anticipated increase in temperatures as a result of climate change, drought situations will only intensify. With the planning area’s dependence on agriculture, there is a significant potential economic loss in the region. In addition, higher temperatures anticipated with climate change would increase vulnerability of the population due to excessive heat, many times associated with drought conditions. In addition, a drought could also impact power supplies at the hydro dams in the area. Based on the potential impact, the Planning Team determined the CPRI score to be 2.35, with overall vulnerability determined to be a medium level.

CHAPTER 8.
EARTHQUAKE

An earthquake is the vibration of the earth's surface following a release of energy in the earth's crust. This energy can be generated by a sudden dislocation of the crust or by a volcanic eruption. Its epicenter is the point on the earth's surface directly above the hypocenter of an earthquake. The location of an earthquake is commonly described by the geographic position of its epicenter and by its focal depth. Earthquakes many times occur along a fault, which is a fracture in the earth's crust.

DEFINITIONS

Earthquake—The shaking of the ground caused by an abrupt shift of rock along a fracture in the earth or a contact zone between tectonic plates.

Epicenter—The point on the earth's surface directly above the hypocenter of an earthquake. The location of an earthquake is commonly described by the geographic position of its epicenter and by its focal depth.

Fault—A fracture in the earth's crust along which two blocks of the crust have slipped with respect to each other.

Focal Depth—The depth from the earth's surface to the hypocenter.

Hypocenter—The region underground where an earthquake's energy originates

Liquefaction— Loosely packed, water-logged sediments losing their strength in response to strong shaking, causing major damage during earthquakes.

8.1 GENERAL BACKGROUND

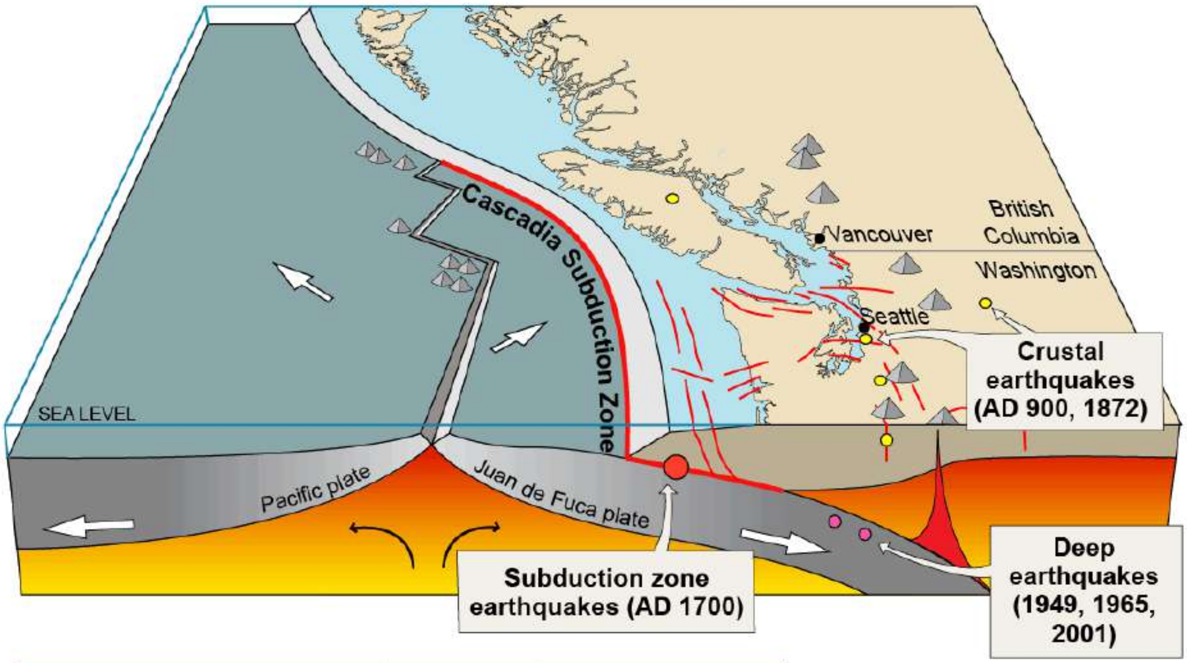
Most destructive quakes are caused by dislocations of the crust. The crust may first bend and then, when the stress exceeds the strength of the rocks, break and snap to a new position. In the process of breaking, vibrations called "seismic waves" are generated. These waves travel outward from the source of the earthquake at varying speeds.

Earthquakes tend to reoccur along faults, which are zones of weakness in the crust. Even if a fault zone has recently experienced an earthquake, there is no guarantee that all the stress has been relieved. Another earthquake could still occur.

Geologists classify faults by their relative hazards. Active faults, which represent the highest hazard, are those that have ruptured to the ground surface during the Holocene period (about the last 11,000 years). Potentially active faults are those that displaced layers of rock from the Quaternary period (the last 1,800,000 years). Determining if a fault is "active" or "potentially active" depends on geologic evidence, which may not be available for every fault.

Faults are more likely to have earthquakes on them if they have more rapid rates of movement, have had recent earthquakes along them, experience greater total displacements, and are aligned so that movement can relieve accumulating tectonic stresses. A direct relationship exists between a fault's length and location and its ability to generate damaging ground motion at a given site. In some areas, smaller, local faults produce lower magnitude quakes, but ground shaking can be strong, and damage can be significant as a result of the fault's proximity to the area. In contrast, large regional faults can generate great magnitudes but, because of their distance and depth, may result in only moderate shaking in the area.

It is generally agreed that three source zones exist for Pacific Northwest quakes: a shallow (crustal) zone; the Cascadia Subduction Zone; and a deep, intraplate "Benioff" zone. These are shown in Figure 8-1. More than 90 percent of Pacific Northwest earthquakes occur along the boundary between the Juan de Fuca plate and the North American plate.



Source	Max. Size	Recurrence
Subduction zone	M 9+	200–600 years
Deep Juan de Fuca plate	M 7+	30–50 years
Crustal faults	M 7+	Hundreds of years?

Volcano

Active crustal fault

Active plate boundary fault

Figure 8-1 Earthquake Types in the Pacific Northwest

An earthquake will generally produce the strongest ground motions near the epicenter (the point on the ground above where the earthquake initiated) with the intensity of ground motions diminishing with increasing distance from the epicenter. The intensity of ground shaking at a given site depends on four main factors:

- Earthquake magnitude
- Earthquake epicenter
- Earthquake depth
- Soil or rock conditions at the site, which may amplify or de-amplify earthquake ground motions.

For any given earthquake, there will be contours of varying intensity of ground shaking with distance from the epicenter. The intensity will generally decrease with distance from the epicenter, and often in an irregular pattern, not simply in concentric circles. The irregularity is caused by soil conditions, the complexity of earthquake fault rupture patterns, and directionality in the dispersion of earthquake energy.

8.1.1 Earthquake Classifications

Earthquakes are typically classified in one of two ways: By the amount of energy released, measured as **magnitude** (size or power based on the Richter Scale); or by the impact on people and structures, measured as **intensity** (based on the Mercalli Scale). Magnitude is related to the amount of seismic energy released at the hypocenter of an earthquake. It is determined by the amplitude of the earthquake waves recorded on instruments. Magnitude is represented by a single, instrumentally determined value for each earthquake event. Intensity indicates how the earthquake is felt at various distances from the earthquake epicenter.

Magnitude

Currently the most commonly used magnitude scale is the moment magnitude (M_W) scale, with the follow classifications of magnitude:

- Great—$M_W \geq 8$
- Major—M_W = 7.0—7.9
- Strong—M_W = 6.0—6.9
- Moderate—M_W = 5.0—5.9
- Light—M_W = 4.0—4.9
- Minor—M_W = 3.0—3.9
- Micro—M_W < 3

Estimates of moment magnitude roughly match the local magnitude scale (ML) commonly called the Richter scale. One advantage of the moment magnitude scale is that, unlike other magnitude scales, it does not saturate at the upper end. That is, there is no value beyond which all large earthquakes have about the same magnitude. For this reason, moment magnitude is now the most often used estimate of large earthquake magnitudes.

Intensity

There are many measures of the severity or intensity of earthquake ground motions. The Modified Mercalli Intensity scale (MMI) (Table 8-1) was widely used beginning in the early 1900s. MMI is a descriptive, qualitative scale that relates severity of ground motions to the types of damage experienced. MMI values range from I to XII (USGS, 1989):

TABLE 8-1 MODIFIED MERCALLI INTENSITY (MMI) SCALE DESCRIPTIONS

MMI VALUE	Description
I	Not felt except by a very few under especially favorable conditions
II	Felt only by a few persons at rest, especially on upper floors of buildings.
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it is an earthquake. Standing cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.

TABLE 8-1 MODIFIED MERCALLI INTENSITY (MMI) SCALE DESCRIPTIONS

IV	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like a heavy truck striking building. Standing cars rocked noticeably.
V	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Felt by all; many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Damage negligible in buildings of good design and construction; slight in well-built ordinary structures; considerable in poorly built or badly designed structures. Some chimneys broken.
VIII	Damage slight in specially designed structures; considerable damage in ordinary buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
X	Damage total. Lines of sight and level are distorted. Objects thrown into the air.

More accurate, quantitative measures of the intensity of ground shaking have largely replaced the MMI and are used in this mitigation plan. These scales use terms that can be physically measured with seismometers, such as the acceleration, velocity, or displacement (movement) of the ground. The intensity may also be measured as a function of the frequency of earthquake waves propagating through the earth. In the same way that sound waves contain a mix of low-, moderate- and high-frequency sound waves, earthquake waves contain ground motions of various frequencies. The behavior of buildings and other structures depends substantially on the vibration frequencies of the building or structure versus the frequency of earthquake waves. Earthquake ground motions also include both horizontal and vertical components.

Ground Motion

Earthquake hazard assessment is also based on expected ground motion. This involves determining the probability that certain ground motion accelerations will be exceeded over a time period of interest. A common physical measure of the intensity of earthquake ground shaking, and the one used in this mitigation plan, is peak ground acceleration (PGA). PGA is a measure of the intensity of shaking relative to the acceleration of gravity (g). For example, an acceleration of 1.0 g PGA is an extremely strong ground motion, which does occur near the epicenter of large earthquakes. With a vertical acceleration of 1.0 g, objects are thrown into the air. With a horizontal acceleration of 1.0 g, objects accelerate sideways at the same rate as if they had been dropped from the ceiling. A PGA equal to 10% g means that the ground acceleration is 10 percent that of gravity, and so on.

Damage levels experienced in an earthquake vary with the intensity of ground shaking and with the seismic capacity of structures. The following generalized observations provide qualitative statements about the likely extent of damage for earthquakes with various levels of ground shaking (PGA) at a given site:

- Ground motions of only 1% g or 2% g are widely felt by people; hanging plants and lamps swing strongly, but damage levels, if any, are usually very low.
- Ground motions below about 10% g usually cause only slight damage.
- Ground motions between about 10% g and 30% g may cause minor to moderate damage in well-designed buildings, with higher levels of damage in more vulnerable buildings. At this level of ground shaking, some poorly built buildings may be subject to collapse.
- Ground motions above about 30% g may cause significant damage in well-designed buildings and very high levels of damage (including collapse) in poorly designed buildings.
- Ground motions above about 50% g may cause significant damage in most buildings, even those designed to resist seismic forces.

PGA is the basis of seismic zone maps that are included in building codes such as the International Building Code. Building codes that include seismic provisions specify the horizontal force due to lateral acceleration that a building should be able to withstand during an earthquake. PGA values are directly related to these lateral forces that could damage "short period structures" (e.g. single-family dwellings). Longer period response components determine the lateral forces that damage larger structures with longer natural periods (apartment buildings, factories, high-rises, bridges). The amount of earthquake damage and the size of the geographic area affected generally increase with earthquake magnitude:

- Earthquakes below M5 are not likely to cause significant damage, even near the epicenter.
- Earthquakes between about M5 and M6 are likely to cause moderate damage near the epicenter.
- Earthquakes of about M6.5 or greater (e.g., the 2001 Nisqually earthquake in Washington) can cause major damage, with damage usually concentrated fairly near the epicenter.
- Larger earthquakes of M7+ cause damage over increasingly wider geographic areas with the potential for very high levels of damage near the epicenter.
- Great earthquakes with M8+ can cause major damage over wide geographic areas.
- An M9 mega-quake on the Cascadia Subduction Zone could affect the entire Pacific Northwest from British Columbia, through Washington and Oregon, and as far south as Northern California, with the highest levels of damage nearest the coast.

Table 8-2 lists damage potential and perceived shaking by PGA factors, compared to the Mercalli scale.

Table 8-2
Comparison of Mercalli Scale and Peak Ground Acceleration

Modified Mercalli Scale	Perceived Shaking	Potential Structure Damage: Resistant Buildings	Potential Structure Damage: Vulnerable Buildings	Estimated PGA[a] (%g)
I	Not Felt	None	None	<0.17%
II-III	Weak	None	None	0.17%—1.4%
IV	Light	None	None	1.4%—3.9%
V	Moderate	Very Light	Light	3.9%—9.2%
VI	Strong	Light	Moderate	9.2%—18%
VII	Very Strong	Moderate	Moderate/Heavy	18%—34%
VIII	Severe	Moderate/Heavy	Heavy	34%—65%
IX	Violent	Heavy	Very Heavy	65%—124%
X—XII	Extreme	Very Heavy	Very Heavy	>124%

a. PGA measured in percent of g, where g is the acceleration of gravity

Sources: USGS, 2008; USGS, 2010

8.1.2 Effect of Soil Types

Liquefaction is a secondary effect of an earthquake in which soils lose their shear strength and flow or behave as liquid, thereby damaging structures that derive their support from the soil. Liquefaction generally occurs in soft, unconsolidated sedimentary soils. The National Earthquake Hazard Reduction Program (NEHRP) creates maps based on soil characteristics to help identify locations subject to liquefaction. Table 8-3 summarizes NEHRP soil classifications. NEHRP Soils B and C typically can sustain ground shaking without much effect, dependent on the earthquake magnitude. Areas that are commonly most affected by ground shaking and susceptible to liquefaction have NEHRP Soils D, E and F.

Table 8-3
NEHRP Soil Classification System

NEHRP Soil Type	Description	Mean Shear Velocity to 30 Meters (m/s)
A	Hard Rock	1,500
B	Firm to Hard Rock	760-1,500
C	Dense Soil/Soft Rock	360-760
D	Stiff Soil	180-360
E	Soft Clays	< 180
F	Special Study Soils (liquefiable soils, sensitive clays, organic soils, soft clays >36 m thick)	

Table 8-4
Acres of NEHRP Soil Classification by Type Countywide

NEHRP Soil Type	Description	Mean Shear Velocity to 30 Meters (m/s)	# of Acres within Pend Oreille County	# of Acres within Kalispel Reservation	# of Acres w/in Town of Cusick	# of Acres w/in Town of Ione	# of Acres w/in City of Newport	# of Acres w/in Town of Metaline	# of Acres w/in Town of Metaline Falls	# of Acres w/in Unincorporated Pend Oreille County
A	Hard Rock	1,500	0	0	0	0	0	0	0	0
B	Firm to Hard Rock	760-1,500	565,761.5	627.3	0	5.2	99.9	0	27.1	564,781.1
C	Dense Soil/Soft Rock	360-760	76,235.8	839.3	0	0	1,217.4	0	0	74,103.7
D	Stiff Soil	180-360	249,423.5	6,781.6	836.9	807.1	0	196.2	278.6	240,710.5
E	Soft Clays	< 180	5,372.9	0	0	0	79.2	0	0	5,293.8
F	Special Study Soils (liquefiable soils, sensitive clays, organic soils, soft clays >36 m thick)	1,500	0	0	0	0	0	0	0	0

8.1.3 Fault Classification

The U.S. Geologic Survey defines four fault classes based on evidence of tectonic movement associated with large-magnitude earthquakes during the Quaternary period, which is the period from about 1.6 million years ago to the present:

- Class A—Geologic evidence demonstrates the existence of a Quaternary fault of tectonic origin, whether the fault is exposed by mapping or inferred from liquefaction or other deformational features.
- Class B—Geologic evidence demonstrates the existence of Quaternary deformation, but either (1) the fault might not extend deep enough to be a potential source of significant earthquakes, or (2) the currently available geologic evidence is too strong to confidently assign the feature to Class C but not strong enough to assign it to Class A.
- Class C—Geologic evidence is insufficient to demonstrate (1) the existence of tectonic faulting, or (2) Quaternary slip or deformation associated with the feature.
- Class D—Geologic evidence demonstrates that the feature is not a tectonic fault or feature; this category includes features such as joints, landslides, erosional or fluvial scarps, or other landforms resembling fault scarps but of demonstrable non-tectonic origin.

8.2 HAZARD PROFILE

Seismic-related hazards in Pend Oreille County include impact from ground motion, and liquefaction and differential settling of soil in areas with saturated sand, silt, or gravel. Earthquakes also can cause damage by triggering landslides or bluff failure. High-magnitude earthquakes are more possible on the western side of the state when the Juan de Fuca slips beneath the North American plates. Deep zone or Benioff zone quakes have occurred within the San De Fuca plate (1949, 1965, and 2001) and can be expected in the future. While impact to Pend Oreille County from these types of events are expected to be much less significant, the influx of citizens evacuating from areas significantly impacted on the western side of the state to the eastern side of the state, including Pend Oreille County, is of great concern to all of the planning partners.

8.2.1 Extent and Location

Washington State as a whole is one of the most seismically active states in United States. Figure 8-2 and Figure 8-3 depict the faults and seismogenic folds known or suspected to be active according to Washington State Department of Natural Resources and the 2013 Washington State Hazard Mitigation Plan.

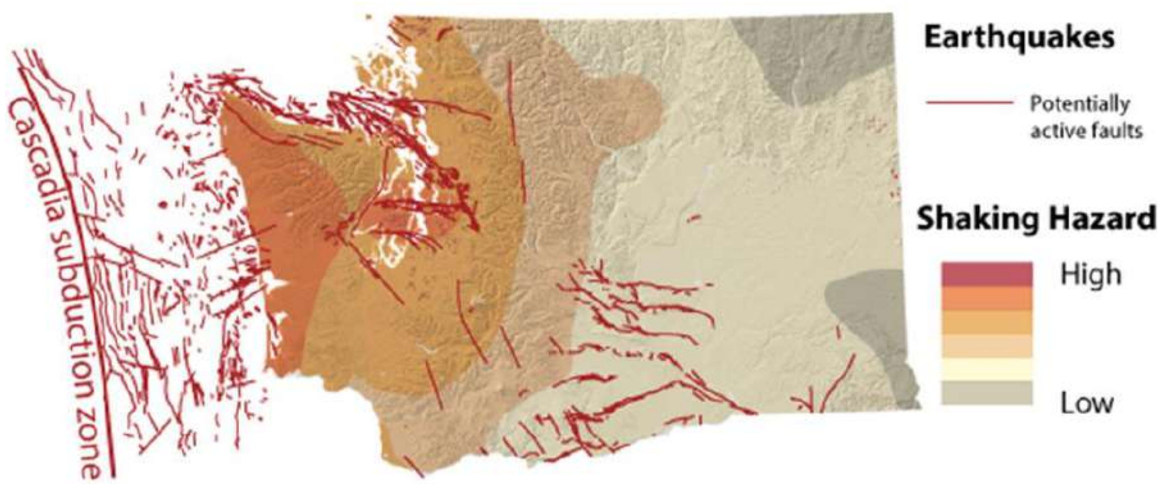


Figure 8-2 Washington State Potential Active Faults

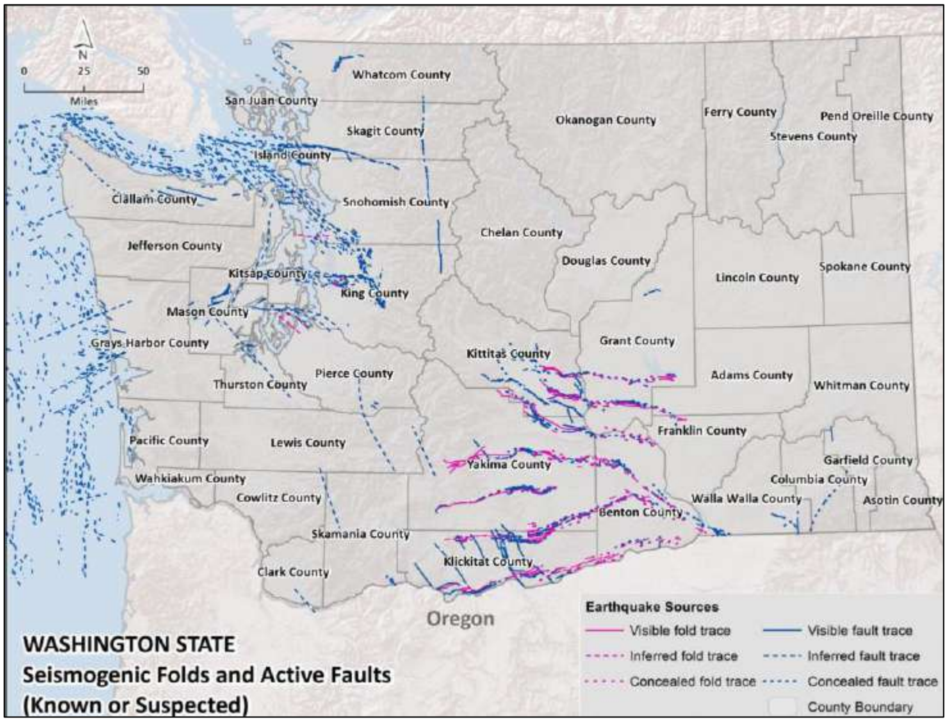


Figure 8-3 Washington State Seismogenic Folds and Active Faults

Local Faults

Review of USGS Data indicates no Class A or B faults within Pend Oreille County. However, within Eastern Washington, geologists have uncovered evidence of a number of surface faults. Unfortunately, they have not yet determined how active the faults are, nor determined the extent of the risk they pose. One fault, Toppenish Ridge, appears to have been the source of two earthquakes with magnitudes of 6.5 to 7.3 in the past 10,000 years.

The major fault of concern in Pend Oreille County is the Newport Fault Zone, identified in Figure 8-4 and Figure 8-5.[33], [34]

The Newport fault of northeastern Washington and northwestern Idaho is a north-plunging, spook-shaped, share zone. The fault has a distinctive U-shaped trace that straddles the state boundary between Washington and Idaho, north of Spokane, with its southern lib extending to the east and west of the City of Newport, at which point the fault turns north, dying out within 15 km of the international boundary. The Newport Fault lies within the Purcell anticlinorium, a regional scale structure that occupies much of the western part of the Cordilleran foreland fold and thrust belt in Montana, Idaho, northeastern Washington, and southern British Columbia (see Figure 8-5).

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[33] Pend Oreille County AHMP, 2004.

[34] Washington State DNR Preliminary Geologic Map of Newport Number 1 (1974). http://www.dnr.wa.gov/publications/ger_gm7_geol_map_newportnumber1_62k.pdf

There have been only a few instrumental earthquakes recorded with epicenters in the County over the past thirty years, but earthquakes are felt from epicenters outside of the County in Idaho, Montana, and western Washington (Harms, 1992).

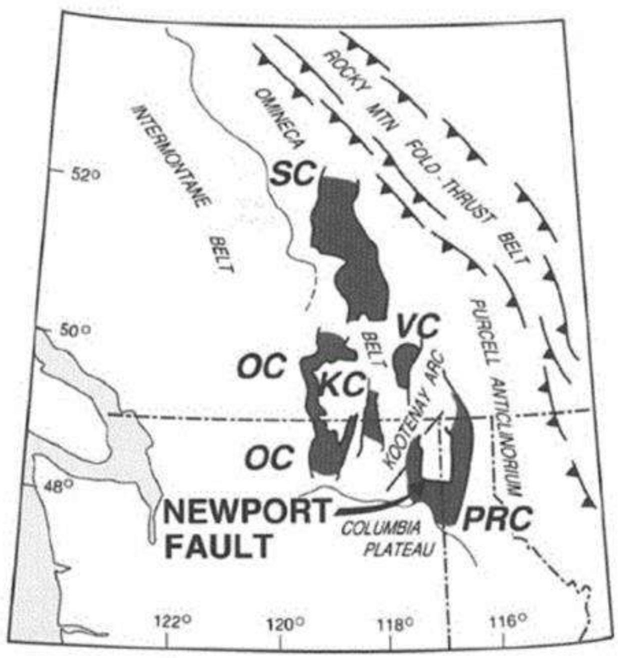


Figure 8-4 Tectonic setting of the Newport Fault

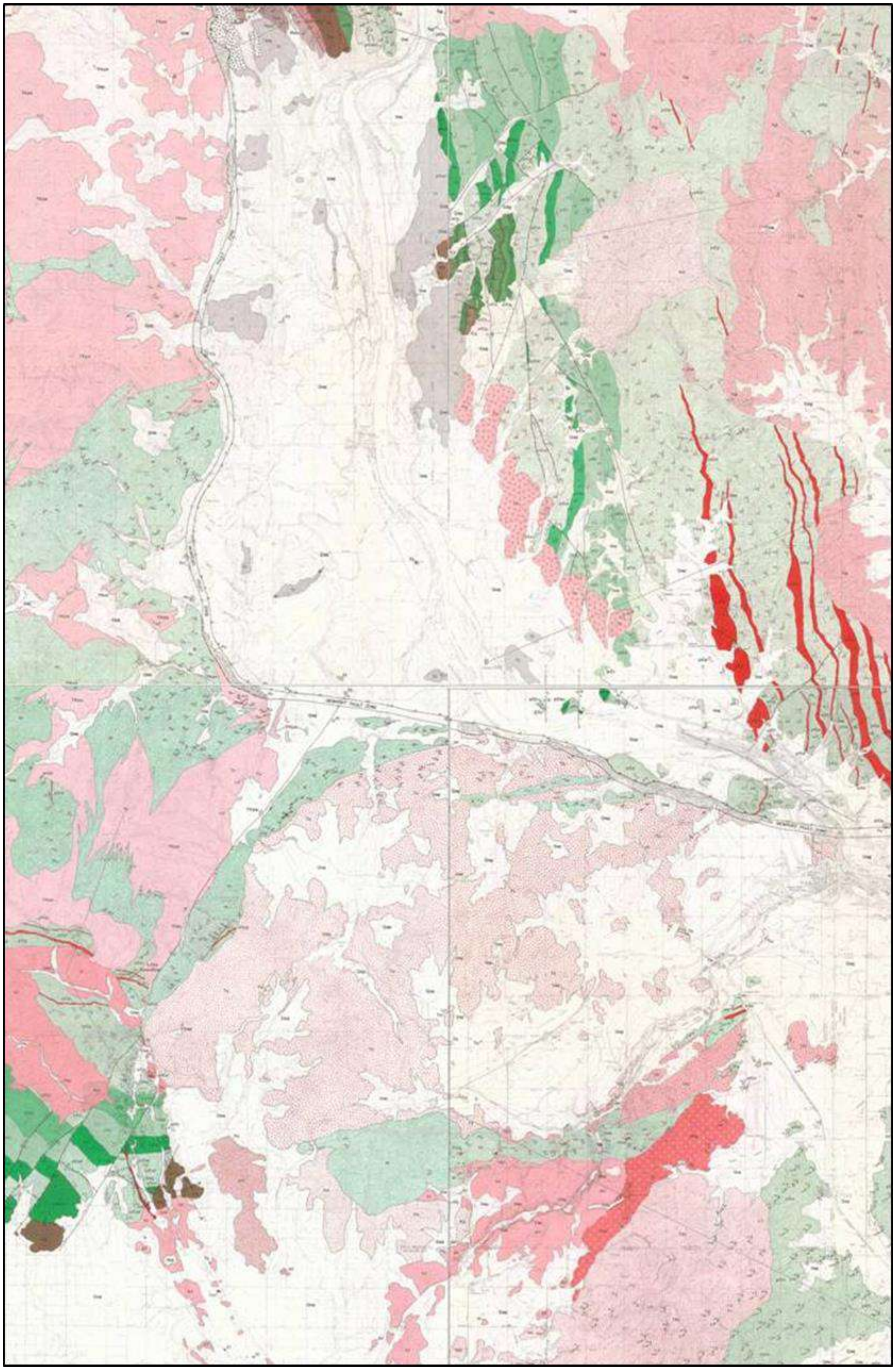


Figure 8-5 Newport Fault Zone Map

Hazard Mapping

Identifying the extent and location of an earthquake is not as simple as it is for other hazards such as flood, landslide, or wildfire. The impact of an earthquake is largely a function of the following factors:

- Ground shaking (ground motion accelerations)
- Liquefaction (soil instability)
- Distance from the source (both horizontally and vertically).

Mapping that shows the impacts of these components was used to assess the risk of earthquakes within the planning area. While the impacts from each of these components can build upon each other during an earthquake event, the mapping looks at each component individually. The mapping used in this assessment is described below.

ShakeMaps

A shake map is a representation of ground shaking produced by an earthquake (Peak Ground Acceleration). The information it presents is different from the earthquake magnitude and epicenter that are released after an earthquake because shake maps focus on the ground shaking resulting from the earthquake, rather than the parameters describing the earthquake source. An earthquake has only one magnitude and one epicenter, but it produces a range of ground shaking at sites throughout the region, depending on the distance from the earthquake, the rock and soil conditions at sites, and variations in the propagation of seismic waves from the earthquake due to complexities in the structure of the earth's crust. A shake map shows the extent and variation of ground shaking in a region immediately following significant earthquakes.

Ground motion and intensity maps are derived from peak ground motion recorded on seismic sensors, with interpolation where data are lacking and site-specific corrections. Color-coded intensity maps are derived from empirical relations between peak ground motions and Modified Mercalli intensity. Two types of shake map are typically generated from the data:

- A probabilistic seismic hazard map shows the hazard from earthquakes that geologists and seismologists agree could occur. The maps are expressed in terms of probability of exceeding a certain ground motion, such as the 10 percent probability of exceedance in 50 years. This level of ground shaking has been used for designing buildings in high seismic areas. The hazard map for the 100-year probabilistic earthquake is shown on Figure 8-6. No scenario shake maps for Pend Oreille County exist which could be utilized for analysis purposes. Therefore, only a probabilistic event was modeled.

NEHRP Soil Maps

NEHRP soil types define the locations that will be significantly impacted by an earthquake. NEHRP Soils B and C typically can sustain low-magnitude ground shaking without much effect. The areas that are most commonly affected by ground shaking have NEHRP Soils D, E and F. Figure 8-7 identifies the various NEHRP soil classifications in Pend Oreille County.

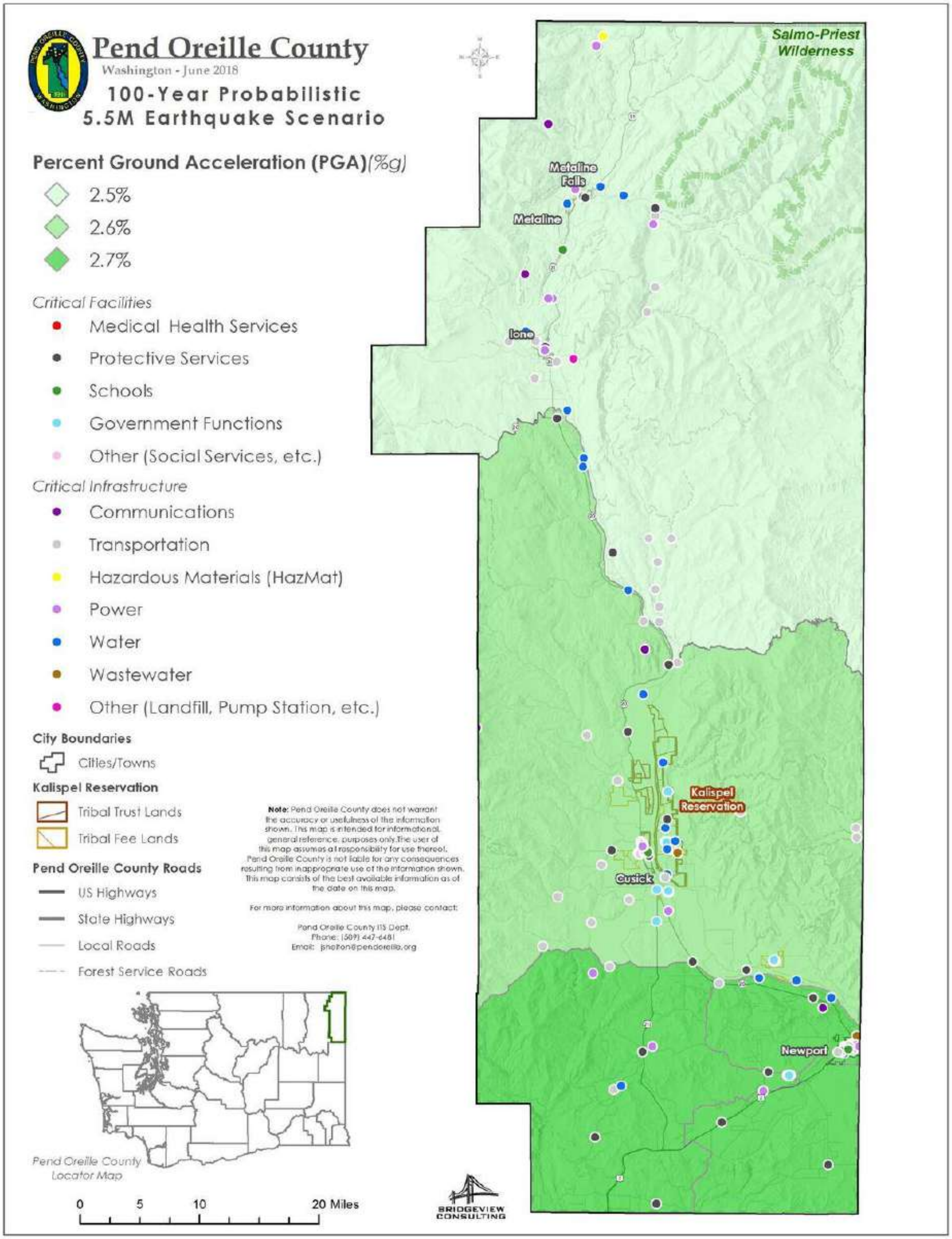


Figure 8-6 100-Year Probabilistic Earthquake Event

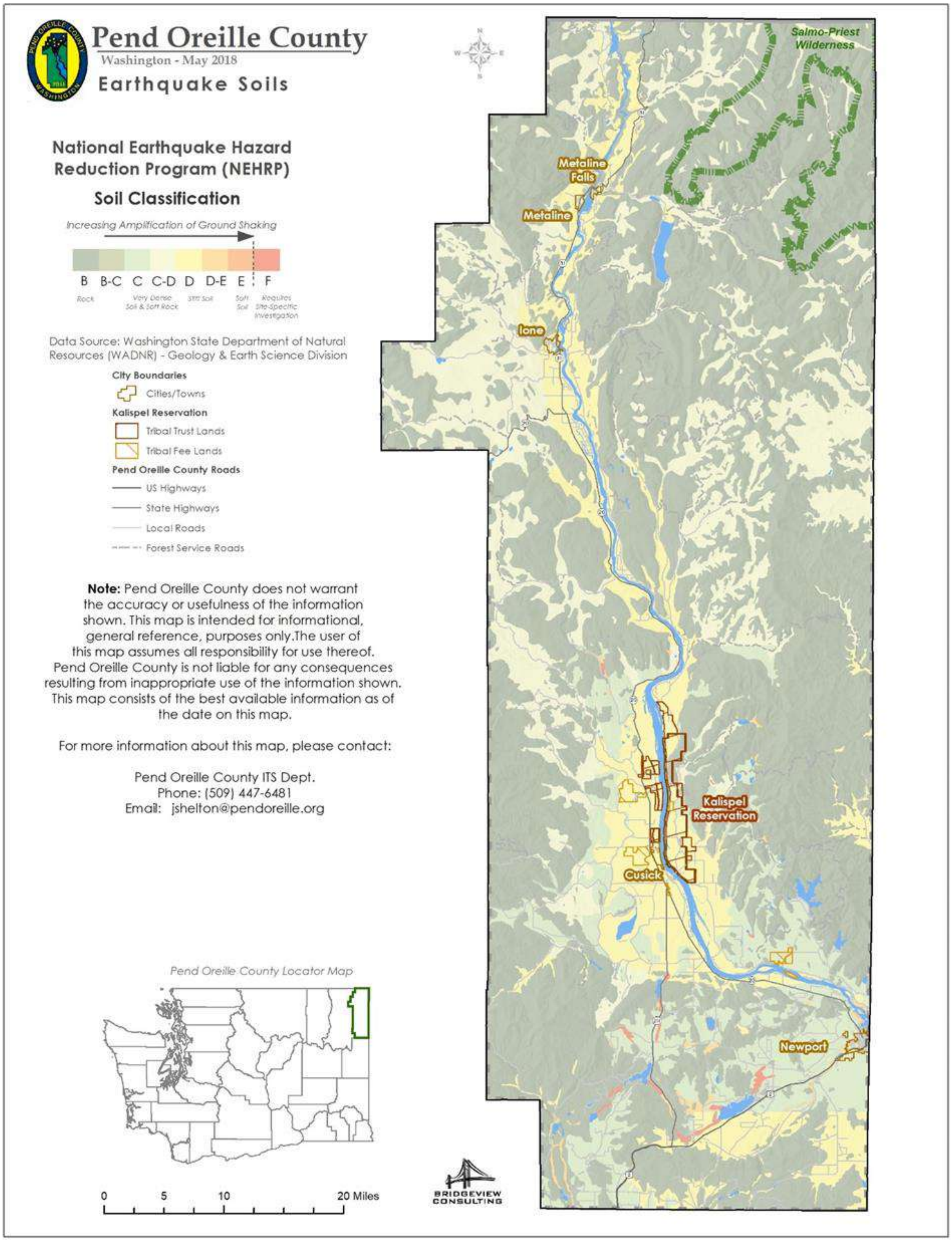


Figure 8-7 NEHRP Soils Classifications

Source: USGS, 2015a

Liquefaction Maps

Soil liquefaction maps are useful tools to assess potential damage from earthquakes. When the ground liquefies, sandy or silty materials saturated with water behave like a liquid, causing pipes to leak, roads and airport runways to buckle, and building foundations to be damaged. In general, areas with NEHRP Soils D, E and F are susceptible to liquefaction. If there is a dry soil crust, excess water will sometimes come to the surface through cracks in the confining layer, bringing liquefied sand with it and creating sand boils. Figure 8-8 shows liquefaction susceptibility throughout the County.

The earthquake risk assessment was completed using local parcel data from the County, as well as the a 100-year probabilistic event. For this study, individual building/parcel data from the county were incorporated into Hazus to report losses at the building level. The results of the analysis completed are summarized in Table 8-5.

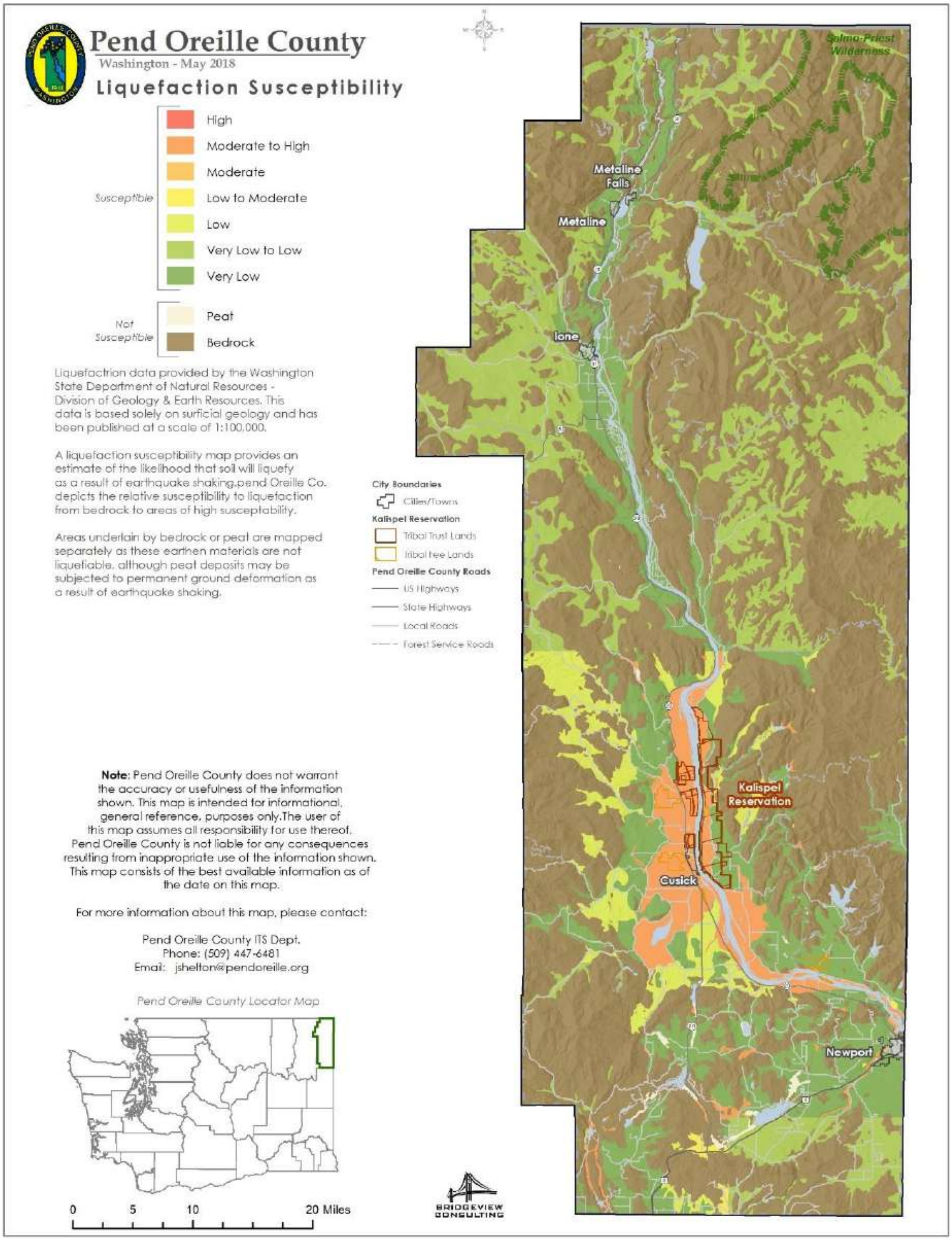


Figure 8-8 Liquefaction Susceptibility Zones

Table 8-5 Potential Building Impact From Liquefaction Zones In Pend Oreille County				
Community	**Total Estimated Number of Critical Facilities Impacted**	**Percent of Buildings in the Moderate-High Liquefaction Zone**	**Number of Buildings in the Moderate – High Liquefaction Zone**	**Loss Ratio (Dollar Losses/Total Building Value)**
Unincorporated County	119	38.7%	46	4.5%
Kalispel Reservation	29	69.0%	20	89.8%
Cusick, Town of	9	100.0%	9	100.0%
Ione, Town of	4	0.0%	0	0%
Newport, City of	37	0.0%	0	0%
Metaline, Town of	1	0.0%	0	0%
Metaline Falls, Town of	5	0.0%	0	0%

Note: The above table shows the total estimate building value by community, and the percent and number of buildings in the high liquefaction zone. A loss ratio is calculated by dividing the dollar loss by the total building value. The loss values are for building losses only; additional damages to infrastructure and building contents are not captured in this table. Figures are rounded up.

8.2.2 Previous Occurrences

Seismic history in the area of Pend Oreille County is poorly understood since past earthquakes resulted in no major property damage, and distant seismograph stations did not pick up much of the low-magnitude earthquakes which have occurred. The most recent incidents occurring of any significance were the 2001 earthquake swarms occurring in the Spokane area, the largest of which was a M4.0. In December 2011, a M4.4 earthquake occurred in the Metaline Falls area. Previous to that event, only one earthquake with an epicenter in Pend Oreille County, above 2.5 on the Richter Scale, had been recorded in Pend Oreille County since 1950. Though earthquakes do not occur frequently in the County, there have been 19 earthquakes felt in Pend Oreille County during the period 1935-1985.[35]

Previously significant historic events in the region are discussed in more detail below.

Lake Chelan, December 14, 1872

The magnitude 6.8 (estimated) Lake Chelan earthquake occurred about 9:40 p.m. and was felt from British Columbia to Oregon and from the Pacific Ocean to Montana. It occurred in a wilderness area that had only a few inhabitants. Reported effects included the following:

- Extensive landslides occurred on shorelines of the Columbia River. One slide, at Ribbon Cliff between Entiat and Winesap, blocked the Columbia River for several hours. Other slides occurred throughout the Cascade Mountains.

[35] Data taken from the NOAA Earthquake Intensity Database. http://www.ngdc.noaa.gov/hazard/int_srch.shtml.

- Ground fissures occurred at the east end of Lake Chelan in the area of the Indian camp area; in the Chelan Landing-Chelan Falls area; on a mountain about 12 miles west of the Indian camp area; on the east side of the Columbia River (where three springs formed); and near the top of a ridge on the east side of the Columbia River.
- Water spouted as much as 27 feet in the air from a fissure at Chelan Falls. The geyser activity continued for several days, and, after diminishing, left permanent springs.
- In the area of the epicenter, the quake damaged one log building near the mouth of the Wenatchee River. Ground shaking threw people to the floor, waves were observed in the ground, and loud detonations were heard. The logs on another cabin caved in about 2 miles above the Ribbon Cliff slide area.
- Damaging ground shaking of intensity VI extended to the west throughout the Puget Sound basin and to the southeast beyond the Hanford Site. Individuals in Idaho, Montana, Oregon, and Canada felt the earthquake. Aftershocks occurred in the area for two years.

Walla Walla Earthquake, July 15, 1936

This magnitude-6.1 earthquake occurred at 11:05 a.m. about 5 miles south-southeast of Walla Walla. It was widely felt through Oregon, Washington, and northern Idaho, with the greatest shaking in northeast Oregon. Property damage was estimated at $100,000 (about $1.35 million in 2004 dollars). The earthquake moved small objects, rattled windows, and cracked plaster in Colfax, Hooper, Page, Pomeroy, Prescott, Touchet, Wallula and Wheeler; most of the impact and damage was near Walla Walla. The earthquake knocked down a few chimneys and many loose chimney bricks; damaged a brick home used by the warden at the State Penitentiary that was condemned and declared unsafe; and damaged the local railroad station. Several homes moved an inch or less on their foundations. Five miles southwest of Walla Walla, the quake restored the flow of a weakened 600-foot deep artesian well to close to original strength; the flow had not diminished after several months. Walla Walla residents reported about 15 or 20 aftershocks.

Hebgen Lake (Montana), August 18, 1959

The Hebgen Lake earthquake in Montana was felt in parts of eastern Washington. The magnitude-7.5 event generated Intensity X shaking, killed 28 people as a result of a landslide, formed “Quake Lake,” and did $11 million in damage to roads and timber. Many campers in the Yellowstone area were trapped for days and a fishing lodge dropped into a lake. There were six aftershocks of magnitude 5.5 or greater within one day. The initial earthquake was felt in an area of over 450,000 square miles.

Borah Peak (Idaho), October 28, 1983

The Borah Peak earthquake was the largest recorded in Idaho, both in magnitude and in the amount of property damage. At a magnitude of 7.3, it was also the largest earthquake to hit the continental United States since the Hebgen Lake quake. The epicenter was in the Barton Flats area, 10 miles northwest of Mackay and 30 miles southeast of Challis. The maximum observed Intensity was IX (based on surface faulting), and the earthquake was felt in an area over 330,000 square miles. Four aftershocks of magnitude 5.5 or greater were recorded within 1 year.

Spokane Earthquake Swarm, 2001

Spokane in 2001 had the most noticed earthquake swarm in the Northwest in recent decades. Dozens of earthquakes occurred over nearly a year. Scientists at the Pacific Northwest Seismograph Network in Seattle said the epicenter of the events was 1 mile north of Gonzaga University and 2.9 miles underground. The largest of the quakes was only a Magnitude 4 event, so little damage done. No major property damage or casualties were caused by the events. However, because the fault whose movement caused the swarm was very shallow, even earthquakes of Magnitude 2 and less were felt. In June and November, there were days with numerous felt events.

From a regional perspective, while earthquakes occur infrequently in the immediate planning area, the western part of the state has a significantly higher risk factor associated with earthquake damage. The recent Cascadia Earthquake Exercise illustrated that the resulting impact on the County from a Cascadia-type event would include an influx of citizens fleeing the western portions of the state, causing significant issues and overwhelming local resources in the eastern counties.

In addition to those events listed above, Table 8-6 lists additional past seismic events that have affected the areas in and around Pend Oreille County.[36] Table 8-7 lists significant incidents which have occurred statewide.

Table 8-6
Historical Earthquakes Impacting the Planning Area

Year	Magnitude	Epicenter	Type/Depth
12/4/2011	2.6	Ione	4.4 km
9/26/2004	2.4	British Columbia (58 miles north of Metaline Falls)	20 km
5/6/1995	2.7	British Columbia (45 miles northeast of Metaline Falls)	10 km
8/6/85	4.0	British Columbia (46 miles northeast of Metaline Falls)	5.0 km
7/8/1983	3.7	British Columbia (47 miles northeast of Metaline Falls)	18 km

Source: Pacific Northwest Seismic Network

Table 8-7
Historical Earthquakes Impacting Washington State

Year	Magnitude	Epicenter	Type
2/28/2001 (DR 1361)	6.8	Olympia (Nisqually)	Benioff
6/10/2001	5.0	Matlock	Benioff
7/3/1999	5.8	8.0 km N of Satsop	Benioff
6/23/1997	4.7	Bremerton	Shallow Crustal

[36] PNSN, 2018

Table 8-7
Historical Earthquakes Impacting Washington State

Year	Magnitude	Epicenter	Type
5/3/1996	5.5	Duvall	Shallow Crustal
1/29/1995	5.1	Seattle-Tacoma	Shallow Crustal
2/1/1984	4.5	Near Glacier National Park	Unknown
10/28/1983	7.3	Borah Peak, ID	Unknown
2/14/1981	5.5	Mt. St. Helens (Ash)	Crustal
9/9/76	4.5	Union	Benioff Zone (28 miles deep)
5/11/1965 (DR 196)	6.6	18.3 KM N of Tacoma	Benioff
4/29/1965	6.5	12 miles North of Tacoma	Benioff
8/6/1959	Unknown	Near Chelan, WA	Unknown
1/13/1949	7.0	12.3 KM ENE of Olympia	Benioff
6/23/1946	7.3	Strait of Georgia	Benioff
2/14/1946	6.3	Puget Sound	Benioff
4/1945	5.7	North Bend (8 miles south/southeast)	Unknown
2/14/1945	6	Sheep Mountain, ID	Unknown
7/12/1944	6.1	Sheep Mountain, ID	Unknown
11/1/1942	Unknown	Northeast of Spokane	Unknown
1939	5.8	Puget Sound – Near Vashon Island	Unknown
10/31/1935	6.3	Helena, Montana	Unknown
10/19/1935	6.3	Helena, Montana	Unknown
1932	5.3	Central Cascades	Unknown
1/23/1920	5.5	Puget Sound	Unknown
12/6/1918	7.0	Vancouver Island	Unknown
8/18/1915	5.6	North Cascades	Unknown
1/11/1909	6.0	Puget Sound	Unknown
4/30/1882	5.8	Olympia area	Unknown
12/15/1872	6.8	Pacific Coast	Unknown

8.2.3 Severity

Earthquakes can last from a few seconds to over five minutes; they may also occur as a series of tremors over several days. The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Casualties generally result from falling objects and debris, because the shocks shake, damage, or demolish buildings and other structures. Disruption of communications, electrical power supplies and gas, sewer and water lines should be expected. Earthquakes may trigger fires, dam failures, landslides, or releases of hazardous material, compounding their disastrous effects.

Small, local faults produce lower magnitude quakes, but ground shaking can be strong, and damage can be significant in areas close to the fault. In contrast, large regional faults can generate earthquakes of great magnitudes but, because of their distance and depth, they may result in only moderate shaking in an area.

USGS ground motion maps based on current information about fault zones show the PGA that has a certain probability (2 or 10 percent) of being exceeded in a 50-year period. The PGA is measured in %g. Figure 8-9 shows the PGA with a 2 percent exceedance chance in 50 years in Washington.

Effects of a major earthquake in the Puget Sound basin area could be catastrophic, providing the worst-case disaster short of drought-induced wild fire sweeping through a suburban area. Hundreds of residents could be killed, and a multitude of others left homeless.

Recorded damage sustained to date in Pend Oreille County has been very low, and the area is not considered a high-hazard area for earthquakes. However, Washington State is a high-hazard area for earthquakes in general, with new faults discovered fairly regularly. In addition, there is the potential for damages occurring from faults in other areas which could impact the County. Impact would be dependent on the time of day and time of year, as the population increases significantly during the summer months.

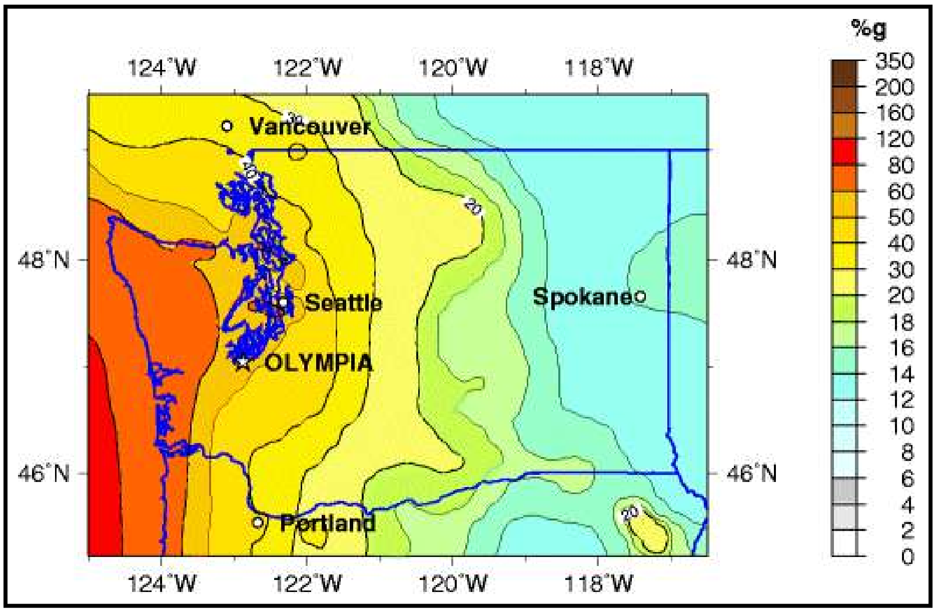


Figure 8-9 PGA with 2-Percent Probability of Exceedance in 50 Years, Northwest Region

8.2.4 Frequency

Recurrence interval data was vague for the Newport Fault, with estimations ranging from one to several thousand years. Engineered reports developed for bridge retrofitting in the County found similar issues with lack of specific recurrence interval data, stating that "[f]aults that could produce surface rupture in the project area are not well-defined and are thought to have recurrence intervals in the range of one to several thousand years. Current state of engineering practice in Washington State is such that surface fault rupture is only considered in extraordinary cases with established evidence or high likelihood that a fault is present within the project area, which is not the case for the Site. In our opinion, the relative risk of fault rupture at the surface of the Site is low" (Pend Oreille, 2017b). The Planning Team also felt that a low recurrence interval was an acceptable level.

Scientists currently estimate that a Magnitude-9 earthquake in the Cascadia Subduction Zone occurs about once every 500 years. The last one was in 1700. Paleoseismic investigations have identified 41 Cascadia Subduction Zone interface earthquakes over the past 10,000 years, which corresponds to one earthquake about every 250 years. About half were M9.0 or greater earthquakes that represented full rupture of the fault zone from Northern California to British Columbia. The other half were M8+ earthquakes that ruptured only the southern portion of the subduction zone.

The 300+ years since the last major Cascadia Subduction Zone earthquake is longer than the average of about 250 years for M8 or greater and shorter than some of the intervals between M9.0 earthquakes.

Scientists currently estimate the frequency of deep earthquakes similar to the 1965 Magnitude-6.5 Seattle-Tacoma event and the 2001 Magnitude-6.8 Nisqually event as about once every 35 years. The USGS estimates an 84-percent chance of a Magnitude-6.5 or greater deep earthquake over the next 50 years.

Scientists estimate the approximate recurrence rate of a Magnitude-6.5 or greater earthquake anywhere on a shallow fault in the Puget Sound basin to be once in about 350 years. There have been four earthquakes of less than Magnitude 5 in the past 20 years.

Earthquakes on the Seattle Faults have a 2-percent probability of occurrence in 50 years. A Benioff zone earthquake has an 85 percent probability of occurrence in 50 years, making it the most likely of the three types.

While the County itself is not at high risk to a significant earthquake, impacts from a west-side quake would significantly impact the County with respect to commodities, and the influx of citizens evacuating from other areas of the state. Mutual aid would tax resources, as would increase response activities due to the increased number of citizens within not only the county, but the entire region as a whole.

8.3 VULNERABILITY ASSESSMENT

8.3.1 Overview

Limited faults within the planning region have the potential to cause direct impact; however, the area is vulnerable to impact from an event outside the County, although the intensity of ground motions diminishes with increasing distance from the epicenter. The age of building stock also is of consideration when determining vulnerability, with much of the county's structures being aged. As a result, the entire population of the planning area is exposed to both direct and indirect impacts from earthquakes. The degree of direct impact (and exposure) is dependent on factors including the soil type on which homes are constructed, the proximity to fault location, the type of materials used to construct residences and facilities, etc. Indirect impacts are associated with elements such as the inability to evacuate the area as a result of earthquakes occurring in other regions of the state as well as impact on commodity flow for goods and services into the area, many of which are serviced only by one roadway in or out.

Methodology

Earthquake vulnerability data was generated using a Level 1 Hazus analysis based on a 100-year probabilistic earthquake. The Spokane County M5.5 ShakeMaps scenario was also tested, but provided minimal results to the county, and therefore the planning team elected to focus impact on the 100-year probabilistic event.

Utilizing the probabilistic event, the location and size of the earthquake was identified (M5.5), and Hazus estimated the intensity of the ground shaking and the number of buildings and infrastructure damaged. Vulnerability to people was estimated based on exposure of the residential structures.

Warning Time

Scientists are currently developing methods to more accurately determine when an earthquake will occur. Recent advancements in determining the probability of an earthquake in a given period use a log-normal, Brownian Passage Time, or other probability distribution in which the probability of an event depends on the time since the last event. Such time-dependent models produce results broadly consistent with the elastic rebound theory of earthquakes. The USGS and others are developing such products as new geologic and seismic information regarding the dates of previous events along faults becomes more and more available. Such early warning systems, referred to as ShakeAlert, have already been deployed in a testing capacity in several places throughout the West Coast, as well as being active in China, Taiwan, Turkey, and Mexico – locations where large previous earthquakes have occurred (USGS, 2016).

These potential warning systems give approximately 40 seconds notice that a major earthquake is about to occur. The warning time is very short, but it could allow for someone to get under a desk, step away from a hazardous material they are working with, or shut down a computer system.

Hazus Global Summary Results

Through the Level 1 Hazus analysis for the 100-year Probabilistic Earthquake scenario event, the summary of the total potential building-related loss was developed as identified below in Table 8-8. Information from the Hazus Global Summary Report was utilized to help identify vulnerability in the following sections.

The geographical size of the region is 1,424.87 square miles and contains five (5) census tracts. There are over 5,000 households in the region which has a total population of 13,001 people (2010 Census Bureau data).

There are an estimated 8,000 buildings in the region with a total building replacement value (excluding contents) of 1,386 (millions of dollars). Approximately 94.00 % of the buildings (and 86.00% of the building value) are associated with residential housing. The Hazus program estimates building count at approximately 10 percent less than the Assessor's data; however, for planning purposes, such variations are acceptable.

In terms of building construction types found in the region, wood frame construction makes up 72% of the building inventory (see Table 8-9). The remaining percentage is distributed between the other general building types. This element does remain consistent when compared to the County's actual Assessor data, and Census data.

8.3.2 Impact on Life, Health, and Safety

The entire population of the planning area is potentially exposed to direct and indirect impacts from earthquakes. Two of the most vulnerable populations to a disaster incident such as this are the young and the elderly. Pend Oreille County has a fairly high population of retirees and individuals with disabilities, both higher than the state averages. The need for increased rescue efforts and/or to provide assistance to such a large population base could tax the first-responder resources in the area during an event. Although many injuries may not be life-threatening, people will require medical attention and, in many cases, hospitalization. Potential life-threatening injuries and fatalities are expected; these are likely to be at an increased level if an earthquake happens during the afternoon or early evening.

The degree of exposure is dependent on many factors, including the soil type their homes are constructed on, quality of construction, their proximity to fault location, etc. Whether impacted directly or indirectly, the entire population will have to deal with the consequences of earthquakes to some degree. Business interruption could keep people from working, road closures could isolate populations, and loss of functions of utilities could impact populations that suffered no direct damage from an event itself.

Given the severity of the earthquake, the number of people without power or water could potentially be high given the number of wells on which the County and its jurisdictions rely to supply water to individuals who most likely do not have generators to run pumps on the wells. This need will increase the number of individuals seeking shelter assistance.

8.3.3 Impact on Property

According to the County's Assessor data and the critical infrastructure list assimilated for this planning process, there are over 8,700 buildings in the planning area (including government structures and critical facilities not contained within the Assessor's database), with an estimated replacement value of in excess of $1.4 billion (structure and content). Most of the buildings in the planning area are residential (many seasonal in nature), and most of the building stock is of considerable age and not supported by building codes which increase resilience to seismic events. This is particularly of concern in the Newport area, where age and ground motion based on the 100-year probabilistic event are of greater concern, with 6.7 percent of the structures in a moderate to high soil liquefaction zone.

The majority of structures in the planning area are of wood frame construction; many have chimneys that may be in need of repair, and many, because of the age of the building stock, may contain some level of asbestos in building components such as the boiler room, ceiling tiles, carpeting, or glue. Since all structures in the planning area are susceptible to earthquake impacts to varying degrees (including liquefaction and landslides), these figures represent total numbers region-wide for property exposure to seismic events.

Review of the %PGA values based on the probabilistic event indicate that much of the area falls within the "light" perceived shaking zone, or the Mercalli Scale of IV – Light. Review of the Hazus Global Summary Report indicates no structure damage to Resistant and Vulnerable Buildings. Rather, damages would more likely be associated with the types of soil and liquefaction on which the structures sit.

Table 8-8 Hazus Results for 100-year Probabilistic M5.5 Earthquake

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	36	0.45	0	0.53	0	0.76	0	2.73	0	4.62
Commercial	255	3.21	3	4.84	1	6.59	0	25.33	0	64.78
Education	15	0.19	0	0.21	0	0.25	0	0.81	0	2.38
Government	17	0.21	0	0.27	0	0.29	0	0.82	0	2.53
Industrial	93	1.16	1	1.75	0	2.46	0	9.11	0	9.90
Other Residential	1,755	22.06	41	69.94	10	77.89	0	48.00	0	10.67
Religion	32	0.40	0	0.45	0	0.51	0	1.52	0	5.13
Single Family	5,752	72.32	13	22.01	2	11.24	0	11.68	0	0.00
Total	**7,954**		**59**		**13**		**0**		**0**	

Table 8-9 Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	5,804	72.97	12	21.05	1	7.88	0	0.00	0	0.00
Steel	97	1.22	1	1.35	0	1.65	0	4.58	0	0.00
Concrete	79	0.99	1	1.30	0	0.96	0	1.46	0	0.00
Precast	78	0.99	1	1.97	1	4.10	0	19.14	0	0.00
RM	201	2.53	2	3.51	1	5.86	0	19.08	0	0.00
URM	30	0.38	1	1.57	0	2.35	0	10.27	0	100.00
MH	1,665	20.93	41	69.25	10	77.19	0	45.47	0	0.00
Total	7,954		59		13		0		0	

*Note:
RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Building Age

Structures that are in compliance with the Uniform Building Code (UBC) of 1970 or later are generally less vulnerable to seismic damage because 1970 was when the UBC started including seismic construction standards 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 in the planning area built after 1972 were built in conformance with UBC seismic standards and have less vulnerability. Issues such as code enforcement and code compliance could impact this assumption. Construction material is also important when determining the potential risk to a structure. 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 g. More recent housing stock is in compliance with Zone 3 standards. In July 2004, the state again upgraded the building code to follow International Building Code Standards. While the “zones” are still referenced, they are, in large part, no longer used in the capacity they once were as there can be different zones within political subdivisions, making it difficult to apply. For instance, within Washington, there are both Seismic Zones 2B and 3.

An analysis was also completed to identify how many buildings were built to a specific building code. Hazus identifies key changes in earthquake building codes based on year. Table 8-10 and Table 8-11 show the results of this analysis.

Table 8-10
Timeline of Building Code Standards

Time Period	Code Significance for Identified Time Period
Pre-1974	No standardized earthquake requirements in building codes. Washington State law did not require the issuance of any building permits, or require actual building officials
1975-2003	UBC seismic construction standards were adopted in Washington.
1994-2003	Seismic Risk Zone 3 was established within the Uniform Building Code in 1994, requiring higher standards.
2004-Present	Washington State upgrades its building codes to follow the International Building Code Standard. As upgrades occur, the State continues to adopt said standards.

Table 8-11
Age Of Structures Within Planning Area

Year Structure Built	Housing Units – Unincorporated County	Housing Units – Cities and Towns	Total Units Countywide
1939 or earlier	353	481	834
1940-1959	767	383	1,150
1960-1969	612	117	729
1970-1979	1,181	164	1,345
1980-1989	972	134	1,106
1990-2000*	1,279	165	1,444
Total*	5,164	1,444	6,608
Total 2000-2010*	6,335	1,601	7,936
Total 2010-2016**	6,615	1,615	8,230

*Based on 2000 US Census Data[37] /
**2010 and 2016 OFM postcensal estimates provides totals with no breakdown[38]

8.3.4 Impact on Critical Facilities and Infrastructure

All critical facilities in Pend Oreille County are exposed to the earthquake hazard, although Hazus results show no essential facility impacted, and all functional on day one of an incident.

Hazardous materials releases can occur during an earthquake from fixed facilities or transportation-related incidents without the structure being significantly impact, so such issues do remain of concern to the planning team members.

In addition, transportation corridors can be disrupted during an earthquake, leading to the release of materials to the surrounding environment. Facilities holding hazardous materials are of particular concern because of possible isolation of residences surrounding them. During an earthquake, structures storing these materials could rupture and leak into the surrounding area or an adjacent waterway, having a disastrous

[37] U.S. Census: https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk
[38] Office of Financial Management http://www.ofm.wa.gov/pop/april1/

effect on the environment. A large portion of the county is coastal. As such, hazardous materials are of particular concern with respect to spills into water bodies, including the coastline or significant rivers in the area, which could have devastating impact. Additionally, the potential for landslide-induced roadway closure is of significant concern. Closure of major arterials could require increased evacuation periods in some instances by several hours. In some instances, commodities would also be impacted in areas, requiring supplies by air or water.

Earthquakes can potentially trigger slope failures as well. Areas susceptible to landslides would be more at risk. These landslides would impact roadways, as well as increase infrastructure impact. Readers should review the landslide profile for identification of areas at higher risk to landslides.

The Hazus Global Summary indicates that the replacement value of the transportation and utility lifeline systems is estimated to be 1,434 and 388 (millions of dollars), respectively (see Figure 8-10). Damage is caused by ground failure, with some highway segments operating at less than 50 percent functionality after day 7.

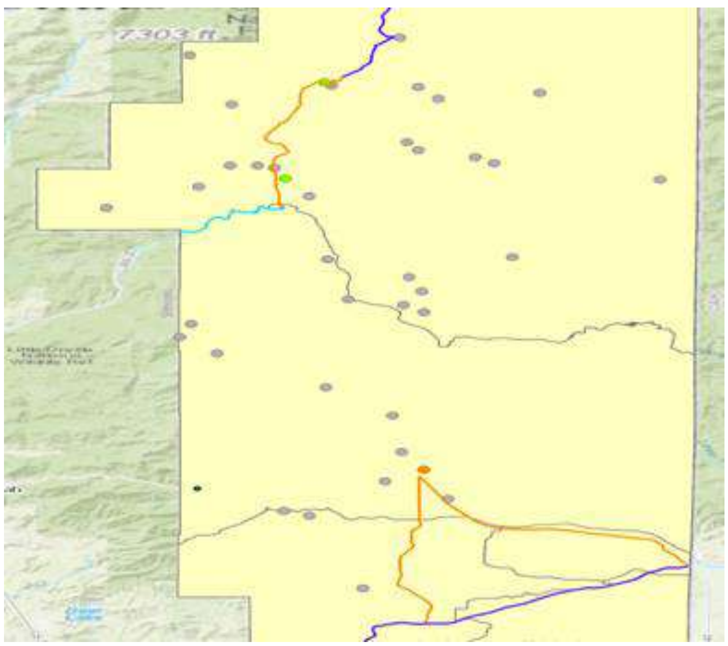


Figure 8-10 Hazus Output of Transportation Lifeline Damage

8.3.5 Impact on Economy

Economic losses due to earthquake damage include damage to buildings, including the cost of structural and non-structural damage, damage to contents, and loss of inventory, loss of wages and loss of income. Loss of tax base both from revenue and lack of improved land values will increase the economic loss to the County and its planning partners. In addition, loss of goods and services may hamper recovery efforts, and even preclude residents from rebuilding within the area.

Hazus estimates the total economic loss based on a probabilistic earthquake to be 0.36 (millions of dollars or $360,000), which includes building and lifeline related losses based on the region's available inventory. The majority of the economic loss is based on lost rental income, and capital stock loss of a non-structural nature.

No specific loss data is available with respect to loss of wages, inventory, or income; however, economic loss with respect to building impact is identified in the data above.

8.3.6 Impact on Environment

Earthquake-induced landslides can significantly impact habitat. It is also possible for streams to be rerouted after an earthquake. This can change water quality, possibly damaging habitat and feeding areas. There is a possibility of streams fed by groundwater drying up because of changes in underlying geology.

8.4 FUTURE DEVELOPMENT TRENDS

Pend Oreille County continues to utilize the International Building Code, which requires structures to be built at a level which supports soil types and earthquake hazards (ground shaking). As existing buildings are renovated, provisions are in place which require reconstruction at higher standards. All new construction in the area would require the application of new codes. Given the countywide application of the land use practices, it is anticipated that they would reduce hazard exposure for any new or significantly renovated structures.

8.5 ISSUES

While the area has a low probability of an earthquake event occurring within its boundaries, an earthquake does not necessarily have to occur in the planning area to have a significant impact as such an event would disrupt transportation to and from the region as a whole and impact commodity flow. As such, any seismic activity of 6.0 or greater on faults in or near the planning area would have significant impact. Potential warning systems could give approximately 40 seconds notice that a major earthquake is about to occur. This would not provide adequate time for preparation. Earthquakes of this magnitude or higher would lead to massive structural failure of property on NEHRP C, D, E, and F soils. Levees and revetments built on these poor soils would likely fail, representing a loss of critical infrastructure. These events could cause secondary hazards, including landslides and mudslides that would further damage structures. River valley hydraulic-fill sediment areas are also vulnerable to slope failure, often as a result of loss of cohesion in clay-rich soils. Soil liquefaction would occur in water-saturated sands, silts, or gravelly soils.

Earthquakes can cause large and sometimes disastrous landslides and mudslides. River valleys are vulnerable to slope failure, often as a result of loss of cohesion in clay-rich soils. Soil liquefaction occurs when water-saturated sands, silts or gravelly soils are shaken so violently that the individual grains lose contact with one another and float freely in the water, turning the ground into a pudding-like liquid. Building and road foundations lose load-bearing strength and may sink into what was previously solid ground. Unless properly secured, hazardous materials can be released, causing significant damage to the environment and people. Earthen dams and levees are highly susceptible to seismic events and the impacts of their eventual failures can be considered secondary risks for earthquakes. Earthquakes at sea can generate destructive tsunamis. Important issues associated with an earthquake include, but are not limited to the following:

- More information is needed on the exposure and performance of construction within the planning area. Much information on the age, type of construction, or updated work on facilities is not readily available in a useable format for a risk assessment of this type.
- It is presently unknown to what standards portions of the planning area’s building stock were constructed or renovated.
- Based on the modeling of critical facility performance for this plan, a high number of facilities in the planning area are expected to have complete or extensive damage from scenario events. These facilities are prime targets for structural retrofits.

- The County and its planning partners are encouraged to create or enhance continuity of operations plans using the information on risk and vulnerability contained in this plan.
- Geotechnical standards should be established that take into account the probable impacts from earthquakes in the design and construction of new or enhanced facilities.
- Dam failure warning, evacuation plans and procedures should be updated (and maintained) to reflect dam risk potential associated with earthquake activity in the region, with said information being distributed to the County and its planning partners to allow for appropriate planning to occur.

8.6 RESULTS

Based on review and analysis of the data, the Planning Team has determined that the probability for an Earthquake throughout the area is low, occurring infrequently. A Spokane-type event, such as that utilized as one of the scenarios modeled for this update has a low probability of occurring within the region. The losses related to earthquake scenarios are also largely due to the proximity to the faults. The closest fault for the County is the Newport Fault; however, no ShakeMaps exists for that fault on which to determine losses. For consideration in determining the impact from an earthquake, other factors also contribute. There is a low percentage of buildings located in the moderate-high liquefaction zone, although there is a large number of buildings designated as pre-code buildings, the highest concentrations of structures at impact being within the City of Newport. Due to the age of these buildings and the absence of building codes at time of construction, they may not perform as well during an earthquake compared to structures built after code implementation.

Beyond the direct impact from an earthquake, a Cascadia or Seattle Fault earthquake occurring on the western portion of the state which generates large amounts of damage and impact to citizens would also impact Pend Oreille County with respect to evacuees and the influx from other areas into the County. Such event would impact response capabilities of first responders, hospitals, and resources. Based on the potential impact, the Planning Team determined the CPRI score to be 1.85; however, when including the influx of citizens that would evacuate to the County, the planning team determined the overall vulnerability determined to be a medium level.

CHAPTER 9.
FLOOD

DEFINITIONS

Flood—The inundation of normally dry land resulting from the rising and overflowing of a body of water.

Floodplain—The land area along the sides of a river that becomes inundated with water during a flood.

100-Year Floodplain—The area flooded by a flood that has a 1-percent chance of being equaled or exceeded each year. This is a statistical average only; a 100-year flood can occur more than once in a short period of time. The 1-percent annual chance flood is the standard used by most federal and state agencies.

Floodway—The channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.

Floods are one of the most common natural hazards in the U.S. They can develop slowly over a period of days or develop quickly, with disastrous effects that can be local (impacting a neighborhood or community) or regional (affecting entire river basins, coastlines and multiple counties or states) (FEMA, 2010). Most communities in the U.S. have experienced some kind of flooding, after spring rains, heavy thunderstorms, coastal storms, or winter snow thaws. Floods are one of the most frequent and costly natural hazards in terms of human hardship and economic loss, particularly to communities that lie within flood-prone areas or floodplains of a major water source.

9.1 GENERAL BACKGROUND

Flooding is a general and temporary condition of partial or complete inundation on normally dry land from the following:

- Riverine flooding, including overflow from a river channel, flash floods, alluvial fan floods, dam-break floods, and ice jam floods;
- Local drainage or high groundwater levels;
- Fluctuating lake levels;
- Coastal flooding;
- Coastal erosion;
- Unusual and rapid accumulation or runoff of surface waters from any source;
- Mudflows (or mudslides);
- Collapse or subsidence of land along the shore of a lake or similar body of water that result in a flood, caused by erosion, waves or currents of water exceeding anticipated levels (Floodsmart.gov, 2012);
- Sea level rise;
- Climate Change (USEPA, 2012).

9.1.1 Flooding Types

Many floods fall into one of three categories: riverine, coastal, or shallow (FEMA, 2005). Other types of floods include: alluvial fan floods, dam failure, flash floods, and floods associated with local drainage or high groundwater. For this hazard mitigation plan and as deemed appropriate by the County, riverine/stormwater flooding are the main flood types of concern for the entire planning area, with snow melt almost annually impacting portions of the planning area.

9.1.2 Riverine

Riverine floods are the most common flood type. They occur along a channel and include overbank and flash flooding. Channels are defined ground features that carry water through and out of a watershed. They may be called rivers, creeks, streams, or ditches. When a channel receives too much water, the excess water flows over its banks and inundates low-lying areas (FEMA, 2005).

9.1.3 Flash Floods

A flash flood is a rapid, extreme flow of high water into a normally dry area, or a rapid water level rise in a stream or creek above a predetermined flood level, beginning within six hours of the causative event (e.g., intense rainfall, dam failure, ice jam). The time may vary in different areas. Ongoing flooding can intensify to flash flooding in cases where intense rainfall results in a rapid surge of rising floodwaters (NWS, 2009).

9.1.4 Dam Failure

Dam failures in the United States typically occur in one of four ways (Association of State Dam Safety Officials, 2012):

- Overtopping of the primary dam structure, which accounts for 34 percent of all dam failures, can occur due to inadequate spillway design, settlement of the dam crest, blockage of spillways, and other factors.
- Foundation defects due to differential settlement, slides, slope instability, uplift pressures, and foundation seepage can also cause dam failure. These account for 30 percent of all dam failures.
- Failure due to piping and seepage accounts for 20 percent of all failures. These are caused by internal erosion due to piping and seepage, erosion along hydraulic structures such as spillways, erosion due to animal burrows, and cracks in the dam structure.
- Failure due to problems with conduits and valves, typically caused by the piping of embankment material into conduits through joints or cracks, constitutes 10 percent of all failures.

The remaining 6 percent of U.S. dam failures are due to miscellaneous causes. Many dam failures in the United States have been secondary results of other disasters. The prominent causes are earthquakes, landslides, extreme storms, massive snowmelt, equipment malfunction, structural damage, foundation failures, and sabotage. Review of available dam response plans for Box Canyon Dam indicates that the most likely disaster-related cause of dam failure would be an earthquake, with the majority of the damage resulting from loss of a spillway gate pier. Similar data for the remaining dams in the area were not available for review.

Poor construction, lack of maintenance and repair, and deficient operational procedures are preventable or correctable by a program of regular inspections. Terrorism and vandalism are serious concerns that all operators of public facilities must plan for; these threats are under continuous review by public safety agencies.

The potential for catastrophic flooding due to dam failures led to passage of the National Dam Safety Act (Public Law 92-367). The National Dam Safety Program requires a periodic engineering analysis of every major dam in the country. The goal of this FEMA-monitored effort is to identify and mitigate the risk of dam failure so as to protect the lives and property of the public.

Washington Department of Ecology Dam Safety Program

The Dam Safety Office (DSO) of the Washington Department of Ecology regulates over 1,000 dams in the state that impound at least 10 acre-feet of water. The DSO has developed dam safety guidelines to provide dam owners, operators, and design engineers with information on activities, procedures, and requirements involved in the planning, design, construction, operation, and maintenance of dams in Washington. The authority to regulate dams in Washington and to provide for public safety is contained in the following laws:

- State Water Code (1917)—RCW 90.03
- Flood Control Act (1935)—RCW 86.16
- Department of Ecology (1970)—RCW 43.21A.

Where water projects involve dams and reservoirs with a storage volume of 10 acre-feet or more, the laws provide for the Department of Ecology to conduct engineering review of the construction plans and specifications, to inspect the dams, and to require remedial action, as necessary, to ensure proper operation, maintenance, and safe performance. The DSO was established within Ecology's Water Resources Program to carry out these responsibilities.

The DSO provides reasonable assurance that impoundment facilities will not pose a threat to lives and property, but dam owners bear primary responsibility for the safety of their structures, through proper design, construction, operation, and maintenance. The DSO regulates dams with the sole purpose of reasonably securing public safety; environmental and natural resource issues are addressed by other state agencies. The DSO neither advocates nor opposes the construction and operation of dams.

U.S. Army Corps of Engineers Dam Safety Program

The U.S. Army Corps of Engineers is responsible for safety inspections of some federal and non-federal dams in the United States that meet the size and storage limitations specified in the National Dam Safety Act. The Corps has inventoried dams; surveyed each state and federal agency's capabilities, practices and regulations regarding design, construction, operation, and maintenance of the dams; and developed guidelines for inspection and evaluation of dam safety (U.S. Army Corps of Engineers, 1997).

Federal Energy Regulatory Commission Dam Safety Program

The Federal Energy Regulatory Commission (FERC) cooperates with a large number of federal and state agencies to ensure and promote dam safety. There are 3,036 dams that are part of regulated hydroelectric projects in the FERC program. Two-thirds of these are more than 50 years old. As dams age, concern about their safety and integrity grows, so oversight and regular inspection are important. FERC staff inspects hydroelectric projects on an unscheduled basis to investigate the following:

- Potential dam safety problems;
- Complaints about constructing and operating a project;
- Safety concerns related to natural disasters;
- Issues concerning compliance with the terms and conditions of a license.

Every five years, an independent engineer approved by the FERC must inspect and evaluate projects with dams higher than 32.8 feet (10 meters), or with a total storage capacity of more than 2,000 acre-feet.

FERC staff monitors and evaluates seismic research and applies it in investigating and performing structural analyses of hydroelectric projects. FERC staff also evaluates the effects of potential and actual large floods on the safety of dams. During and following floods, FERC staff visits dams and licensed projects, determines the extent of damage, if any, and directs any necessary studies or remedial measures the licensee must undertake. The FERC publication *Engineering Guidelines for the Evaluation of Hydropower Projects* guides the FERC engineering staff and licensees in evaluating dam safety. The publication is frequently revised to reflect current information and methodologies.

The FERC requires licensees to prepare emergency action plans and conducts training sessions on how to develop and test these plans. The plans outline an early warning system if there is an actual or potential sudden release of water from a dam due to failure. The plans include operational procedures that may be used, such as reducing reservoir levels and reducing downstream flows, as well as procedures for notifying affected residents and agencies responsible for emergency management. These plans are frequently updated and tested to ensure that everyone knows what to do in emergency situations.

Pend Oreille County does have FERC regulated dams within its county boundaries owned by Seattle City Light and Pend Oreille Public Utility District.

9.1.5 Dam Safety Office Hazard Classifications

The DSO classifies dams and reservoirs in a hazard rating system based solely on the potential consequences to downstream life and property that would result from a failure of the dam and sudden release of water. The following codes are used as an index of the potential consequences in the downstream valley if the dam were to fail and release the reservoir water:

- 1A = Greater than 300 lives at risk (High hazard);
- 1B = From 31 to 300 lives at risk (High hazard);
- 1C = From 7 to 30 lives at risk (High hazard);
- 2 = From 1 to 6 lives at risk (Significant hazard);
- 3 = No lives at risk (Low hazard).

The Corps of Engineers developed the hazard classification system for dam failures shown in Table 9-1. The Washington and Corps of Engineers hazard rating systems are both based only on the potential consequences of a dam failure; neither system takes into account the probability of such failures.
Pend Oreille County has 42 dams within its boundaries identified by the Washington State Department of Ecology Dam Safety Program.[39] Those dams and their hazard rankings are identified in Table 9-2. High hazard dams are highlighted in blue.

Table 9-1
Corps of Engineers Hazard Potential Classification

Hazard Category[a]	Direct Loss of Life[b]	Lifeline Losses[c]	Property Losses[d]	Environmental Losses[e]
Low	None (rural location, no permanent structures for human habitation).	No disruption of services (cosmetic or rapidly repairable damage).	Private agricultural lands, equipment, and isolated buildings.	Minimal incremental damage.
Significant	Rural location, only transient or day-use facilities.	Disruption of essential facilities and access.	Major public and private facilities.	Major mitigation required.

[39] https://fortress.wa.gov/ecy/publications/documents/94016.pdf

Table 9-1
Corps of Engineers Hazard Potential Classification

Hazard Category[a]	Direct Loss of Life[b]	Lifeline Losses[c]	Property Losses[d]	Environmental Losses[e]
High	Certain (one or more) extensive residential, commercial, or industrial development.	Disruption of essential facilities and access.	Extensive public and private facilities.	Extensive mitigation cost or impossible to mitigate.

a. Categories are assigned to overall projects, not individual structures at a project.
b. Loss of life potential based on inundation mapping of area downstream of the project. Analyses of loss of life potential should take into account the population at risk, time of flood wave travel, and warning time.
c. Indirect threats to life caused by the interruption of lifeline services due to project failure or operational disruption; for example, loss of critical medical facilities or access to them.
d. Damage to project facilities and downstream property and indirect impact due to loss of project services, such as impact due to loss of a dam and navigation pool, or impact due to loss of water or power supply.
e. Environmental impact downstream caused by the incremental flood wave produced by the project failure, beyond what would normally be expected for the magnitude flood event under which the failure occurs.

Source: U.S. Army Corps of Engineers, 1995

Table 9-2
Pend Oreille County Dam List and Classifications

Dam Name	River or Stream	Purpose	Year Completed	Hazard Class	Crest Length (ft)	Dam Height (ft)	Storage (acre-ft)	Max Storage (acre-ft)	Max Discharge (cfs)
Baker Lake Dam	Tr-Deer Creek	I, R	1966	3	110	10	20	61	0
Big Meadow Lake Dam	Meadow Creek	R	1974	3	700	12	500	500	0
Box Canyon Dam	Pend Oreille River	H, R	1955	1A	200	106	60000	100000	350000
Cedar Lake Dam	Tr-Deer Creek	I,R	1967	1C	280	19	21	50	0
Conger Lake Dam	Trimble Creek	R	1926	3	75	22	50	150	0
Conger Pond Dam	Trimble Creek	R	1926	3	75	10	20	35	0
Cusic Polishing Lagoon	Off-Pend Oreille River	Q	1978	2	2000	8	30	48	0

Table 9-2
Pend Oreille County Dam List and Classifications

Dam Name	River or Stream	Purpose	Year Completed	Hazard Class	Crest Length (ft)	Dam Height (ft)	Storage (acre-ft)	Max Storage (acre-ft)	Max Discharge (cfs)
Decie Lake Dam	Tr-Little Spokane River	I,R	1960	3	190	22	25	33	0
Diamond Lake Aeration Lagoon No. 2	Tr-Little Spokane River-Offstr	Q	1987	1C	800	17	51	61	20
Diamond Lake Aeration Lagoon No. 3	Tr-Little Spokane River-Offstr	Q	1987	1C	1570	18	51	61	20
Diamond Lake Sewage Lagoon No. 1	Tr-Little Spokane River-Offstr	Q	1988	1C	500	16	10	12	20
Duncan Dam No. 1	Tr-Pend Oreille River	I,R	1966	3	176	16	96	150	0
Duncan Dam No. 2	Tr-Pend Oreille River	I,R	1966	3	325	18	95	150	139
Flying Goose Ranch-Wetland Dam No. 1		F,Q	1995	3	358	10	60	100	140
Heater Pond Dam	Tr-Pend Oreille River	P,R	1952	3	2000	10	18	40	0
Homestead Lake Dam	Tr-Ione Mill Pond	R	1971	3	420	22	30	52	20
Ione Mill Pond	Big Muddy Creek	R	1914	3	1050	35	500	557	0
Isabelle Lake Dam	Tr-Little Spokane River	I,R	1960	3	180	22	10	16	0
Kettwig Wildlife Dam	Spring Heel Creek	F,R,S	1979	3	550	13	100	180	0
Koenig Dam	Tr-Otter Creek	R	1968	3	80	16	15	35	5

Table 9-2
Pend Oreille County Dam List and Classifications

Dam Name	River or Stream	Purpose	Year Completed	Hazard Class	Crest Length (ft)	Dam Height (ft)	Storage (acre-ft)	Max Storage (acre-ft)	Max Discharge (cfs)
Little Spokane River Dam	West Branch Little Spokane River	R	1960	3	290	12	20	35	0
Locke Dam	Tr-Pend Oreille River	C	1973	2	158	30	1000	1860	174
Lynda Lake Dam	Tr-Little Spokane River	I,R	1960	3	170	22	9	17	0
Mallard Marsh Dam		R	1960	3	350	8	168	250	22
Marshall Lake Dam	Marshall Creek	I,R	1912	1C	565	10	1292	1919	133
Metaline Falls Wastewater Lagoon No. 3	Offstream -Pend Oreille	O	1964	2	610	12	12	10	1
Mill Pond Dam (Removed)	Sullivan Creek	H, R	1923	1B	130	64	1200	1430	8000
Mountain Meadows Lake Dam	Kent Creek	R	1959	2	120	10	1000	1000	0
Pend Oreille County PUD Dam	Tr-Pend Oreille River	R	1973	3	250	18	15	18	0
Pend Oreille Mine-NE Tailings Dam	Offstream , Pend Oreille River	T	2001	2	500	72	4000	4100	0
Pend Oreille Mine-NW Tailings Dam	Offstream -Pend Oreille River	T	2002	2	800	67	4000	4100	0
Pend Oreille Mines Pond No. 1			1977	3	1600	38	10	11	0
Ponderay Newsprint Mill Setting Lagoon	Pend Oreille River-Offstream	Q	1989	3	2250	24	82	105	1

Table 9-2
Pend Oreille County Dam List and Classifications

Dam Name	River or Stream	Purpose	Year Completed	Hazard Class	Crest Length (ft)	Dam Height (ft)	Storage (acre-ft)	Max Storage (acre-ft)	Max Discharge (cfs)
Power Lake Dam	North Fork Calispell Creek	H	1922	1C	150	56	1000	1450	11300
Seattle City Light Boundary Hydroelectric Dam	Pend Oreille River	H, R	1967	1A	740	340	95000	122000	360000
Sullivan Lake Dam	Sullivan and Harvey Creeks	H, R	1931	1A	210	32	29700	47000	4000
Tacoma Sportsman Pond	Tr-Tacoma Creek	R	1954	3	50	10	12	50	0
Vaagen Mitigation Control Structure	Pend Oreille River-Offstream	C	1990	3	9	18	50	120	65
Willy O Lake Dam	Tr-Pend Oreille River	R	1959	3	1155	19	28	42	0
Woltering Dam		R	1960	3	70	15	12	16	11
Woods Lake Dam	Tr-Little Spokane River	R	1930	3	225	7	35	35	0
Yergens & Anselmo Dam No.1	Tr-Pend Oreille River	R	1970	3	245	15	45	51	47
Yergens & Anselmo Dam No.2	Tr-Pend Oreille River	R	1970	3	150	15	16	24	26

High hazard dams highlighted in blue. Purpose Definition Code: C=Flood Control, F=Fish, H=Hydroelectric, I=Irrigation, O=Other, Q=Water Quality, R=Recreation, S= Water Supply, T=Tailings.

Based on review of the data, there are three (3) high hazard (1A) dams within its boundary, two of which are owned by the County itself – Box Canyon Dam and Sullivan Lake Dam, and the third owned by Seattle City Light – the Boundary Hydro Dam. The County also owns the Power Lake Dam, which is a high hazard (1C) level dam.

Boundary Dam

The Boundary Dam, owned by Seattle City Light, was most recently licensed by FERC on March 20, 2013 (see Figure 9-1). Boundary Dam is a concrete double-curvature arch dam located on the Pend Oreille River near the city of Metaline Falls. The dam rises 340 feet from its bedrock and is 740 feet long at the top. It is 32 feet thick at its base and only eight feet thick at its crest. Adjacent to the dam is the powerhouse, built completely inside of the rock that makes up the left abutment of the dam. With four turbines, the dam can supply 35 to 45 percent (depending on water conditions) of Seattle's power requirements. Boundary's output also supplies water throughout the western United State via the Bonneville Power Administration transmission lines. The reservoir behind the dam is 17.5 miles long, extending through mountain forests and the towns of Metaline Falls and Metaline to the base of the Pend Oreille PUD's Box Canyon Dam.

Figure 9-1 Seattle City Light's Boundary Dam

Box Canyon Hydroelectric Project

The Box Canyon Hydroelectric Project is owned by the people of Pend Oreille County and operated by Pend Oreille Public Utility District (see Figure 9-2). The Project is a run-of-river facility located on the Pend Oreille River near the town of Ione, Washington. The project is located downstream of the Army Corps of Engineers' Albeni Falls Hydroelectric Project and discharges directly into the reservoir of Seattle City Light's Boundary Hydroelectric Project. Construction of Box Canyon Dam was completed in 1956 with a full upgrade completed in 2015. The project has a rated capacity of 90 megawatts at a flow of 32,000 cubic feet per second (cfs). The principal project features are the dam and spillway, diversion tunnel, forebay channel, auxiliary spillway, and powerhouse. The dam is 160 feet long, and 62 feet tall to the top of the gates.

A failure of the Box Canyon Dam would not represent an immediate danger to the public safety or downstream structures.

Figure 9-2 Pend Oreille County PUD's Box Canyon Dam

Sullivan Lake Dam

Sullivan Lake Dam is a concrete gravity dam located approximately four miles east of the Town of Metaline Falls, Washington. Sullivan Lake Dam was constructed in 1909 by Portland Inland Cement Company and purchased by the Pend Oreille Public Utility District in 1956. Sullivan Lake Dam is a non- power-generating facility however, is maintained at full pool during the summer months for recreational purposes.

A failure of Sullivan Creek Dam would include the potential for loss of life and property damage to downstream campgrounds and structures. The dam is therefore classified as High Hazard by the Federal Energy Regulatory Commission.

Power Lake Dam

Power Lake Dam is located about 15 miles west of Newport. The lake is located on the North Fork of Calispell Creek, about three miles upstream of where it flows into Calispell Lake. Power Lake Dam was constructed around 1920 by the Calispell Light and Power Company. In 1953, the dam was sold to Pend Oreille Public Utility District. Water from Power Lake is used to produce hydroelectric power at the PUD's Calispell Power Plant.

A failure of the dam would include the potential for loss of life and property damage to approximately five structures along Calispell Creek, with potential damage to the powerhouse, and loss of the reservoir for power generation. According to the Washington State Department of Ecology, the hazard classification for the Power Lake Dam is a High Hazard Class 1C.

Dam Inundation Maps

The owner of a dam is responsible for developing an inundation map, which is used in determining exposure to a potential dam failure or breech during development of dam response plans. Some of those maps are represented below, although not for every dam (2011 HMP). The representations are also dated maps, and should be viewed as informational only, as the landscape and development in the areas will undoubtedly have changed. In many instances, such maps are not available for public release as inundation maps are considered privileged information. Therefore, it is difficult to estimate the population living within the inundation zone beyond the information designated in the dam classification analysis. Without the ability to perform an inundation study, it is also not possible to estimate property losses from a dam failure which could ultimately affect the planning area.

Dam Failure Impact

Review of existing data illustrates that there have been no recorded dam failures in Pend Oreille County. Two bridges are in the potential inundation zone, both on State Highway 31 (WA Bridge ID Numbers WA000339 and WA000725). Metaline and Metaline Falls are the only incorporated communities which would be affected by dam failure, with impacts including loss of property, economic loss, and potential injuries. Review of existing data indicates that there are approximately 20 structures identified within the inundation zones, inclusive of some critical facilities. Exact locations and lists of those structures is protected information, and not discoverable under public disclosure due to the sensitive nature of the data.

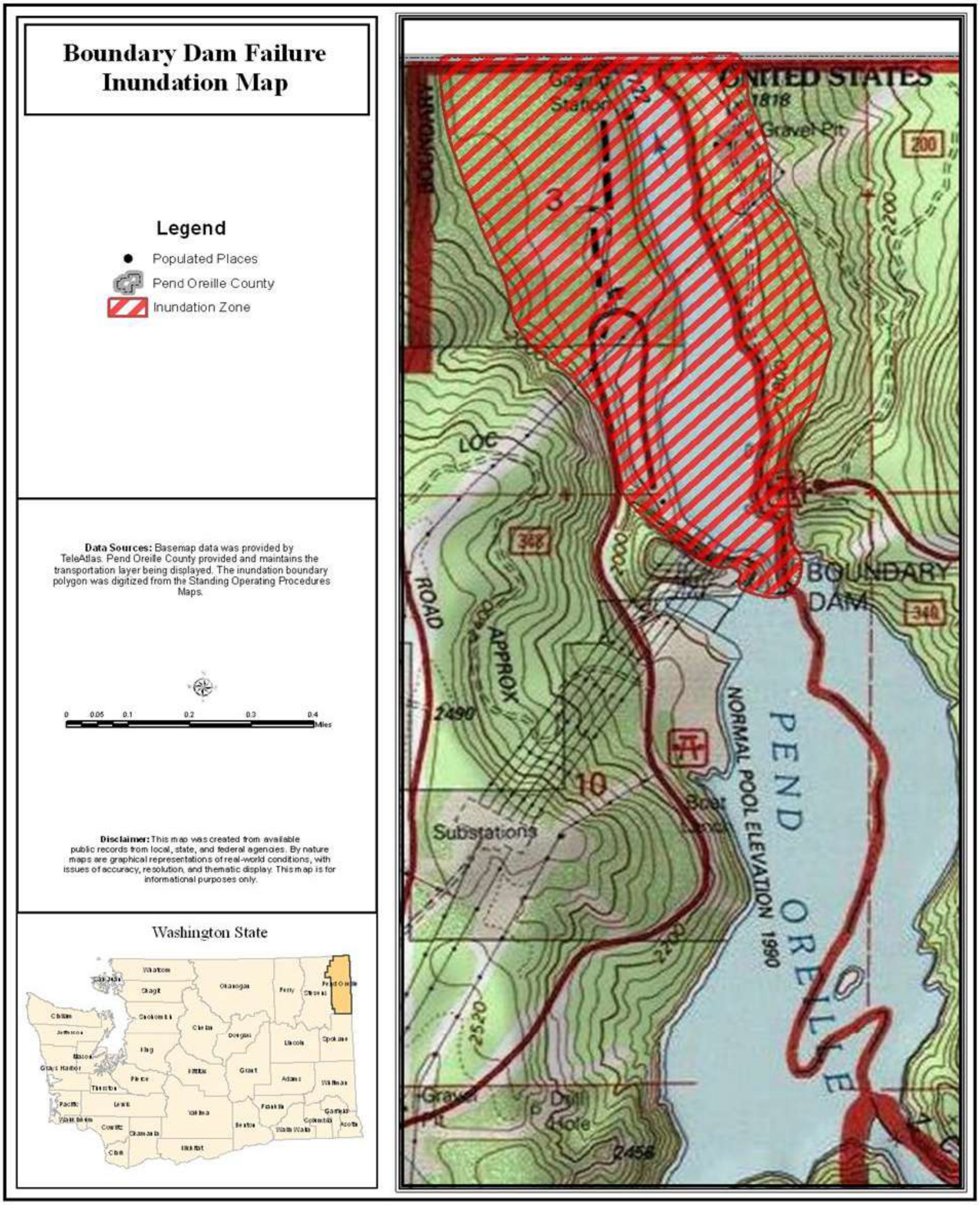


Figure 9-3 Boundary Dam Inundation Zone

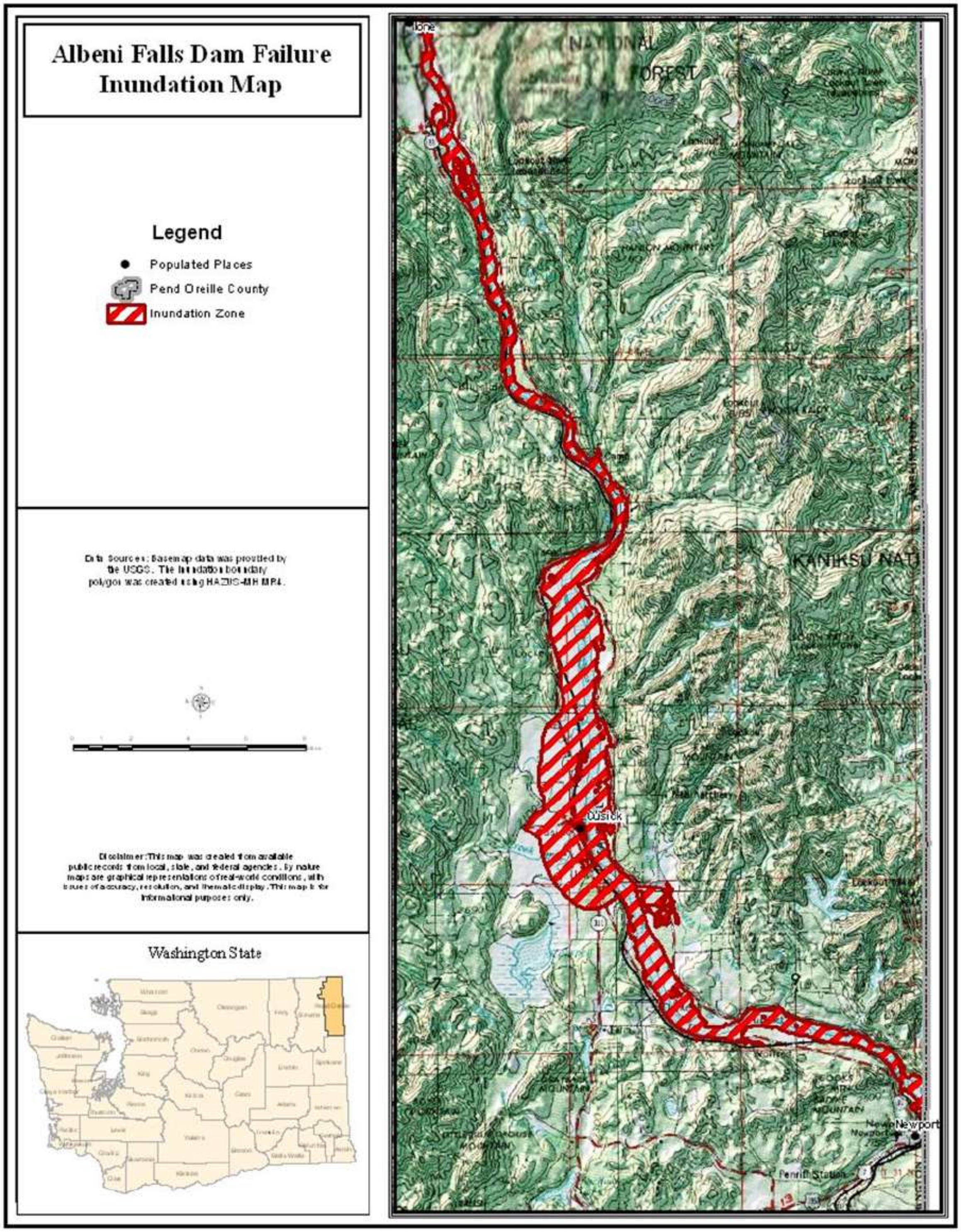


Figure 9-4 Albeni Falls Inundation Map

For those dams for which no additional dam failure inundation studies or maps are available, in some instances those inundation areas coincide with flood hazard areas. Review of the flood profile may provide a general concept of structures at risk, although, based on the size of the dams, damage would vary. As development occurs downstream of dams, it is necessary to review the dams' emergency action plans and inundation maps to determine whether the dams require reclassification based on the established standards. The County and its planning partners will continue to work to gain information for high-hazard dams.

9.1.6 Measuring Floods and Floodplains

A floodplain is the area adjacent to a river, creek or lake that becomes inundated during a flood. Floodplains may be broad, as when a river crosses an extensive flat landscape, or narrow, as when a river is confined in a canyon. Connections between a river and its floodplain are most apparent during and after major flood events. These areas form a complex physical and biological system that not only supports a variety of natural resources, but also provides natural flood and erosion control. When a river is separated from its floodplain with levees and other flood control facilities, natural, built-in benefits can be lost, altered, or significantly reduced.

In the case of riverine or flash flooding, once a river reaches flood stage, the flood extent or severity categories used by the NWS include minor flooding, moderate flooding, and major flooding. Each category has a definition based on property damage and public threat (NWS, 2011):

- Minor Flooding—Minimal or no property damage, but possibly some public threat or inconvenience.
- Moderate Flooding—Some inundation of structures and roads near streams. Some evacuations of people and/or transfer of property to higher elevations are necessary.
- Major Flooding—Extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations.

9.1.7 Flood Insurance Rate Maps

According to FEMA, flood hazard areas are defined as areas that are shown to be inundated by a flood of a given magnitude on a map (see Figure 9-5). These areas are determined using statistical analyses of records of river flow, storm tides, and rainfall; information obtained through consultation with the community; floodplain topographic surveys; and hydrologic and hydraulic analyses. Three primary areas make up the flood hazard area: the floodplains, floodways, and floodway fringes. Figure 9-6 depicts the relationship among the various designations, collectively referred to as the special flood hazard area.

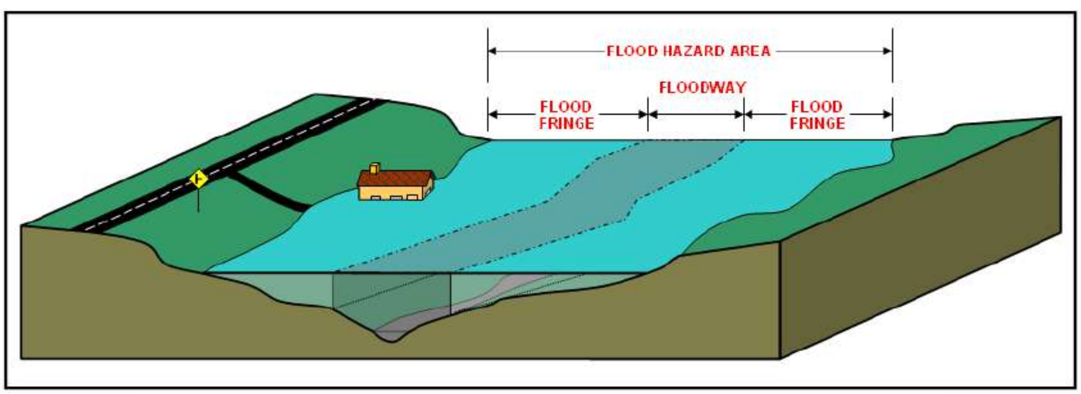


Figure 9-5 Flood Hazard Area Referred to as a Floodplain

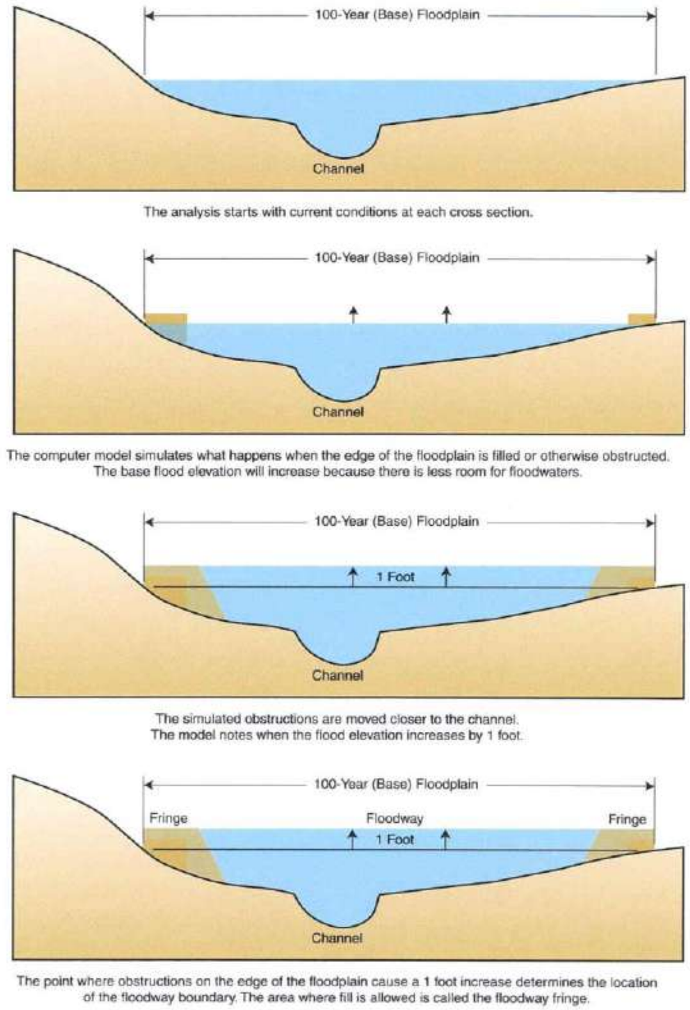


Figure 9-6 Special Flood Hazard Area

Flood hazard areas are delineated on FEMA's Flood Insurance Rate Maps (FIRM), which are official maps of a community on which the Federal Insurance and Mitigation Administration has indicated both the special flood hazard areas (SFHA) and the risk premium zones applicable to the community. These maps identify the geographic areas or zones that FEMA has defined according to varying levels of flood risk and include: special flood hazard areas; the location of a specific property in relation to the special flood hazard area; the base (100-year) flood elevation at a specific site; the magnitude of a flood hazard in a specific area; and undeveloped coastal barriers where flood insurance is not available. The maps also locate regulatory floodways and floodplain boundaries—the 100-year and 500-year floodplain boundaries (FEMA, 2003; FEMA, 2005; FEMA, 2008). Table 9-3 identifies the various rate map zones.[40]

[40] http://msc.fema.gov/webapp/wcs/stores/servlet/info?storeId=10001&catalogId=10001&langId=-1&content=floodZones&title=FEMA%20Flood%20Zone%20Designations

Table 9-3
Flood Insurance Rate Map Zones

Moderate to Low Risk Areas: Areas of moderate or minimal hazard are studied based upon the principal source of flood in the area. However, buildings in these zones could be flooded by severe, concentrated rainfall coupled with inadequate local drainage systems. Local stormwater drainage systems are not normally considered in a community's flood insurance study. The failure of a local drainage system can create areas of high flood risk within these zones. Flood insurance is available in participating communities, but is not required by regulation in these zones. Nearly 25-percent of all flood claims filed are for structures located within these zones.

Zone	Description
B and X (shaded)	Area of moderate flood hazard, usually the area between the limits of the 100-year and 500-year floodplain area with a 0.2% (or 1 in 500 chance) annual chance of flooding. B Zones are also used to designate base floodplains of lesser hazards, such as areas protected by levees from 100-year flood, or shallow flooding areas with average depths of less than one foot or drainage areas less than one (1) square mile.
C and X (unshaded)	Area of minimal flood hazard, usually depicted on FIRMs as above the 500-year flood level. Zone C may have ponding and local drainage problems that do not warrant a detailed study or designation as base floodplain. Zone X is the area determined to be outside the 500-year flood and protected by levee from 100-year flood.

High Risk Areas: Special Flood Hazard Areas represent the area subject to inundation by 1-percent-annual chance flood. Structures located within the SFHA have a 26-percent chance of flooding during the life of a standard 30-year mortgage. Federal floodplain management regulations and mandatory flood insurance purchase requirements apply to participating communities in these zones.

Zone	Description
A	Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these zones.
AE	The base floodplain where base flood elevations are provided. AE Zones are now used on new format FIRMs instead of A1-A30 Zones.
A1-30 (old map format)	These are known as numbered A Zones (e.g., A7 or A14). This is the base floodplain where the FIRM shows a BFE (old format). Older maps still utilize this numbered system, but newer FEMA products no longer use the "numbered" A Zones. (Zone AE is used on new and revised maps in place of Zones A1–A30.)
AH	Areas with a 1% annual chance of shallow flooding, usually in the form of a pond, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.
AO	River or stream flood hazard areas, and areas with a 1% or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Average flood depths derived from detailed analyses are shown within these zones.

Table 9-3 Flood Insurance Rate Map Zones	
AR	Areas with a temporarily increased flood risk due to the building or restoration of a flood control system (such as a levee or a dam). Mandatory flood insurance purchase requirements will apply, but rates will not exceed the rates for unnumbered A zones if the structure is built or restored in compliance with Zone AR floodplain management regulations.
A99	Areas with a 1% annual chance of flooding that will be protected by a Federal flood control system where construction has reached specified legal requirements. No depths or base flood elevations are shown within these zones.
High Risk - Coastal High Hazard Areas (CHHA): These represent the area subject to inundation by 1-percent-annual chance flood, extending from offshore to the inland limit of a primary front al dune along an open coast and any other area subject to high velocity wave action from storms or seismic sources. Structures located within the CHHA have a 26-percent chance of flooding during the life of a standard 30-year mortgage. Federal floodplain management regulations and mandatory purchase requirements apply in the following zones.	
Zone	**Description**
V	Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26% chance of flooding over the life of a 30-year mortgage. No base flood elevations are shown within these zones.
VE, V1-30	Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.
Undetermined Risk Areas	
Zone	**Description**
D	Areas with possible but undetermined flood hazard. No flood hazard analysis has been conducted. Flood insurance rates are commensurate with the uncertainty of the flood risk.

The frequency and severity of flooding are measured using a discharge probability, which is a statistical tool used to define the probability that a certain river discharge (flow) level will be equaled or exceeded within a given year. Flood studies use historical records to determine the probability of occurrence for the different discharge levels.

The extent of flooding associated with a 1-percent annual probability of occurrence (the base flood or 100-year flood) is used as the regulatory boundary by many agencies. Also referred to as the special flood hazard area, this boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities. Many communities have maps that show the extent and likely depth of flooding for the base flood. Corresponding water-surface elevations describe the elevation of water that will result from a given discharge level, which is one of the most important factors used in estimating flood damage.

A structure located within a 1 percent (100-year) floodplain has a 26 percent chance of suffering flood damage during the term of a 30-year mortgage. The 100-year flood is a regulatory standard used by federal agencies and most states to administer floodplain management programs. The 1 percent (100-year) annual chance flood is used by the NFIP as the basis for insurance requirements nationwide. FIRMs also depict 500-year flood designations, which is a boundary of the flood that has a 0.2-percent chance of being equaled or exceeded in any given year (FEMA, 2003; FEMA, 2005). It is important to recognize, however, that flood events and flood risk are not limited to the NFIP delineated flood hazard areas. The table below illustrates the estimated probability of flood events as utilized by the NFIP.

Table 9-4
Estimated Probability of Flood Event

EVENT	ANNUAL CHANCE OF OCCURRENCE
10-year flood	10%
25-year flood	4%
50-year flood	2%
100-year flood	1%
500-year flood	0.2%

9.1.8 National Flood Insurance Program (NFIP)

The NFIP is a federal program enabling property owners in participating communities to purchase insurance as a protection against flood losses in exchange for state and community floodplain management regulations that reduce future flood damage. The U.S. Congress established the NFIP with the passage of the National Flood Insurance Act of 1968 (FEMA's 2002 *National Flood Insurance Program (NFIP): Program Description*). There are three components to the NFIP: flood insurance, floodplain management, and flood hazard mapping. Nearly 20,000 communities across the U.S. and its territories participate in the NFIP by adopting and enforcing floodplain management ordinances to reduce future flood damage. In exchange, the NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in these communities. Community participation in the NFIP is voluntary.

For most participating communities, FEMA has prepared a detailed Flood Insurance Study. The study presents water surface elevations for floods of various magnitudes, including the 1-percent annual chance flood and the 0.2-percent annual chance flood (the 500-year flood). Base flood elevations and the boundaries of the 100- and 500-year floodplains are shown on Flood Insurance Rate Maps (FIRMs), which are the principle tool for identifying the extent and location of the flood hazard. FIRMs are the most detailed and consistent data source available, and for many communities they represent the minimum area of oversight under their floodplain management program.

NFIP Participants must regulate development in floodplain areas in accordance with NFIP criteria. Before issuing a permit to build in a floodplain, participating jurisdictions must ensure that three criteria are met:

- New buildings and those undergoing substantial improvements must, at a minimum, be elevated to protect against damage by the 100-year flood.
- New floodplain development must not aggravate existing flood problems or increase damage to other properties.

- New floodplain development must exercise a reasonable and prudent effort to reduce its adverse impacts on threatened salmonid species.

NFIP Status and Severe Loss/Repetitive Loss Properties

Pend Oreille County is a member in good standing in the NFIP and does incorporate regulatory authority within its land use planning. Table 9-5 presents the NFIP enrollment date and date of current FIRM as of May 2, 2018.

Table 9-5
NFIP Participation and FIRM Date

Community Name	Date Participating in NFIP	Date of Current FIRM (Q3 Only)
Pend Oreille County	4/17/1985	3/4/2002
Kalispel Tribe	NA	NA
Newport, City of	6/30/1976	3/4/2002
Cusick, Town of	6/19/1985	3/4/2002; some 2005
Ione, Town of	Unknown	Unknown
Metaline, Town of	4/17/1985	3/4/2002
Metaline Falls, Town of	4/17/1985	3/4/2002

Repetitive Flood Claims

Residential or non-residential (commercial) properties that have received one or more NFIP insurance payments are identified as repetitive flood properties under the NFIP. Such properties are eligible for funding to help mitigate the impacts of flooding through various FEMA programs, subject to meeting certain criteria and based on the State's Hazard Mitigation Plan maintaining a Repetitive Loss Strategy. Washington State's 2013 Hazard Mitigation Plan does contain such a strategy. Specifically, the Repetitive Loss Strategy must identify the specific actions the State has taken to reduce the number of repetitive loss properties, which must include severe repetitive loss properties, and specify how the State intends to reduce the number of such repetitive loss properties. In addition, the hazard mitigation plan must describe the State's strategy to ensure that local jurisdictions with severe repetitive loss properties take actions to reduce the number of these properties, including the development of local hazard mitigation plans.

Repetitive flood claims provide funding to reduce or eliminate the long-term risk of flood damage to structures insured under the NFIP that have had one or more claim payments for flood damages.

Severe Repetitive Loss Program

The severe repetitive loss program is authorized by Section 1361A of the National Flood Insurance Act (42 U.S.C. 4102a), with the goal of reducing flood damages to residential properties that have experienced *severe* repetitive losses under flood insurance coverage and that will result in the greatest savings to the NFIP in the shortest period of time. A severe repetitive loss property is a residential property that is covered under an NFIP flood insurance policy and:

- a) That has at least four NFIP claim payments (including building and contents) over $5,000 each, and the cumulative amount of such claims payments exceeds $20,000; or

- b) For which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.

For both (a) and (b) above, at least two of the referenced claims must have occurred within any 10-year period and must be greater than 10 days apart.

During the 2010 update, the County had two repetitive loss properties. For the 2018 update, no properties are reported by the State or FEMA as either RL or SRL properties (see table below for additional data).

The Community Rating System

The Community Rating System (CRS) is a voluntary program within the NFIP that encourages floodplain management activities that exceed the minimum NFIP requirements. Flood insurance premiums are discounted to reflect the reduced flood risk resulting from community actions.

Flood claim, repetitive loss, and severe repetitive loss property data is indicated in Table 9-6, which also identifies the CRS Community Status in the County. At present, the County nor any of its planning partners participate as a CRS community.

Six ways to Protect Your Home

1. Elevate your home above possible flood levels on a new foundation. Alternatively, consider elevating or relocating furnaces/heat pumps, water heaters, appliances, and electrical panels higher above ground, out of harm's way.
2. Cut openings in foundation walls to allow water to flow freely through underneath the home. This helps to prevent the collapse of a wall(s).
3. Build and install flood shields for doors and other openings which will help prevent floodwaters from getting into your home or structure.
4. Install back-flow valves or plugs for drains, toilets, and other connections to prevent floodwaters from entering your home.
5. Install sump pumps with backup power in basements or crawl spaces to help pump out accumulating water.
6. Keep hazardous materials like fertilizers, pesticides, paint and household cleaners inside a plastic bucket or bin, off the floor to make sure floodwaters aren't contaminated. Make sure to take unwanted materials to an appropriate hazardous waste disposal site.
7. When building, renovating, or landscaping, remember that tree-cutting, grading, back-filling, concrete and asphalt work, retaining walls, and other land use development may increase flood waters and damage. When in doubt, check with the local building officials to make sure you won't be negatively impacting your or your neighbor's flood risk.

TABLE 9-6
NATIONAL FLOOD INSURANCE DATA

Community Name	CRS Community	Total Losses	Flood Claims Closed	Total Flood Loss Payments	Repetitive Loss Properties	Severe Repetitive Loss Properties	Total Flood Policies In Force	Total Insurance Coverage In Force
Unincorporate Pend Oreille County	N	85	76	1,225,388	0	0	134	28,541,400
Kalispel Tribe	N	0	0	0	0	0	0	0
Cusick	N	3	3	70,646	0	0	6	1,123,300
Ione	N	0	0	0	0	0	0	0
Metaline	N	1	1	1,907	0	0	0	0
Metaline Falls	N	0	0	0	0	0	0	0
Newport City	N	2	2	28,451	0	0	2	435,700

Source: Repetitive Loss and Severe Repetitive Loss Data from State and FEMA (5/2018); NFIP Policies in Force (2/28/18) Data from NFIP https://bsa.nfipstat.fema.gov/reports/1011.htm#WAT
Statistics for Policies as of 2/28/18

9.2 HAZARD PROFILE

9.2.1 Extent and Location

Flooding is the most common hazard occurring in Pend Oreille County, and is mostly due to riverine flooding, with some urban flooding also occurring. Riverine flooding is seen on all main rivers and tributaries in the county, with the primary cause being the Pend Oreille River and its tributaries. The Pend Oreille River runs almost the entire length of the county, with the exception of approximately 10 miles. Urban flooding generally occurs within the boundaries of the cities. In addition, the County is also subject to flooding from mountain snowmelt from upstream sources, producing more than can be conveyed through the river channels.

Wintertime climates are customarily wet, including snowy winters which dictate the weather patterns in the County. Flood season usually begins in late October/early November when heavy rainfall occurs. Weather systems often times become stationary over the region, bringing long periods of rain- and snow-fall through February and often extending into March and April.

Snowfall and snowmelt in Idaho and Montana also contribute significantly to floods occurring in Pend Oreille County. Impact to the Town of Cusick and the Kalispel Reservation are many times as a result of a combination of snowmelt occurring in Montana due to increased temperatures in the springtime, while precipitation in the form of rain is falling within Pend Oreille County.

Some level of flooding occurs annually throughout various areas of the county, especially during springtime months when the snowmelt occurs. During long periods of rainfall, river and stream channels fill to overflowing. Sudden increased temperatures then cause snow to rapidly melt, inducing or increasing the potential for flooding. Such is the case occurring as of this 2018 update. In March 2018 the National Weather Service forecasted a warmer spring than normal, increasing the level of the snowmelt as a result of the increased snowpack occurring during the 2017-2018 winter months.

FEMA Flood Maps

Flood maps for the area are significantly dated (2002), especially in light of the significant wildfires which have occurred in the County, impacting vegetation, and increasing the risk for flooding. In addition, the County's PUD also removed one of the dams along the Sullivan River, changing the path of the river and its tributaries.

The County has identified a strategy within the plan to work with FEMA to seek updates to those maps. As a result of the dated maps, only Q3 data and an updated 2002 study were available for use in this process, limiting the scope of analysis performed. No 500-year boundary was identified within the maps. The FEMA Flood Panel is illustrated in Figure 9-7.

Pend Oreille County's adopted 100-year flood areas are illustrated in Figure 9-8 (Q3 Study) and Figure 9-9 (Updated 2002 Study). No 500-year data was provided within the FEMA maps for use in this analysis.

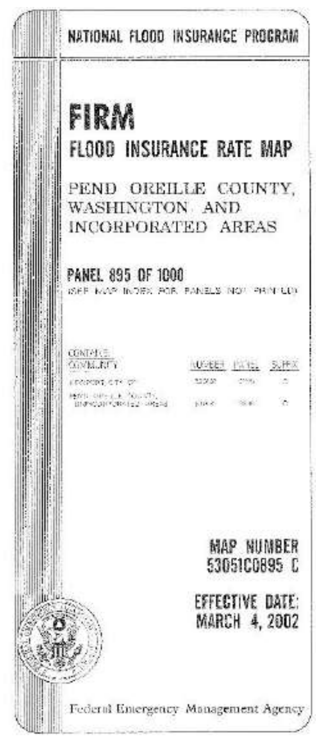


Figure 9-7 FEMA Flood Panel

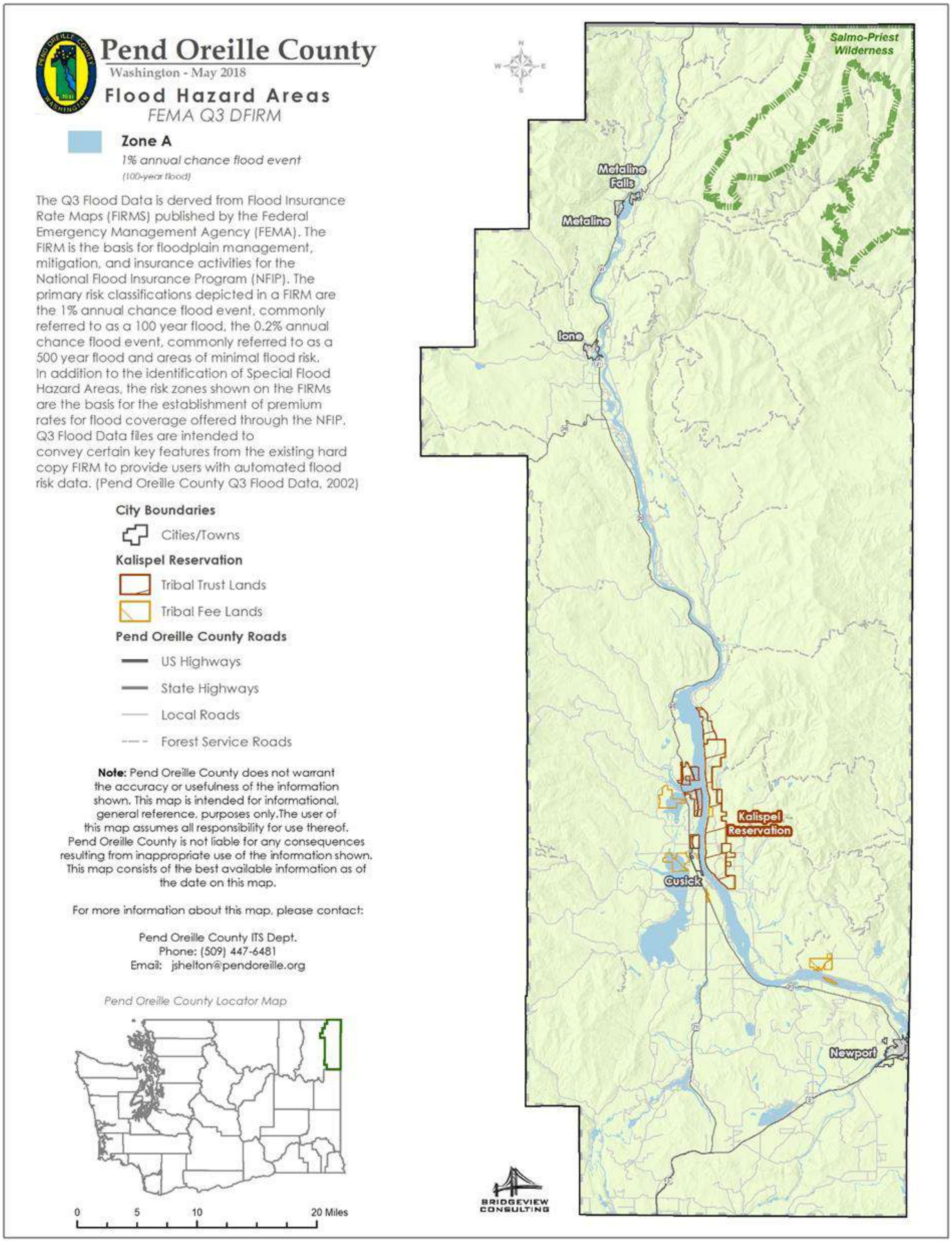


Figure 9-8 100-year Flood Hazard Areas

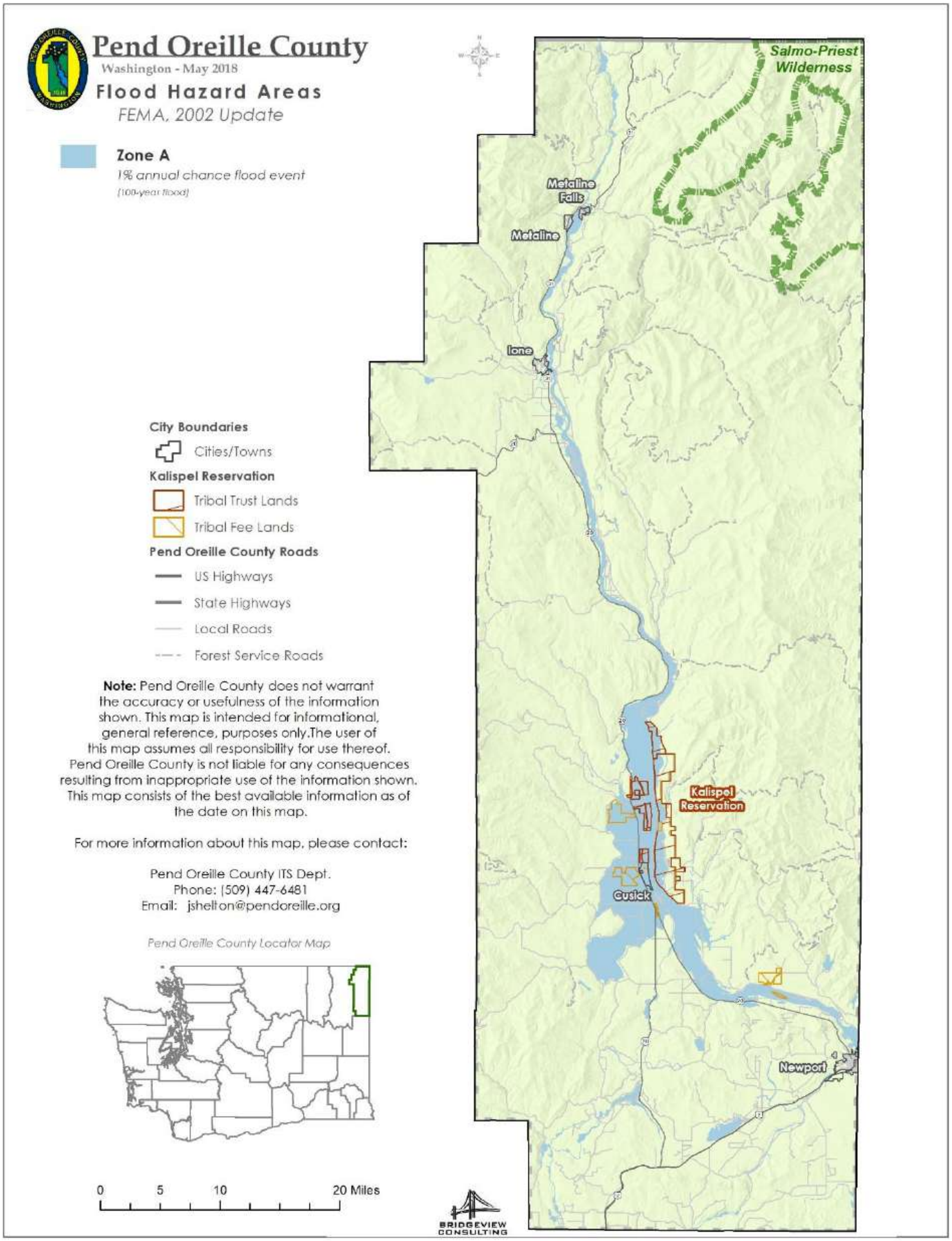


Figure 9-9 Pend Oreille County Flood Hazard Areas Defined in the FEMA 2002 Study Update

9.2.2 Principal Flooding Sources

The primary flooding source is the Pend Oreille River, which runs almost the entire length of the County. Late spring/early summer snowmelt along the river and its tributaries regularly cause flooding in the area, but the level to which that flooding occurs is dependent on the snow pack levels. In recent years, snow pack in the mountains of Montana, where the Pend Oreille River begins its journey to Washington have been much higher than normal. The majority of the flow in the Pend Oreille River is the discharge from Albeni Falls Dam. A 2002 FEMA Flood Insurance Study indicates that local inflow provides only a minor contribution due to the narrow drainage basin and moderate snowpack in the surrounding mountains between Albeni Falls and Box Canyon Dams, with mountains in the area ranging from 3,000-6,000 feet, and snowpack runoff tending to peak in early spring, customarily before the May-June flood season.

Total drainage area between Albeni Falls Dam and Box Canyon Dam is 700 square miles, with drainage area above Albeni Falls Dam being approximately 24,200 square miles, consisting of the Pend Oreille, Clark Fork, and Flathead Rivers, among others. The headwaters of the Clark Fork-Pend Oreille river basin originate along the western slopes of the Rocky Mountains, slowing into Hungry Horse Reservoir, down the Flathead River into Flathead Lake, though a series of small projects on the Clark Fork River, and eventually into Pend Oreille Lake. Pend Oreille Lake flows into the Pend Oreille River, entering the forebay of the Albeni Falls Dam.

Overbank flooding is possible on the west bank floodplains extending from Calispell Lake and continuing to Jared. Attributed to high river flows and backwater effects of the Pend Oreille River into Calispell Flats, flooding also occurs on the floodplains of the Kalispel Indian Reservation and near Skookum Creek on the east bank.

Certain low-lying areas around the rivers and lakes are prone to flooding. Some of the areas along the Pend Oreille River experience pool fluctuations of up to 4 feet (downstream in the northern part of the County), while others experience river fluctuations up to 12 feet (upstream in the southern part of the County).

With several dams established on the river, the water level in the various reservoirs change quickly relative to river flows and location. The mean annual fluctuations in water surface within the reservoirs vary from 3 feet at Ione to 10 feet near Newport. During dry and wet years, the fluctuations can change dramatically, with dry years experiencing up to 5 feet of fluctuation and wet years experiencing up to 14 feet of fluctuation (Mainstream 2007).

9.2.3 Previous Occurrences

Major floods in the planning area have resulted from intense rainstorms customarily between October and April, and snowmelt resulting in increased runoff beginning as early as March annually. Table 9-7 highlights historical declared flood events. It should be noted that due to the disaster *typing* which occurs at the FEMA level, there are other types of events which also include flooding, but due to the naming convention, are listed other than Flood. Those are identified below with gray shading. Specific examples of this include Severe Weather events which include flooding as a hazard of impact. Viewers should also review the Severe Weather hazard profile for additional information.

TABLE 9-7
FLOOD EVENTS IMPACTING PLANNING AREA 1964-2016

Disaster Number	Declaration Date	Disaster Type	Incident Type	Title	Incident Begin Date	Incident End Date	PA Dollars Obligated or Losses (State)
4309	4/21/2017	DR	Flood	Severe Winter Storm, Flooding, Landslides, Mudslides	1/30/2017	2/22/2017	PA Only Dollars obligated >$21M
Severe winter storms, flooding, landslides and mudslides occurred during the period of January 30-Feruary 22, 2017. Gov. Inslee requested a declaration for PA for 15 counties statewide.[41]							
4249	November 2015	DR	Severe Storm	Severe storm, straight-line winds, flooding, landslides and mudslides	11/12/15	11/21/2015	PA only; Dollars obligated >$22M
Severe storm, including straight-line winds, flooding, landslides and mudslides.							
1641	5/17/2006	DR	Severe Storm	Severe Storms, Flooding, Tidal Surge, Landslides, Mudslides	1/27/2006	2/2/2006	
January 2006 brought severe storms with record-breaking precipitation to Pend Oreille County. Heavy rains continued throughout the state for 44 days in a 45-day period causing flooding of the rivers in the area. Rivers and retention ponds spilled over and flooded streets, farmland, houses, and other structures. High water and landslides forced many roads and state highways to close. Power outages were reported.							
1182	7/21/1997	DR	Flood	Flooding, Snowmelt	4/10/1997	6/30/1997	IA In Pend Oreille Only
A presidential disaster declaration was declared for flooding occurring along the Pend Oreille River resulting from snowmelt. It is estimated that there was nearly $5 million in damages.							
1172	4/2/1997	DR	Flood	Heavy Rains, Snow Melt, Flooding, Land Slides	3/18/1997	3/28/1997	Stafford Act provided $6.5 million statewide
Low-elevation mountain snowmelt accompanied by a week of torrential rain in late March 1997 created flooding and landslides in multiple places in Washington State, causing road closers over the five-day period of heavy rains.							
1159	12/1996 – 1/1997	DR	Severe Storm	Severe Storms and Flooding	10/15/2003	10/23/2003	Stafford Act $83M; SBA $31.7M; total losses $140M
24 deaths occurred throughout the state. Saturated ground combined with snow, freezing rain, rain, rapid warming and high winds within a five-day period produced flooding and landslides. 37 counties were impacted, with large power outages throughout the impacted counties.							
414	1/25/1974	DR	Flood	Severe Storms, Snowmelt & Flooding	1/25/1974	1/25/1974	$5.1 M combined all 10 affected counties
Unseasonably warm temperatures (+/- 65 degrees), along with monsoon-like rains caused extensive flooding within three states: Washington, Oregon and Idaho. Impacts included roadway closures from flooding and landslides in the area.							

[41] KHQ Television http://www.khq.com/story/14922427/homes-flooding-on-pend-oreille-river

Below are additional historic events in the area:

- In 1948, flooding caused damages of more than $2 million when the Calispel Valley was submerged under six to eight feet of water. The town of Cusick was almost completely flooded. This is considered one of the most devastating floods to have impacted the county in its history (see Figure 9-10).
- In mid-June 1972, flooding occurred along the Pend Oreille River. It was stated that several summer cabins had reported flooding.[42]
- In April 1997, a presidential disaster declaration was declared for flooding occurring along the Pend Oreille River and also Diamond Lake (see Figure 9-11).[43]
- In June 1997, a presidential disaster declaration was declared for flooding occurring along the Pend Oreille River. It is estimated that there was nearly $5 million in damages.[44]

PEND OREILLE DAMAGE HEAVY

Flood Havoc Total Is Placed at $2,583,000

COLVILLE, Wash., June 26.—Flood damage in Pend Oreille county was set at $2,583,000 this week in a report prepared here by the Colville office of the United States conservation service.

Dean Jones, district conservator, who prepared the damage summary in conjunction with E. E. Hupp, Pen Oreille county extension agent, said that the figure included crop losses, damage to farm and city property, and damage to utilities in the district.

The survey showed that an estimated 27,400 acres of land bordering the Pend Oreille river was swamped out in the flood destroying and preventing the cultivation of crops valued at near $950,000, Jones said.

$812,000 Building Damage

Damage to farm buildings, fences, dikes and other property was set at $812,000 while water damage to city structures, schools, roads and other untilities was estimated at $822,000.

Over 1000 miles of fence, valued at $400,000, was destroyed in the high water. Twenty-nine farm homes and 120 city homes in Cusick and Usk suffered near ruin in the flood.

Highest Since 1894

Dike damage in the area is expected to reach $280,000 while the damage to the Diamond Match company mill at Cusick will top a $300,000 figure, according to the survey.

Jones said that the water in the river reached its highest crest since the major floods of 1894. The crest then soared to 33.9 feet above normal while this year the crest rose to 28.9 feet above average.

Figure 9-10 Spokesman Review, Sunday, June 27, 1948

Flash Floods

In addition, the County has also experienced four flash flood events based on data from the National Climatic Data Center as identified in the table below.

Table 9-8
Flash Flood Events 1998-2016

Jurisdiction	Date	Damages	Injuries or Deaths
Cusick	5/26/98	$250,000	None reported
Diamond Lake	9/27/11	$0.0	None reported
Wolfred	9/27/11	$5,000.00	None reported
Newport	6/1/15	$0.0	None reported

[42] Spokesman Review. June 12, 1972.
[43] 1172-DR-WA
[44] Pend Oreille County Hazard Identification and Vulnerability Analysis, E-1, Flooding

Figure 9-11 April 1997 Flood-Related Highway Damage

Figure 9-12 April 2018 Flood-Related Highway Closure North of Cusick

Figure 9-13 April 2018 Flooding along Pend Oreille River

9.2.4 Severity

The severity of a flood depends not only on the amount of water that accumulates in a period of time within the rivers and streams, but also on the land's ability to manage this water – the land's absorbency. When it rains, soil acts as a sponge. When the land is saturated or frozen, infiltration into the ground slows and any more water that accumulates must flow as runoff (Harris, 2001).

The principal factors affecting flood damage are flood depth and velocity. The deeper and faster flood flows become, the more damage they can cause. Shallow flooding with high velocities can cause as much damage as deep flooding with slow velocity. This is especially true when a channel migrates over a broad floodplain, redirecting high velocity flows and transporting debris and sediment. Flood severity is often evaluated by examining peak discharges. USGS provides gage data for use in determining flood stages on many of the rivers within Pend Oreille County, as illustrated in Figures 9-14 through Figure 9-16.

There is limited information concerning flooding in the 1800's; however, review of data indicates that it was not until the 1900's that floods become an issue within the County (2011 HMP). Early flood management were local efforts such as the construction of dike and levee systems. As problems increased, the United State Army Corps of Engineers (USACE) began to play an important role in supporting the county with flood management activities. In the 1930's, the USACE assisted the county with flood control to help maintain shipping channels for navigation purposes.

- The largest recorded peak flow within the period of record of the Newport gage (June 1902-September 1941, October 1952 to present) was 136,000 cfs on June 12, 1972, with a second largest peak flow of 133,000 cfs two years later on June 23, 24, and 24, 1974. Both of these floods had recurrence intervals between 15 to 20 years (FEMA, 2002).
- The largest recorded flood before Albeni Falls Dam was established occurred on June 13, 1948, when peak flow measured at 171,300 cfs at the Z Canyon gage near Metaline Falls.
- The largest estimated peak flow on the Pend Oreille River was 200,000 cfs, occurring June 1894.

As climate change predicted, the number of flood and storm events has increased, as has the higher-than-average amount of snowfall which has occurred. Snowfall and preciptation events occurring as far away as Montana impact the Pend Oreille River, thereby increasing the likelihood of an incident occurring.

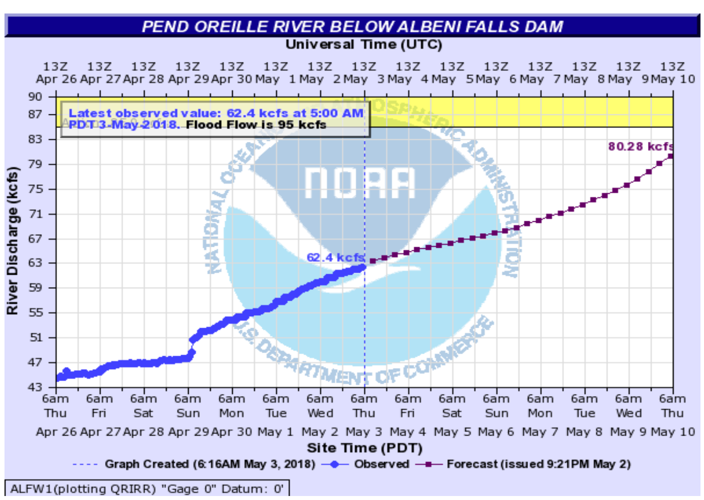


Figure 9-14 USGS Gage-Pend Oreille River Below Albeni Falls

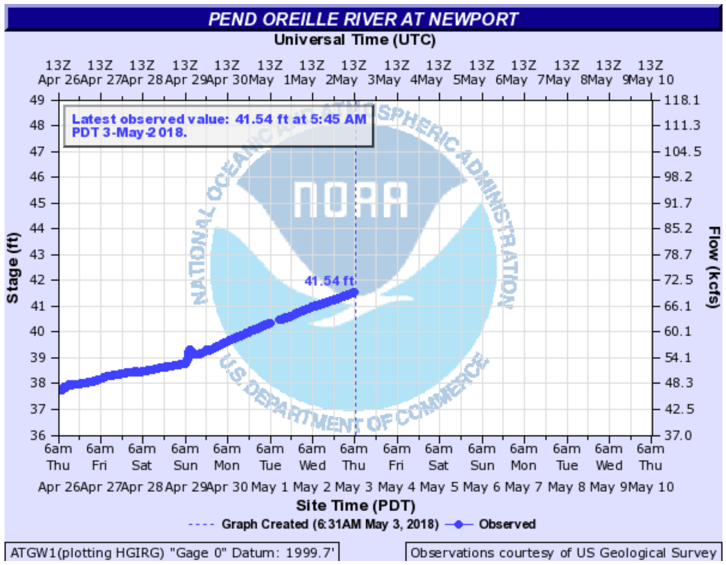


Figure 9-15 USGS River Gage at Newport

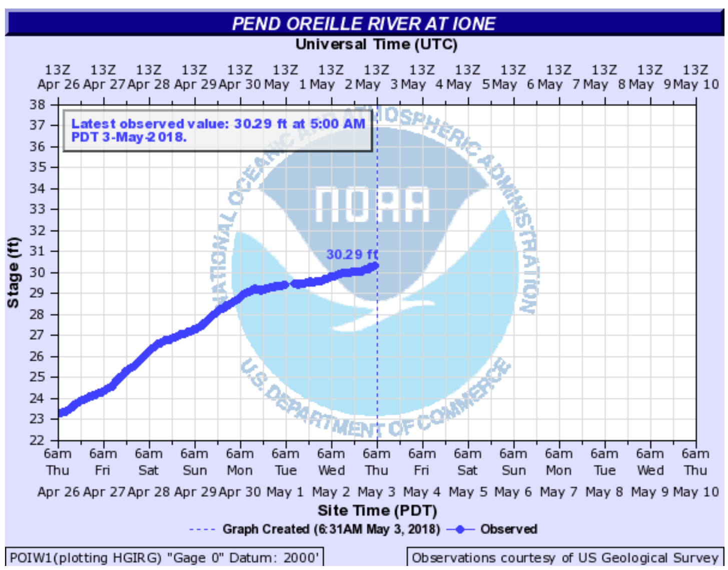


Figure 9-16 USGS River Gage at Ione

9.2.5 Frequency

Floods are commonly described as having a 10-, 50-, 100-, and 500-year recurrence interval, meaning that floods of these magnitudes have (respectively) a 10-, 2-, 1-, or 0.2-percent chance of occurring in any given year. These measurements reflect statistical averages only; it is possible for two or more rare floods (with a 100-year or higher recurrence interval) to occur within a short time period. Assigning recurrence intervals to historical floods on different rivers can help indicate the intensity of a storm over a large area.

Pend Oreille County experiences some level of flooding on an annual basis. While "normal" flood season customarily occurs from October through April, Pend Oreille County has received flood warnings issued by the National Weather Service during every month, especially during months with high snowpack and rapid increases in temperature.

Large floods that can cause property damage have occurred four (4) times during the time period 1964 through 2017. When combining "Severe Weather" incidents which include flooding, that increases the number to seven (7). In determining frequency for flooding, the period covering 1964 to 2018 and the number of events was utilized to establish the return interval for a flood event (inclusive of FEMA's severe storm designation). Utilizing this method, the average between flood events is 7.71 years, or a 13 percent chance of some level of a flood event occurring every year. Such calculations do not reflect the scientific recurrence interval, as that calculation is specific on varying factors, such as the incident type, discharge rate, etc. Urban portions of the county annually experience nuisance flooding related to drainage issues.

9.3 VULNERABILITY ASSESSMENT

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. Customarily for planning purpose, the flood hazard areas identified include the 1-percent (100-year) and 0.2 % (500-year) floodplains. These events are generally those considered by planners and evaluated under federal programs such as the NFIP; however, no 500-year floodplain is identified within the FEMA flood studies. Therefore, only a 100-year event is assessed. The following text evaluates and estimates the potential impact of flooding in Pend Oreille County.

9.3.1 Overview

All types of flooding can cause widespread damage throughout rural and urban areas, including but not limited to: water-related damage to the interior and exterior of buildings; destruction of electrical and other expensive and difficult-to-replace equipment; injury and loss of life; proliferation of disease vectors; disruption of utilities, including water, sewer, electricity, communications networks and facilities; loss of agricultural crops and livestock; placement of stress on emergency response and healthcare facilities and personnel; loss of productivity; and displacement of persons from homes and places of employment.

Methodology

As indicated, the County's effective FIRMs were adopted in 2002. In completing the analysis, only an exposure analysis was conducted for a 100-year level flood, as no other NFIP map data was available. The project team completed the flood risk assessment using local parcel and assessors' data from Pend Oreille County to identify potential dollar losses, incorporating individual building data, which allows losses to be reported at the building level. During this HMP update, the HMP planning team also developed a new list of critical facilities, which also identified potential exposure to those structures.

In order to estimate the population exposed to the 1 percent annual chance (100-year) flood events, the adopted DFIRM floodplain boundaries were intersected with residential parcels (based off of Pend Oreille County Assessor data) whose centers intersect the floodplain. Total population was estimated by multiplying the number of single-family residential structures by the average Pend Oreille County household size of 2 persons per household (based on Census data); for the Kalispel Tribe, 3 persons per household were utilized based on their Census data).

Warning Time

Due to the sequential pattern of meteorological conditions needed to cause serious flooding, it is unusual for a flood to occur without some warning. Warning times for floods can be between 24 and 48 hours. Flash flooding can be less predictable, but potential hazard areas can be warned in advanced of potential flash flooding danger. Dam inundation due to dam failure can occur within mere minutes of a dam breach or failure.

Each watershed has unique qualities that affect its response to rainfall. A hydrograph, which is a graph or chart illustrating stream flow in relation to time (see Figure 9-14, Figure 9-15, and Figure 9-16), is a useful tool for examining a stream's response to rainfall. Once rainfall starts falling over a watershed, runoff begins and the stream begins to rise. Water depth in the stream channel (stage of flow) will continue to rise in response to runoff even after rainfall ends. Eventually, the runoff will reach a peak and the stage of flow will crest. It is at this point that the stream stage will remain the most stable, exhibiting little change over time until it begins to fall and eventually subside to a level below flooding stage.

The potential warning time a community has to respond to a flooding threat is a function of the time between the first measurable rainfall and the first occurrence of flooding. The time it takes to recognize a flooding threat reduces the potential warning time to the time that a community has to take actions to protect lives and property. Another element that characterizes a community's flood threat is the length of time floodwaters remain above flood stage. The Pend Oreille County flood threat system consists of a network of precipitation gauges throughout the watershed and stream gauges at strategic locations in the county that constantly monitor and report stream levels. This information is fed into a U.S. Geological Survey forecasting program, which assesses the flood threat based on the amount of flow in the stream (measured in cubic feet per second). In addition to this program, data and flood warning information is provided by the National Weather Service (NWS). All of this information is analyzed to evaluate the flood threat and possible evacuation needs.

The NWS issues watches and warnings when forecasts indicate rivers may approach bank-full levels. When a watch is issued, the public should prepare for the possibility of a flood. When a warning is issued, the public is advised to stay tuned to a local radio station for further information and be prepared to take quick action if needed. A warning means a flood is imminent, generally within 12 hours, or is occurring. Local media broadcast NWS warnings. The County utilizes its webpage and various social media to distribute this data to its citizens.

9.3.2 Impact on Life, Health, and Safety

The impact of flooding on life, health, and safety is dependent upon several factors, including the severity of the event and whether or not adequate warning time is provided to residents. Exposure represents the population living in or near floodplain areas that could be impacted should a flood event occur. Additionally, exposure should not be limited to only those who reside in a defined hazard zone, but everyone who may be affected by the effects of a hazard event (e.g., people are at risk while traveling in flooded areas, or their access to emergency services is compromised during an event). The degree of that impact will vary and is not measurable. However, of significant concern within the planning area is the number of tourists who can be impacted during periods of flooding. Tourism is a very large economic base within the planning area during summertime months and during winter ski season, with water sports, large recreational camping locations, and hiking trails, with many tourists traveling through the area, especially during summer months.

There are both residential and business structures in the path of potential waterflow with respect to the various dams throughout the County. Therefore, consideration should also be given to employees working in those potential inundation areas who would also be at potential risk.

Table 8-7 lists the estimated population located within the 100-year flood zone by municipality based on both the original 2002 100-year flood study, and the 2002 Updated 100-year flood study. It should be noted that the planning area also has structures which have a multi-family designation. However, due to the undetermined level of occupancy, calculations for those structures are not included to the full potential population impact totals as the variables are too great to determine (by day, season, number of units rented, number of individuals housed in the institutional dormitories per day, etc.).

Of the population exposed, the most vulnerable include the economically disadvantaged and the population over the age of 65. Economically disadvantaged populations are more vulnerable because they are likely to evaluate their risk and make decisions to evacuate based on the net economic impact on their family. The population over the age of 65 is also more vulnerable because they are more likely to seek or need medical attention which may not be available due to isolation during a flood event and they may have more difficulty evacuating.

The number of injuries and casualties resulting from flooding is generally limited based on advance weather forecasting, blockades, and warnings. Therefore, injuries and deaths generally are not anticipated if proper warning and precautions are in place. Ongoing mitigation efforts should help to avoid the most likely cause of injury, which results from persons trying to cross flooded roadways or channels during a flood.

Table 9-9
Populations Exposed within 100- Year Flood Hazard Areas

Jurisdiction	Number of Residential Structures 100-Year Q3 Data	Population Exposed*	Number of Residential Structures in 100-Year 2002 Updated Study	Population Exposed*
Unincorporated Pend Oreille County	610	1,220	1,410	2,820
Kalispel Tribe	4	12	9	27
Cusick, Town of	0	0	172	344
Ione, Town of	11	22	5	10
Metaline, Town of	0	0	0	0
Metaline Falls, Town of	0	0	0	0
Newport, City of	14	28	0	0
Total	639	1,282	1,596	3,201

**Residential structures include both single and multi-family structures. Average single-family residence within County is 2 persons per single residential household. For the Kalispel Reservation, there are 3 persons per household.*

9.3.3 Impact on Property

Figure 9-17 summarizes the total number of structures and losses based on the existing 2002 Q3 GIS dataset. This table identifies those structures within Special Flood Hazard Areas (SFHAs). The SFHAs are the areas that would be inundated by the 1-percent-annual-chance flood. Table 9-11 summarizes the building exposure to the Updated 2002 Flood Study. No 500-year flood data was presented in the Q3 or 2002 Updated analysis completed by FEMA.

Jurisdiction	Estimated 2017 Population (1)	Estimated Building Count (2)	Total Building Value (Structure and contents in $) (2)	FEMA Q3 100-Year Flood Hazard (3)				
				Building Exposure				
				Buildings Exposed (2)	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Total Value (Structure and contents in $)	% of Total Value
Cusick	205	115	$8,135,247	0	$0	$0	$0	0.00%
Ione	445	265	$25,582,201	5	$335,573	$167,786	$503,359	1.97%
Metaline	170	104	$11,460,141	0	$0	$0	$0	0.00%
Metaline Falls	240	135	$17,305,898	0	$0	$0	$0	0.00%
Newport	2,170	839	$181,801,463	14	$2,108,962	$1,054,480	$3,163,442	1.74%
Kalispel Tribe	275	102	$98,614,681	0	$0	$0	$0	0.00%
Unincorporated County	10,140	6,897	$1,086,351,621	636	$57,919,575	$30,377,125	$88,296,700	8.13%
Pend Oreille County	13,645	8,457	$1,429,251,252	655	$60,364,110	$31,599,391	$91,963,501	6.43%

Figure 9-17 Potential Structure Risk for 100-Year Event Based on Q3 Flood Study (2002 original)

Sources: (1) 2017 State of Washington, Office of Financial Management Estimated Populations; (2) Exposure numbers were estimated using Pend Oreille County Parcel and Assessor data; (3) FEMA Flood analysis based on Q3 GIS dataset.

Jurisdiction	Estimated 2017 Population (1)	Estimated Building Count (2)	Total Building Value (Structure and contents in $) (2)	2002 Update 100-Year Flood Hazard (3)				
				Building Exposure				
				Buildings Exposed (2)	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Total Value (Structure and contents in $) Exposed(2)	% of Total Value
Cusick	205	115	$8,135,247	115	$5,177,785	$2,957,462	$8,135,247	100.00%
Ione	445	265	$25,582,201	2	$145,471	$72,735	$218,206	0.85%
Metaline	170	104	$11,460,141	0	$0	$0	$0	0.00%
Metaline Falls	240	135	$17,305,898	0	$0	$0	$0	0.00%
Newport	2,170	839	$181,801,463	0	$0	$0	$0	0.00%
Kalispel Tribe	275	102	$98,614,681	20	$41,658,010	$30,552,089	$72,210,099	73.22%
Unincorporated County	10,140	6,897	$1,086,351,621	1541	$127,232,025	$67,152,789	$194,384,814	17.89%
Pend Oreille County	13,645	8,457	$1,429,251,252	1678	$174,213,291	$100,735,075	$274,948,366	19.24%

Figure 9-18 Potential Structure Risk for 100-Year Event Based on Updated Flood Study (2002)

Sources:
(1) 2017 State of Washington, Office of Financial Management Estimated Populations; (2) Exposure numbers were estimated using Pend Oreille County Parcel and Assessor data; (3) 2002 Pend Oreille County Flood Hazard Update.

9.3.4 Impact on Critical Facilities and Infrastructure

In addition to considering general building stock at risk, the risk of flood to critical facilities and utilities was evaluated. ArcGIS was used to estimate critical facilities exposed to the 100-year flood risk. This process was conducted utilizing the critical facilities database and the Q3 data. Table 9-10 and Table 9-11 list critical facilities and infrastructure exposed in the FEMA 100-year flood hazard area (2002 Updated Adopted FIRM). Figure 9-19 illustrates the location of the critical facilities impacted by the adopted FIRMS.

It should be noted that all facilities identified are listed based on geographic location, not on ownership. Therefore, as an example, the town of Cusick lists eight (8) critical facilities within its boundary; not all may be "owned" by Cusick.

In cases where short-term functionality is impacted by a hazard, other facilities of neighboring municipalities may need to increase support response functions during a disaster event. Mitigation planning should consider means to reduce impact on critical facilities and ensure sufficient emergency and school services remain when a significant event occurs.

Table 9-10
Critical Facilities in the (Effective) 100-year Floodplain (2002 Updated Study)

Jurisdiction	Medical and Health Services	Government Function	Protective	Hazardous Materials	School	Other	Total
Unincorporated County	0	1	1	1	0	29	**32**
Kalispel Reservation	1	3	0	0	2	1	**7**
Cusick, Town of	0	1	1	0	5	1	**8**
Ione, Town of	0	0	0	0	0	0	**0**
Newport, City of	0	0	0	0	0	0	**0**
Metaline, Town of	0	0	0	0	0	0	**0**
Metaline Falls, Town of	0	0	0	0	0	0	**0**

Note: For the municipal jurisdictions, numbers identified are not determined by ownership, as other entities may own structures in other geographic boundaries (e.g., the school district may fall within a city boundary).

Table 9-11
Critical Infrastructure in (Effective) 100-Year Floodplain (2002 Updated Study)

Jurisdiction	Water Supply	Waste-water	Power	Communication	Transportation	Other	Total
Unincorporated County	4	1	3	0	16	0	**24**
Kalispel Reservation	4	1	0	1	1	0	**7**
Cusick, Town of	0	0	0	0	1	0	**1**
Ione, Town of	0	0	0	0	0	0	**0**
Newport, City of	0	0	0	0	0	0	**0**
Metaline, Town of	0	0	0	0	0	0	**0**
Metaline Falls, Town of	0	0	0	0	0	0	**0**

Note: For the municipal jurisdictions, numbers identified are not determined by ownership, as other entities may own structures in other geographic boundaries (e.g., the school district falls within a city boundary).

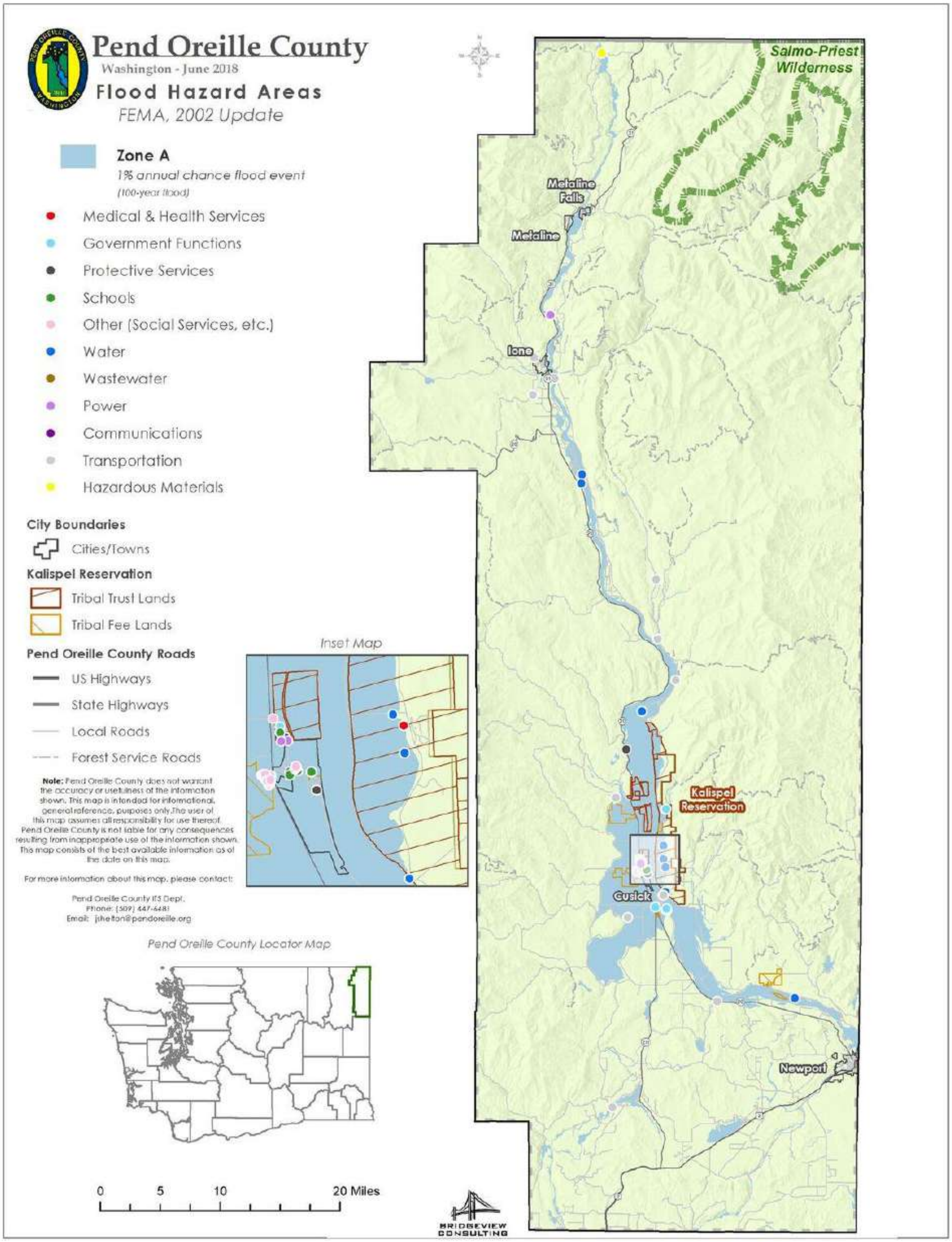


Figure 9-19 Critical Facilities Impacted in the 100-year Flood Hazard Areas

9.3.5 Impact on Economy

Impact on the economy related to a flood event in Pend Oreille County would include loss of property and associated tax revenue, as well as potential loss of businesses, including tourism. Depending on the duration between onset of the event and recovery, businesses within the area may not be able to sustain the economic loss of their business being disrupted for an extended period of time. Historical data has demonstrated that those businesses impacted by a disaster are less likely to reopen after an event. Flooding has impacts on agricultural and forestland. Agricultural land throughout the County are subject to flooding. This includes livestock and pasture lands which carry livestock. Likewise, inundation frequently affects croplands, something on which the County relies as a source of income (see Drought profile for more detail on potential impact from crop loss). Forestland is also vulnerable to floods due to erosion when river and stream banks fail and overflow. Excessive historic logging within watersheds likely affected natural runoff patterns. All of these issues have the potential to impact the economy of the County and its planning partners.

9.3.6 Impact on Environment

Flooding is a natural event, and floodplains provide many natural and beneficial functions. Nonetheless, with human development factored in, flooding can impact the environment in negative ways.

Because they border water bodies, floodplains have historically been popular sites to establish settlements. Human activities tend to concentrate in floodplains for a number of reasons: water is readily available; land is fertile and suitable for farming; transportation by water is easily accessible; and land is flatter and easier to develop. But human activity in floodplains frequently interferes with the natural function of floodplains. It can affect the distribution and timing of drainage, thereby increasing flood problems. Human development can create local flooding problems by altering or confining drainage channels. This increases flood potential in two ways: it reduces the stream’s capacity to contain flows, and it increases flow rates or velocities downstream during all stages of a flood event. Pollution from roads, such as oil, and hazardous materials can wash into rivers and streams. During floods, these can settle onto normally dry soils, polluting them for agricultural uses. Human development such as bridge abutments and levees, and logjams from timber harvesting can increase stream bank erosion, causing rivers and streams to migrate into non-natural courses.

Floodplains can support ecosystems that are rich in quantity and diversity of plant and animal species. This is especially true in Pend Oreille County, where several species of fish, wildlife, and plants exist that are protected. A floodplain can contain 100 or even 1000 times as many species as a river. Wetting of the floodplain soil releases an immediate surge of nutrients: those left over from the last flood, and those that result from the rapid decomposition of organic matter that has accumulated since then. Microscopic organisms thrive, and larger species enter a rapid breeding cycle. Opportunistic feeders (particularly birds) move in to take advantage. The production of nutrients peaks and falls away quickly; however, the surge of new growth endures for some time. This makes floodplains particularly valuable for agriculture. Species growing in floodplains are markedly different from those that grow outside floodplains. For instance, riparian trees (trees that grow in floodplains) tend to be very tolerant of root disturbance and very quick-growing compared to non-riparian trees.

9.4 FUTURE DEVELOPMENT TRENDS

Pend Oreille County and its planning partners are subject to the provisions of the Washington State Growth Management Act (GMA), which regulates identified critical areas. The County Critical Areas Protection Ordinance, which was updated in 2016, includes regulatory authority concerning frequently flooded areas, which are defined as the FEMA 100-year mapped floodplain. The GMA establishes review and evaluation programs that monitor commercial, residential, and industrial development and the densities at which this development has occurred under each jurisdiction's GMA comprehensive plan and development regulations. An evaluation is required at least every five years of the sufficiency of remaining land within urban growth areas to accommodate projected residential, commercial, and industrial growth at development densities observed since the adoption of GMA plans. This buildable lands report compares planned versus actual urban densities in order to determine whether original plan assumptions were accurate. These plans exclude areas designated as "critical areas" from consideration as buildable lands due to the scope of regulations affecting them. Some floodplains in the planning area can be developed but are subject to regulatory provisions in the codes of Pend Oreille County and its partner city and towns. The buildable lands analysis assumes that these regulations will discourage development from these areas. Section 3 of this plan discusses the County's land use designations, including identification of critical areas.

The floodplain portions of the planning area are regulated under the GMA and the NFIP. Development will occur in the floodplain; however, it will be regulated such that the degree of risk will be reduced through building standards and performance measures. As NFIP map updates have occurred, those updates will be utilized to further expand, modify, and enhance planning efforts occurring within the County.

The County also has a separate Floodplain Management regulations which addresses floodplain management regulations, designed to control the use, alteration, modification, and construction of and on lands subject to flooding.

9.5 ISSUES

A large portion of the planning area has the potential to flood, generally in response to a succession of winter rainstorms and heavy snowfall, followed by increased temperatures, causing the snowpack to melt. Storm patterns of warm, moist air are normal events, usually occurring between October and April can cause severe flooding in the planning area, although flooding can occur at any time.

Development has affected these natural features over time as the County developed from a wilderness to the present day. Along with development came land alternations that have been a factor in increasing the magnitude and frequency of floods in the County. Encroachment on floodplains by structures and fill material reduces carrying capacity and increases flood heights and velocities. Dams alter the hydrology of a watershed and stormwater runoff from impervious surfaces contributes to the volume and velocity of floodwater.

A worst-case scenario for a flood event within the County would be a series of storms that result in high accumulations of runoff surface water within a relatively short time period, especially when occurring simultaneous with a high-snowfall event. These types of events have occurred in Pend Oreille County, and have overwhelmed response capabilities within the County.

The results of such an event could again block major roads as has previously occurred, preventing critical access for residents and critical functions in portions of the planning region. High in-channel flows would cause watercourses to scour, possibly washing out roads or impacting bridges, creating more isolation problems, and further exacerbating erosion along the coastline. In the case of multi-basin flooding, repairs could not be made quickly enough to restore critical facilities and infrastructure. While human activities influence the impact of flooding events, human activities can also interface effectively with a floodplain as long as steps are taken to mitigate the activities' adverse impacts on floodplain functions.

The following flood-related issues are relevant to the planning area:

- The Pend Oreille River at Cusick has a lower elevation, frequently flooding as a result of snowmelt.

- The lack of current flood hazard mapping was a difficult obstacle to overcome when attempting to develop a strategy for hazard prone areas in land use planning, the decision to pursue CRS, and for development of this mitigation plan.
- The risk associated with the flood hazard overlaps the risk associated with other hazards such as erosion, severe storm events, large amounts of snowfall, earthquake, and landslide. This provides an opportunity to seek mitigation goals with multiple objectives to reduce the risk of multiple hazards.
- Potential climate change may impact flood conditions throughout the County.
- More information is needed on flood risk with respect to structure type, year built, elevation, etc., to support the concept of risk-based analysis of capital projects.
- There needs to be a sustained effort to gather historical damage data, such as high-water marks on structures and damage reports, to measure the cost-effectiveness of future mitigation projects.
- Ongoing flood hazard mitigation will require funding from multiple sources.
- There needs to be a coordinated hazard mitigation effort between the county, cities, and the Washington Department of Transportation as it relates to flooding and flood induced issues and the potential for areas to experience isolation as a result of limited ingress and egress to certain areas of the County during storm/flooding events.
- Floodplain residents need to continue to be educated about flood preparedness, including insurance, and the resources available during and after floods. This should occur on an annual basis.
- The promotion of flood insurance as a means of protecting property from the economic impacts of frequent flood events should continue. Future outreach efforts should include the insurance industry in attendance to assist in determining the types of insurance available, and associated costs at the individual homeowner level.
- Existing floodplain-compatible uses such as agricultural and open space need to be maintained.

9.6 RESULTS

Based on review and analysis of the data, the Planning Team has determined that the probability for impact from flood throughout the area is highly likely. The area experiences some level of flood annually, albeit not necessarily to the level of a disaster declaration on every occurrence. Certain areas of the County (particularly the Kalispel Reservation and the Town of Cusick) are particularly susceptible to flooding as a result of snowmelt.

While structural damage may vary due to flood depths and existing floodplain management regulations, there is a fairly high rate of property ownership that does not have flood insurance. In addition, because of the impact to the various communities, the County provides assistance via emergency response activities, providing resources to help citizens and the communities. Structural vulnerability of the County is also fairly significant, with over 17 percent of the structures being exposed to the 100-year floodplain. Based on the potential impact, the Planning Team determined the CPRI score to be 2.95, with overall vulnerability determined to be a high level.

CHAPTER 10.
LANDSLIDE

10.1 GENERAL BACKGROUND

A landslide is defined as the sliding movement of masses of loosened rock and soil down a hillside or slope. Such failures occur when the strength of the soils forming the slope is exceeded by the pressure acting upon them, such as weight or saturation. Earthquakes provide many times more energy than needed to initiate soil liquefaction, enhancing not only the probability of a landslide, but also its magnitude. Washington State climate, topography, and geology create a perfect setting for landslides, which occur in the state every year. They can be initiated by storms, earthquakes, fires, volcanic eruptions, or human modification of the land.

In Washington, most landslides are triggered during fall and winter after storms dump large amounts of rain or snow (Washington Department of Natural Resources, 2015). Landslides can be shallow or deep. Shallow landslides occur in winter in Western Washington and summer in Eastern Washington but are possible at any time. They often form as slumps along roadways or fast-moving debris flows down valleys or concave topography. They are commonly called "mudslides" by the news media. Deep-seated landslides are often slow moving but can cover large areas and devastate infrastructure and housing developments.

Mudslides (mud- or debris- flows) are rivers of rock, earth, organic matter, and other soil materials saturated with water. They develop in the soil overlying bedrock on sloping surfaces when water rapidly accumulates in the ground, such as during heavy rainfall or rapid snowmelt. Water pressure in the pore spaces of the material increases to the point that the internal strength of the soil is drastically weakened. The soil's reduced resistance can then easily be overcome by gravity, changing the earth into a flowing river of mud or "slurry." A mudslide or debris flow is a fast-moving fluid mass of rock fragments, soil, water, and organic material with more than half of the particles being larger than sand size. Generally, these types of movement occur on steep slopes or in gullies and can travel long distances. A debris flow or mudflow can move rapidly down slopes or through channels and can strike with little or no warning at avalanche speeds. The slurry can travel miles from its source, growing as it descends, picking up trees, boulders, cars, and anything else in its path. Although these slides behave as fluids, they pack many times the hydraulic force of water, due to the mass of material included in them. Locally, they can be some of the most destructive events in nature. A rock fall is the fall of newly detached segments of bedrock from a cliff or steep slope. The rock descends by free fall, bouncing, or rolling. Movements are rapid to extremely rapid and may not be preceded by minor movements.

All mass movements are caused by a combination of geological and climate conditions, as well as the encroaching influence of urbanization. Vulnerable natural conditions are affected by human residential, agricultural, commercial, and industrial development and the infrastructure that supports it.

The occurrence of a landslide is dependent on a combination of site-specific conditions and influencing factors. Most commonly, the factors that contribute to landslides fall into four broad categories:

- Climatic or hydrologic (rainfall or precipitation);
- Geomorphic (slope form and conditions, e.g., slope, shape, height, steepness, vegetation, and underlying geology);
- Geologic/geotechnical/hydrogeological (groundwater);
- Human activity.

Change in slope of the terrain, increased load on the land, shocks, and vibrations, change in water content, groundwater movement, frost action, weathering of rocks, and removing or changing the type of vegetation covering slopes are all contributing factors. In general, landslide hazard areas are where the land has characteristics that contribute to the risk of the downhill movement of material, such as the following:

- Areas identified as having slopes greater than 40 percent;
- A history of landslide activity or movement during the last 10,000 years;
- Stream or wave activity, which has caused erosion, undercut a bank, or cut into a bank to cause the surrounding land to be unstable;
- The presence of an alluvial fan, indicating vulnerability to the flow of debris or sediments;
- The presence of impermeable soils, such as silt or clay, which are mixed with granular soils such as sand and gravel.

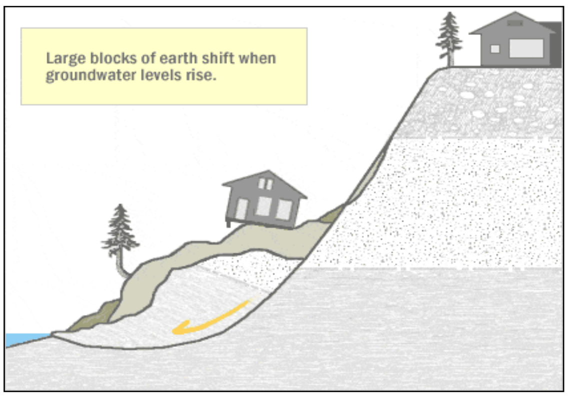


Figure 10-1. Deep Seated Slide

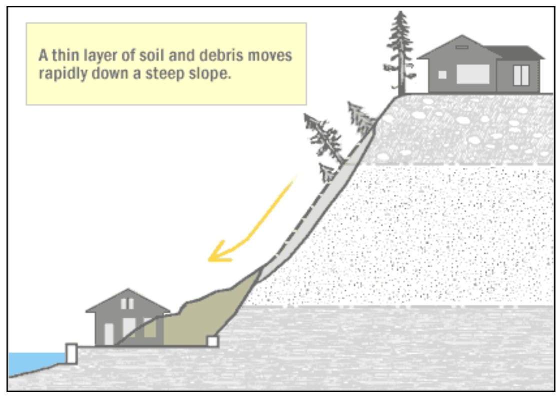


Figure 10-2. Shallow Colluvial Slide

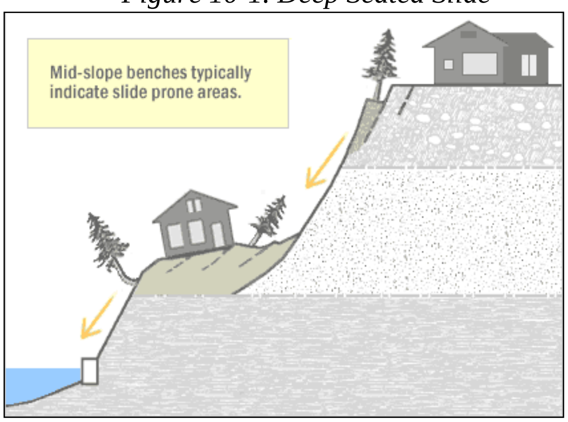


Figure 10-3. Bench Slide

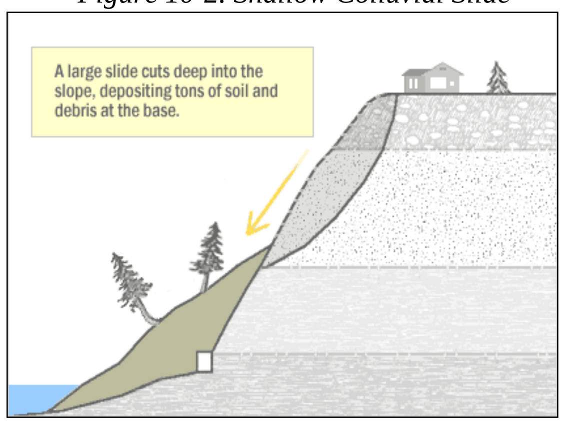


Figure 10-4. Large Slide

Flows and slides are commonly categorized by the form of initial ground failure. Common types of slides are shown on Figure 10-1 through Figure 10-4 (Washington State Department of Ecology, 2014). The most common is the shallow colluvial slide, occurring particularly in response to intense, short-duration storms, where antecedent conditions are prevalent (Baum, et. al, 2000). The largest and most destructive are deep-seated slides, although they are less common.

Deep-seated landslides are much larger than shallow landslides and can occur at any time of the year. Soil degradation can happen over years, decades, and centuries with little to no warning to people above ground. The most notable and deadliest deep-seated landslide event in the United States was SR 530 (also known as the Oso Landslide) that took the lives of 43 people in Oso, Washington, in 2014.

Slides and earth flows can pose serious hazard to property in hillside terrain. They tend to move slowly and thus rarely threaten life directly. When they move—in response to such changes as increased water content, earthquake shaking, addition of load, or removal of downslope support—they deform and tilt the ground surface. The result can be destruction of foundations, offset of roads, breaking of underground pipes, or overriding of downslope property and structures.

While a certain amount of erosion is natural and healthy for an ecosystem—such as gravel continuously moving downstream in watercourses—excessive erosion causes serious problems, such as receiving water sedimentation, ecosystem damage and loss of soil and slop stability. Erosion can cause a loss of forests and trees, which causes serious damage to aquatic life, irrigation, and power development by heavy silting of streams, reservoirs, and rivers. Concentrated surface water runoff in drainages and swales can lead to channel-confined slope failures, involving the rapid transport of fluidized debris, known as debris flows.

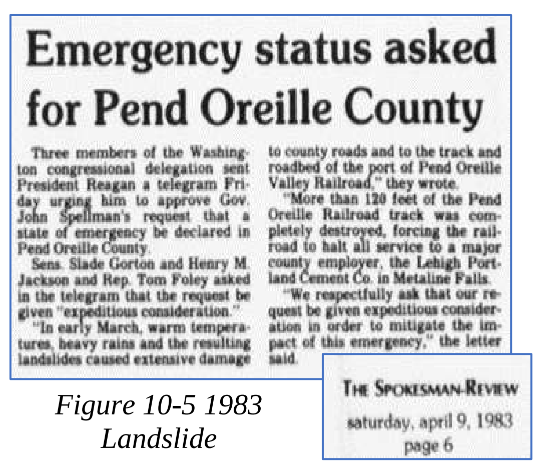
10.2 HAZARD PROFILE

10.2.1 Extent and Location

The best predictor of where slides and earth flows might occur is the location of past movements. Past landslides can be recognized by their distinctive topographic shapes, which can remain in place for thousands of years. Most landslides recognizable in this fashion range from a few acres to several square miles. Most show no evidence of recent movement and are not currently active. A small portion of them may become active in any given year. The recognition of ancient dormant mass movement sites is important in the identification of areas susceptible to flows and slides because they can be reactivated by earthquakes or by exceptionally wet weather. Also, because they consist of broken materials and frequently involve disruption of groundwater flow, these dormant sites are vulnerable to construction-triggered sliding. A 2007 USGS Landslide Hazard area which occurred for the Seattle, Washington area further confirms that "when slopes are dry, steepness and strength control potential instability. However, where ground water perches on lower permeability clay layers, extended wet winter conditions can increase the water table near the bluff face. Elevated ground-water pressures can lower slope stability" (USGS, 2007).

Generally, landslides in the County will develop at the base or top of a steep cut slope; on developed hillsides or bluffs; from activities that disturb slopes such as construction, road building and logging; and on old existing landslides. Other factors inducing landslides include: poorly located septic systems that contribute to slope unsuitability; areas where surface water is channeled along roads and below culverts; water leakage from utilities; vegetation removal, and along paths or trails down a bluff leading to beach access.

Based on review of Washington State DNR data of identified historic landsides recorded within Pend Oreille County, the primary types of landslides that occur in Pend Oreille County are shallow undifferentiated, deep-seated, and debris flows in order of number of occurrence (see Table 10-1).



Emergency status asked for Pend Oreille County

Three members of the Washington congressional delegation sent President Reagan a telegram Friday urging him to approve Gov. John Spellman's request that a state of emergency be declared in Pend Oreille County.

Sens. Slade Gorton and Henry M. Jackson and Rep. Tom Foley asked in the telegram that the request be given "expeditious consideration."

"In early March, warm temperatures, heavy rains and the resulting landslides caused extensive damage to county roads and to the track and roadbed of the port of Pend Oreille Valley Railroad," they wrote.

"More than 120 feet of the Pend Oreille Railroad track was completely destroyed, forcing the railroad to halt all service to a major county employer, the Lehigh Portland Cement Co. in Metaline Falls.

"We respectfully ask that our request be given expeditious consideration in order to mitigate the impact of this emergency," the letter said.

THE SPOKESMAN-REVIEW
saturday, april 9, 1983
page 6

Figure 10-5 1983 Landslide

Pend Oreille County has experienced fairly significant slides in the past. These landslides have impacted transportation corridors, the rail line, and residential structures. Clusters of landslides occur along transportation corridors which include: Rocky Creek Road, Horseshoe Lake Road, Dry Canyon Road, Fort LeClerc Creek, Yokum Lake Road, and county/state highways connecting the county to British Columbia and Spokane County.[45] Damage in the County also consists of blockages on the railroad tracks in the Metaline Falls area, Outpost, and Dalkena areas, with blockage of another roadway in the Sullivan Lake area, north of Ione and along Sullivan Lake Road.[46] Table 10-1 identifies the types and acres impacted by each landslide type as identified by WA DNR. **Error! Reference source not found.** illustrates the same information countywide in mapped format.

Table 10-1
Types And Number Of Landslides And Impacted Area

Landslide Type	**Number of Recorded Landslides by Type in Pend Oreille County**	**Total Area Impacted by Slides**
Debris Flow	3	0.03
Debris slide and avalanches	0	0.00
Deep-seated	20	136.86
Deep-seated earthflow	0	0.00
Shallow undifferentiated	23	11.38
Unknown	1	0.04
TOTAL	47	148.32

Of particular concern in the County is the Blueslide Tunnel (Figure 10-7). Over the past forty-five years, the mountain that the Blueslide Tunnel passes through has been shifting towards the Pend Oreille River. The Washington State Department of Transportation (WSDOT) has reported that the highway above the tunnel has not experienced movement, but rather the movement exists in the mountain, below the surface. The cause of the movement is currently unknown, but it is hypothesized that the movement is caused by either sub water pressure or an undercutting of the mountain in the Pend Oreille River. There has been a movement of 4.7 feet over the 10 year period from 2000 to 2010 (see Table 10-2).

Table 10-2
Blueslide Tunnel Movement 1999-2010

	H-1A-99	(DEPTH = 48.7')
DATE	W.T. FEET	CHANGE FT.
7/10/1999	25.3	
4/24/2000	25.1	0.2
5/26/2010	29.8	-4.7

[45] 2002. Ramakrishnan, et al. Landslide Disaster Management and Planning. Indian Cartographer. 192-195.
[46] Conversation With Cliff Bauer of Pend Oreille Valley Railroad.

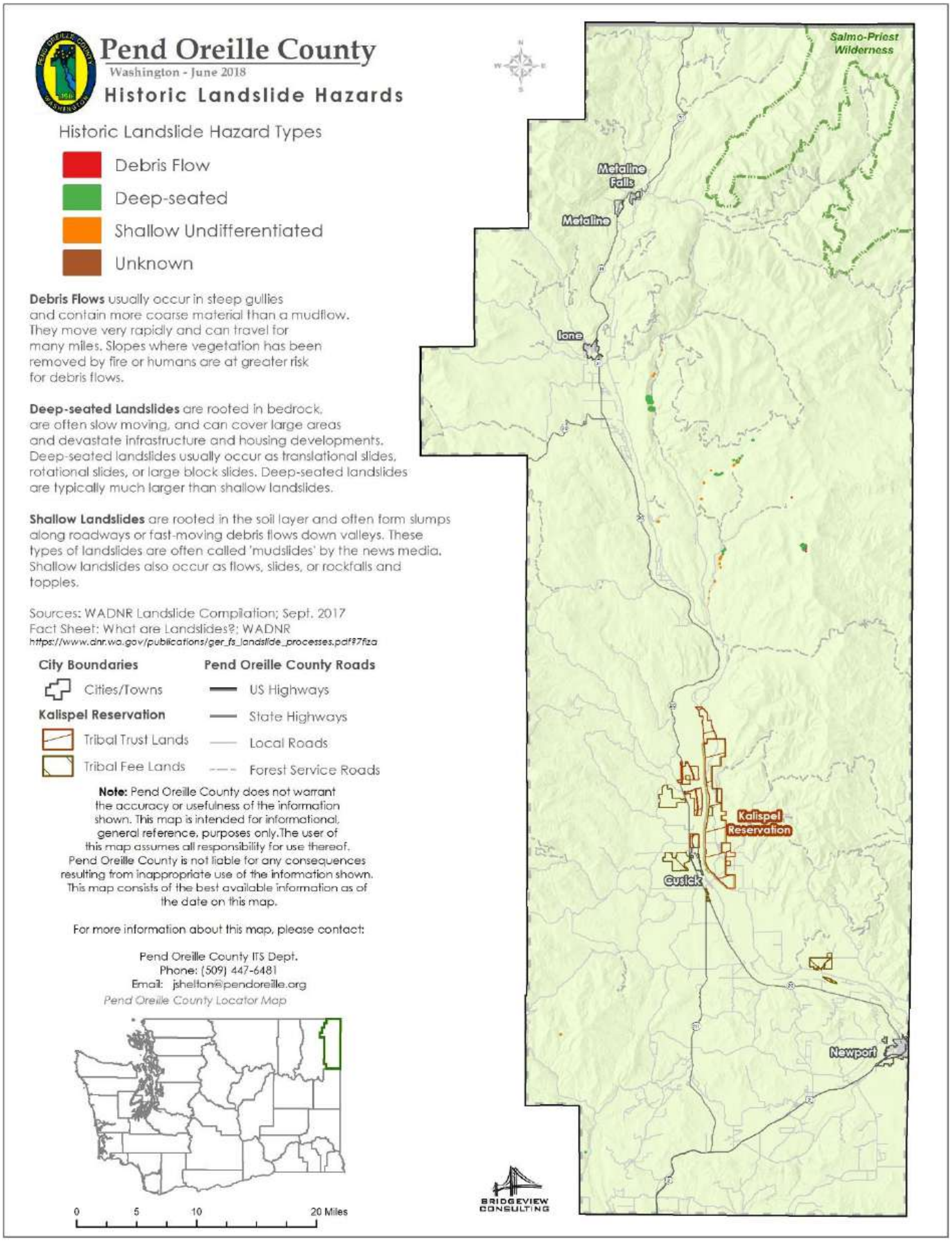


Figure 10-6 Landslide Types as Established by Washington State Department of Natural Resources

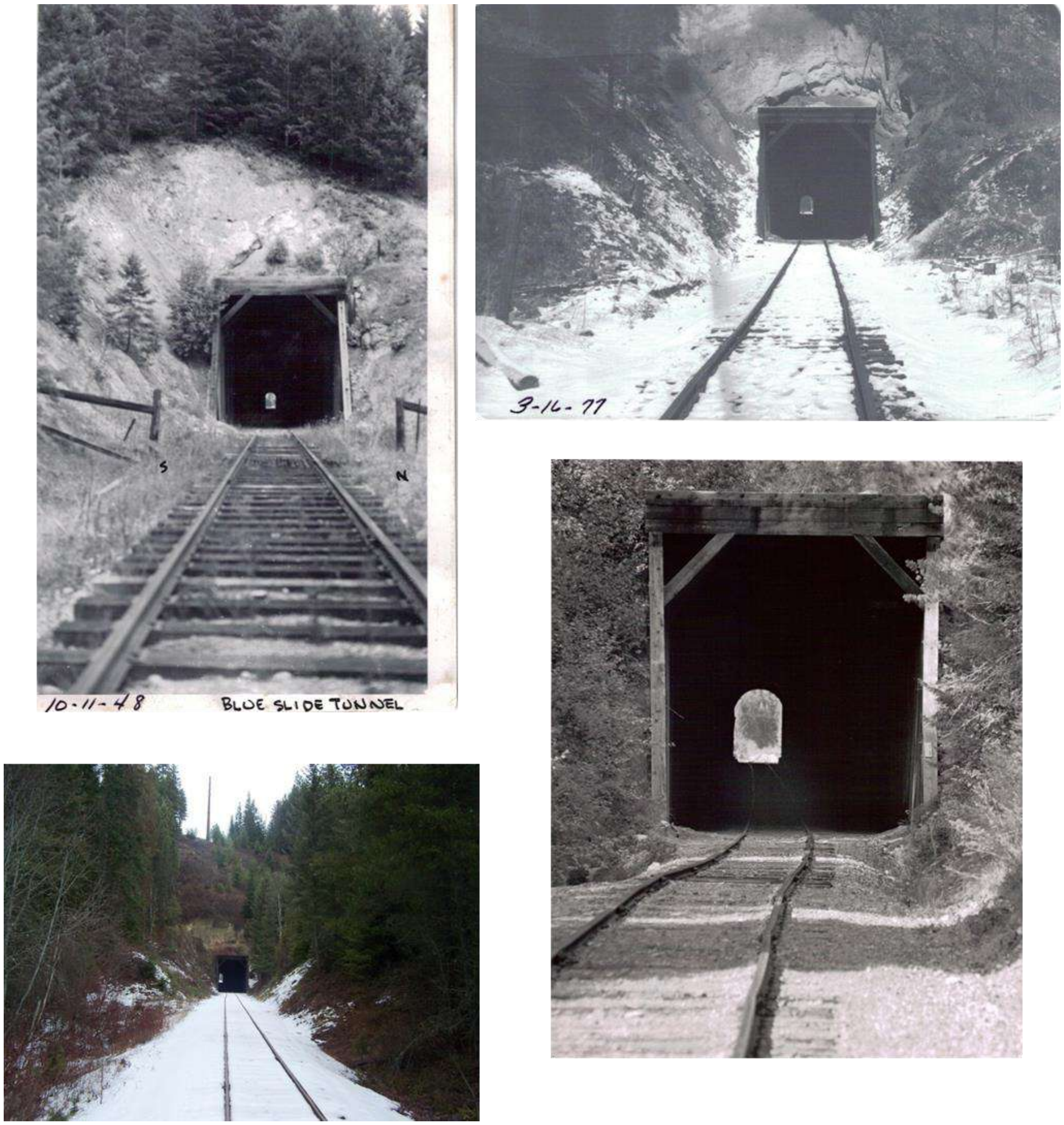
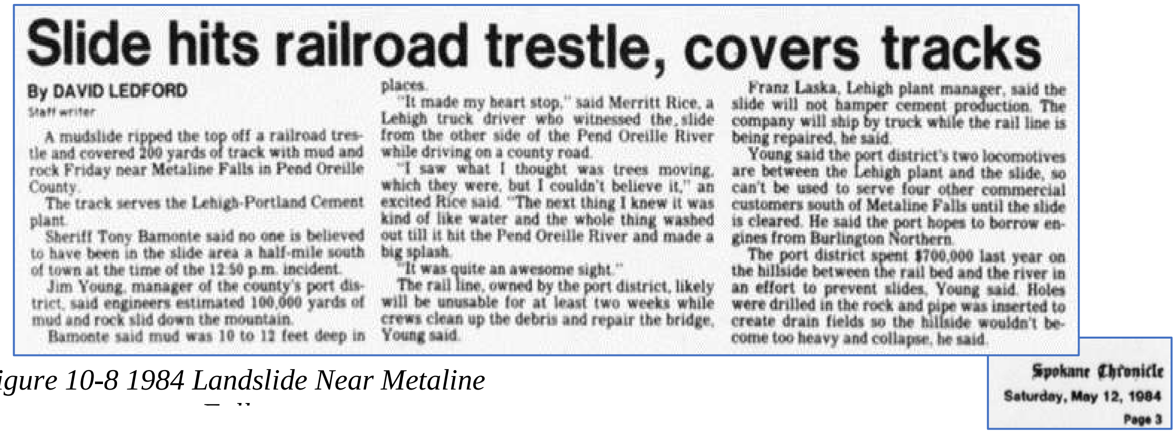


Figure 10-7 Blueslide Tunnel 1948-2010

10.2.2 Previous Occurrences

Landslides within the planning area are common. Since 1964, a total of six disaster declarations were made as a result of weather events including impact from landslides or mudslides. The County has never received a disaster declaration specifically typed *Landslide* by FEMA. (Reviewers should examine the Disaster Event tables in both the Severe Weather and Flood Chapters to identify disaster-related landslide occurrences included with other hazards of concern.)

There is no record of any fatality due to landslides in the County occurring; however, people have been evacuated from residences on several occasions as a result of landslides occurring, as well as being isolated due to impact to roadways, which have been left impassable.



Slide hits railroad trestle, covers tracks

By DAVID LEDFORD
Staff writer

A mudslide ripped the top off a railroad trestle and covered 200 yards of track with mud and rock Friday near Metaline Falls in Pend Oreille County.

The track serves the Lehigh-Portland Cement plant.

Sheriff Tony Bamonte said no one is believed to have been in the slide area a half-mile south of town at the time of the 12:50 p.m. incident.

Jim Young, manager of the county's port district, said engineers estimated 100,000 yards of mud and rock slid down the mountain.

Bamonte said mud was 10 to 12 feet deep in places.

"It made my heart stop," said Merritt Rice, a Lehigh truck driver who witnessed the slide from the other side of the Pend Oreille River while driving on a county road.

"I saw what I thought was trees moving, which they were, but I couldn't believe it," an excited Rice said. "The next thing I knew it was kind of like water and the whole thing washed out till it hit the Pend Oreille River and made a big splash.

"It was quite an awesome sight."

The rail line, owned by the port district, likely will be unusable for at least two weeks while crews clean up the debris and repair the bridge, Young said.

Franz Laska, Lehigh plant manager, said the slide will not hamper cement production. The company will ship by truck while the rail line is being repaired, he said.

Young said the port district's two locomotives are between the Lehigh plant and the slide, so can't be used to serve four other commercial customers south of Metaline Falls until the slide is cleared. He said the port hopes to borrow engines from Burlington Northern.

The port district spent $700,000 last year on the hillside between the rail bed and the river in an effort to prevent slides, Young said. Holes were drilled in the rock and pipe was inserted to create drain fields so the hillside wouldn't become too heavy and collapse, he said.

Spokane Chronicle
Saturday, May 12, 1984
Page 3

Figure 10-8 1984 Landslide Near Metaline

The Washington State Department of Natural Resources (WSDNR) maintains a geographic database of known landslide. Utilizing that dataset, the County's 2010 HMP identified that during that 46 year period, the County reported 48 landslides (1954-2000). Additional historic landslide data follows:

- The years of greatest landslide impact were: 1954, 1971, 1984, 1993, 1994, 1996, 1997, and 2000.
- Thirty-four (34) landslides occurred during 1954.
- One dwelling has been destroyed as a result of a landslide in the Town of Ione (year unknown).
- Seven (7) landslides occurred in the County during 1997, a year in which serious flooding also occurred, resulting in two disaster declarations in the County (April and March 1997).
- Since 2010, the County has experienced two additional disaster declarations which include landslides.
- Figures 10-9 and 10-10 illustrate additional areas of erosion and bank seepage occurring in 2015 along the Pend Oreille River.
- On March 16, 2017, mudslides closed Highway 31 at mile post 11 in both directions, with commercial vehicles stopped at the port of entry until alternate routes became available (see figure right). Melting snowpack and record rainfall saturated the bank of clay soil, causing the slide. Approximately three weeks after being closed, the roadway was considered still too unstable to have workers respond, and a 90-foot crane was used to remove the unstable clay and debris. The Washington State Department of Transportation hired a contractor to assist in repairing the landslide damage. The highway is one of the main routes connecting Spokane and the Inland Northwest with southeastern British Columbia.

Table 10-3
Landslide Incidents 1964-2016

Disaster Number	Declaration Date	Disaster Type	Incident Type	Title	Incident Begin Date	Incident End Date	PA Dollars Obligated or Losses (State)
4309	4/21/2017	DR	Flood	Severe Winter Storm, Flooding, Landslides, Mudslides	1/30/2017	2/22/2017	PA Only Dollars obligated >$21M
Severe winter storms, flooding, landslides and mudslides occurred during the period of January 30-Feruary 22, 2017. Gov. Inslee requested a declaration for PA for 15 counties statewide.							
4249	November 2015	DR	Severe Storm	Severe storm, straight-line winds, flooding, landslides and mudslides	11/12/15	11/21/2015	PA only; Dollars obligated >$22M
Severe storm, including straight-line winds, flooding, landslides and mudslides.							
4243	August 9, 2015	DR	Wildfire and Mud-slides	Wildfire and mudslides	8/9/2015	9/10/2015	Unknown
1682	December 2008	DR	Severe Storm	Severe storm, straight-line winds, flooding, landslides and mudslides	12/14/2006	12/15/2006	Unknown
Severe storm, including straight-line winds, flooding, landslides and mudslides.							
1641	5/17/2006	DR	Severe Storm	Severe Storms, Flooding, Tidal Surge, Landslides, Mudslides	1/27/2006	2/2/2006	
January 2006 brought severe storms with record-breaking precipitation to Pend Oreille County. Heavy rains continued throughout the state for 44 days in a 45-day period causing flooding of the rivers in the area. Rivers and retention ponds spilled over and flooded streets, farmland, houses, and other structures. High water and landslides forced many roads and state highways to close. Power outages were reported.							
1172	4/2/1997	DR	Flood	Heavy Rains, Snow Melt, Flooding, Land Slides	3/18/1997	3/28/1997	Stafford Act assistance ~ $6.5 million statewide
Low-elevation mountain snowmelt accompanied by a week of torrential rain in late March 1997 created flooding and landslides in multiple places in Washington State, causing road closers over the five-day period of heavy rains..							
1159	12/1996 – 1/1997	DR	Severe Storm	Severe Storms and Flooding	10/15/2003	10/23/2003	Stafford Act assistance $83M; SBA $31.7 million; total losses $140 million statewide
24 deaths occurred throughout the state. Saturated ground combined with snow, freezing rain, rain, rapid warming and high winds within a five-day period produced flooding and landslides. 37 counties were impacted, with large power outages throughout the impacted counties.							

Figure 10-9 Erosion from Bank Seepage along Box Canyon Reservoir (2015)

Figure 10-10 Bank Seepage Along Box Canyon Reservoir (2015)

10.2.3 Severity

Landslides destroy property and infrastructure, having a long-lasting effect on the environment and can take the lives of people. Nationally, landslides account for more than $2 billion in losses annually and result in an estimated 25 to 50 deaths a year (Spiker and Gori, 2003; Schuster and Highland, 2001; Schuster, 1996).

Washington is one of seven states listed by the Federal Emergency Management Agency as being especially vulnerable to severe land stability problems. Topographic and geologic factors cause certain areas of Pend Oreille County to be highly susceptible to landslides. Ground saturation and variability in rainfall patterns and increased snowpack are also important factors affecting slope stability in area susceptible to landslides.

With respect to Blueslide Tunnel's movement impacting the railroad, tunnel movement can also affect Washington SR 20 and the Pend Oreille PUD's major transmission line that runs on top of the mountain. A major slide into the river could also cause flooding and environmental damage. According to the Pend Oreille Valley Railroad, the movement is getting larger each year.

Figure 10-11 illustrates the Steep Slopes in Pend Oreille County which are identified with 40 percent or greater slopes – areas identified by Washington State Department of Natural Resources (WA DNR) as being more susceptible to landslide areas.

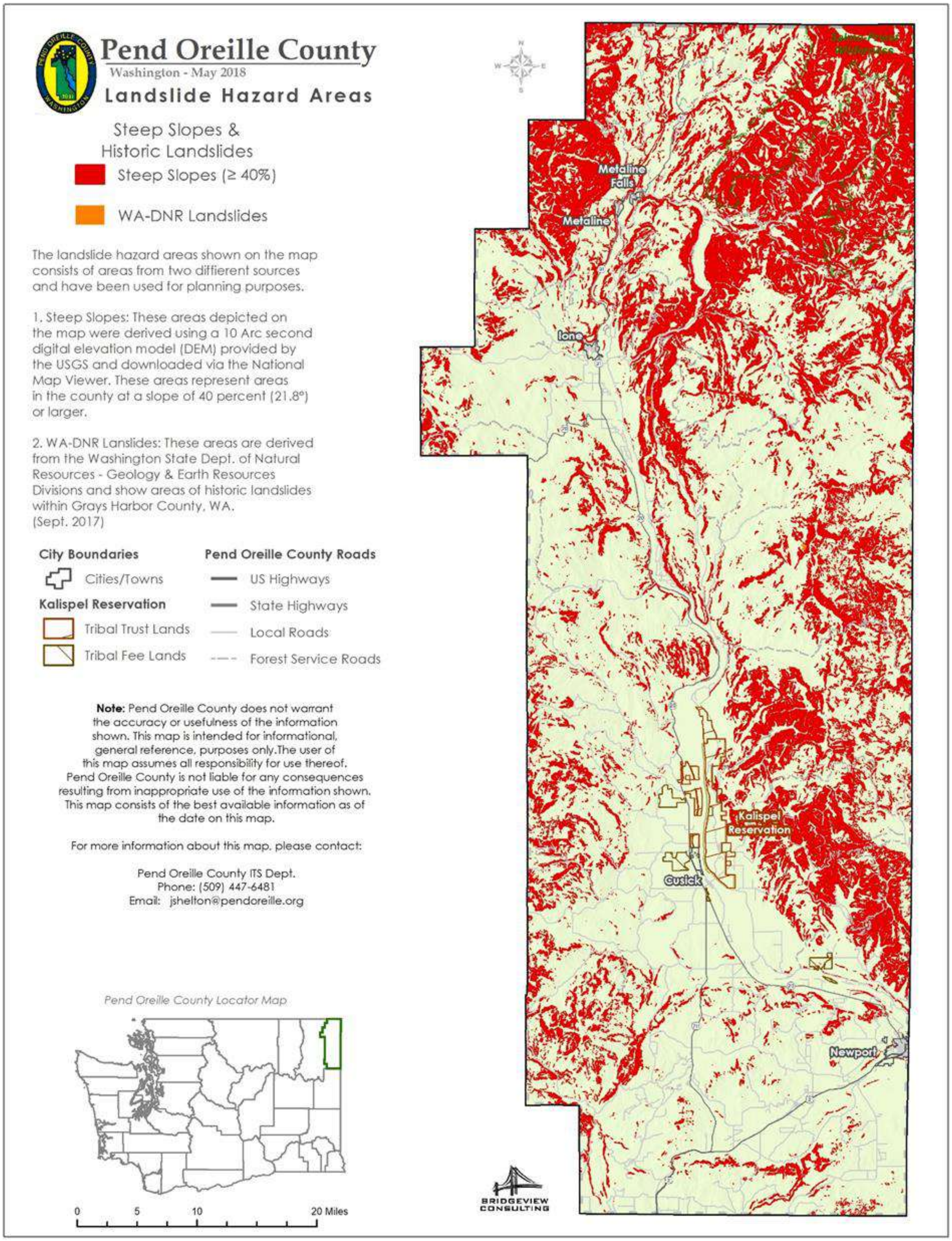


Figure 10-11 Landslide Hazard Areas

10.2.4 Frequency

Landslides are often triggered by other natural hazards such as, heavy rain or snow fall, earthquakes, erosion, freeze-thaw weakening of geologic structures; floods, or wildfires, so landslide frequency is often related to the frequency of these other hazards. In addition, human factors such as excavation and mining, deforestation, or vibration from explosions or other such sources contribute to landslide events. Landslides typically occur during and after major storms, so the potential for landslides largely coincides with the potential for sequential severe storms and flood events that saturate steep, vulnerable soils.

While the County has not received a disaster declaration specifically for a landslide, there have been 11 disaster declarations which have included mud- or land-slides which occurred in conjunction with severe storm (or flood) events over the course of the last 53 years. However, some type of landslide event occurs almost annually within the planning region. A specific recurrence interval has not been established by geologists, but historical data indicates several successive years of slide activities, followed by dormant periods.

Landslides customarily are most likely to occur during periods of higher than average rainfall. The ground in many instances is already saturated prior to the onset of a major storm, which increases the likelihood of significant landslides to occur. Within Pend Oreille County, landslides often occur in the spring and summer months, due to the snowmelt along the Pend Oreille River causing flooding in the area.

Precipitation influences the timing of landslides on three scales: total annual rainfall, monthly rainfall, and single precipitation events. In general, landslides are most likely during periods of higher than average rainfall.

The ground must be saturated prior to the onset of a major storm for significant landsliding to occur. Studies conducted by the USGS have identified two precipitation thresholds to help identify when landslides are likely (USGS, 2007) [47]:

- Cumulative Precipitation Threshold (Figure 10-12)—A measure of precipitation over the last 18 days, indicating when the ground is wet enough to be susceptible to landslides. Rainfall of 3.5 to 5.3 inches is required to exceed this threshold, depending on how much rain falls in the last 3 days.
- Intensity Duration Threshold (Figure 10-13)—A measure of rainfall during a storm, indicating when it is raining hard enough to cause multiple landslides if the ground is already wet.

These thresholds are most likely to be crossed during the rainy season. The 2007 USGS study indicates that by comparing recent and forecast rainfall amounts to the thresholds, meteorologists, geologists, and city officials can help people know when to be prepared for landslides. The thresholds as developed and tested are accurate, but imperfect indicators of when landslides may occur. During the study, statistical analysis of landslides that occurred between 1978 and 2003 showed that 85% occurred when the Cumulative Precipitation Threshold was exceeded (USGS, 2007).

[47] USGS Landslide Hazards in the Seattle, Washington, Area. Accessed 20 Aug 2017. Available at: https://pubs.usgs.gov/fs/2007/3005/pdf/FS07-3005_508.pdf

Review of existing data illustrates that slide events in the planning area most commonly occur from November through April, after water tables have risen. Review of historic disasters provides the following breakdown:

- January experienced two (2) landslides;
- December had two (2) landslide occurrences;
- November had one (1) landslide occurrence; and
- March had one (1) landslide occurrence.

All of these events rose to a disaster declaration in the county for either a severe weather or flood related declaration which included land- or mud-slides.

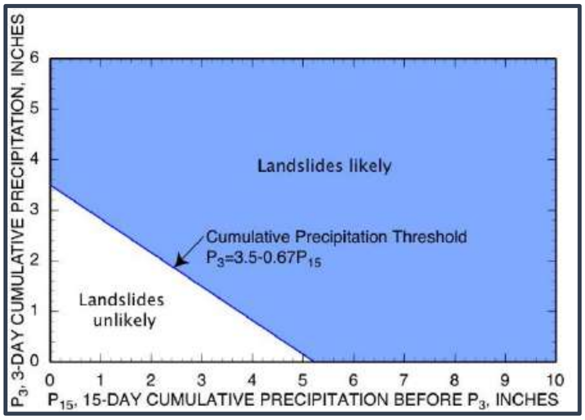


Figure 10-12 Cumulative Precipitation Threshold

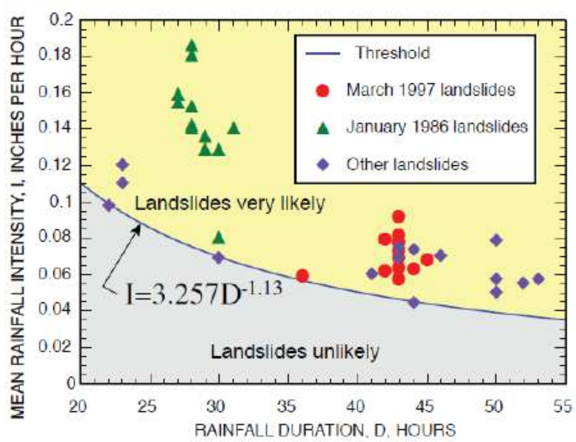


Figure 10-13 Landslide Intensity Duration Threshold

10.3 VULNERABILITY ASSESSMENT

10.3.1 Overview

Landslides have the potential to cause widespread damage throughout both rural and urban areas. While some landslides are more of a nuisance-type event, even the smallest of slides has the potential to injure or kill individuals and damage infrastructure. Given Pend Oreille County’s steep slopes in certain areas, its soil type, and its historical patterns of previous slide occurrences, the landslide hazard is of concern for the planning partners.

Methodology

Historical occurrences, combined with analysis of the slope and the type of soil, are the most effective indicator of areas at risk to landslide. The Washington Department of Natural Resources collects data to use in determining historical events and landslide danger; however, no damage figures have been developed for the landslide hazard. Therefore, for planning purposes, landslide hazard areas are those identified by Washington State DNR as having previous landslide events, and includes structures exposed to those areas of slopes greater than or equal to 40 percent (or 21.8 degrees). It should be noted that this data is for mitigation planning purposes only and should not be considered for life safety matters. No landslide hazard analysis was conducted as a result of this project as such studies far exceed the intent of this planning purpose. Rather, only reprojection of existing data is used in determining potential areas at risk. Additional landslide data is available at: http://www.dnr.wa.gov/programs-and-services/geology/geologic-hazards/landslides

Warning Time

Unlike flood hazards which often are predictable, mass movements or landslides are generally unpredictable, with little or no advanced warning. The speed of onset and velocity associated with a slide event can have devastating impacts. While some methods used to monitor mass movements can provide an idea of the type of movement and provide some indicators (potentially) with respect to the amount of time prior to failure, exact science is not available.

Mass movements can occur suddenly or slowly. The velocity of movement may range from a slow creep of inches per year to many feet per second, depending on slope angle, material, and water content. Generally accepted warning signs for landslide activity include:

- Springs, seeps, or saturated ground in areas that have not typically been wet before;
- New cracks or unusual bulges in the ground, street pavements or sidewalks;
- Soil moving away from foundations;
- Ancillary structures such as decks and patios tilting and/or moving relative to the main house;
- Tilting or cracking of concrete floors and foundations;
- Broken water lines and other underground utilities;
- Leaning telephone poles, trees, retaining walls or fences;
- Offset fence lines;
- Sunken or down-dropped road beds;
- Rapid increase in creek water levels, possibly accompanied by increased turbidity (soil content);
- Sudden decrease in creek water levels though rain is still falling or just recently stopped;
- Sticking doors and windows, and visible open spaces indicating jambs and frames out of plumb;
- A faint rumbling sound that increases in volume as the landslide nears;
- Unusual sounds, such as trees cracking or boulders knocking together.

It is possible, based on historical occurrences, to determine what areas are at a higher risk. Assessing the geology, vegetation, and amount of predicted precipitation for an area can help in these predictions; such an analysis is beyond the scope of this planning effort. However, there is no practical warning system for individual landslides. Historical events remain the best indicators of potential landslide activity, but it is generally impossible to determine with precision the size of a slide event or when an event will occur. Increased precipitation in the form of snow or rain increases the potential for landslide activity. Steep slopes also increase the potential for slides, especially when combined with specific types of soil.

Within Washington State, in a partnership with the National Oceanic and Atmospheric Administration (NOAA) and the National Weather Service, Washington State Department of Natural Resources monitors conditions that could produce shallow landslides. Landslide warning information can be viewed at https://fortress.wa.gov/dnr/protection/landslidewarning/.

10.3.2 Impact on Life, Health, and Safety

A population estimate was made using the structure count of residential buildings within the landslide hazard areas and applying the census value of two (2) persons per household for Pend Oreille County, and three (3) persons per household for the Kalispel Reservation. Using this approach, the population living in the landside risk area is identified in Table 10-4. It should be noted that areas identified within this document were based on existing data; no geotechnical or scientific analyses were conducted for development of this hazard mitigation plan as such analyses far exceed the intent of this document; therefore, no data should not be relied upon for life safety measures, or anything other than informing emergency managers of potential risk for planning purposes.

Table 10-4
Population and Residential Impact in Landslide Risk Area

Jurisdiction	Residential Building Count*	Population Exposed
Unincorporated Pend Oreille County	153	306
Kalispel Reservation	0	0
Cusick, Town of	0	0
Ione, Town of	0	0
Metaline, Town of	1	2
Metaline Falls, Town of	0	0
Newport, City of	4	8
Total	158	316

For these planning purposes, risk area is defined as slopes 40% (21.8°) and above, and areas identified within WADNR mapped historic landslides.
*Based on factor of 2 per person/household for County areas and 3 persons per household for Kalispel.

Also to be taken into account when determining affected population are the area-wide impacts on transportation systems and the isolation of residents who may not be directly impacted but whose ability to ingress and egress is restricted, such as areas along major highways, which have a high transient population of tourists, especially during summertime months. In addition, Pend Oreille County's population of retirees may increase the level of first-responder requirements for residents whose structures were not directly impacted, but who were affected by power outages, lack of logistical support, etc. The increased level of population resulting from tourists in the area must also be considered for planning purposes by first responders. Landslides can also damage water treatment facilities, potentially harming water quality.

10.3.3 Impact on Property

Landslides affect private property and public infrastructure and facilities. A predominant land use in the planning area is single-family residential, much of it supporting multiple families. In addition, there are many small businesses in the area as well as large commercial industries and government facilities. Development in landslide hazard area is guided by building code and the critical area ordinance to prevent the acceleration of manmade and natural geological hazards, and to neutralize or reduce the risk to the property owner or adjacent properties from development activities.

For mitigation planning purposes only (not specific to the County's ordinance), the Washington State Department of Natural Resources Landslide Dataset was utilized to identify areas of historic events. In addition, slopes identified as being forty (40) percent or steeper were included in this analysis. The area and percent of the total planning area exposed to the landslide hazard in the planning area are summarized below. Data presented in these maps and tables are not a substitute for site-specific investigations by qualified practitioners. Table 10-5 identifies the area within the landslide risk, as well as the percent of the total planning area. Table 10-6 identifies dollar loss estimates based on exposed building values.

Table 10-5
Percent of Land Area in Landslide Risk Areas

Jurisdiction	Land Area in Landslide Risk (in Acres)	Total Planning Area in Acres	Percent of Total Planning Area
Unincorporated Pend Oreille County	198,148.54	901,309.26	21.98%
Kalispel Reservation	126.42	8,478.11	1.49%
Cusick, Town of	0.00	837.94	0.00%
Ione, Town of	1.92	869.76	0.22%
Metaline, Town of	21.91	201.97	10.85%
Metaline Falls, Town of	39.27	322.52	12.17%
Newport, City of	18.49	2,273.93	0.81%
Total	198,356.56	914,293.51	21.70%

For these planning purposes, risk area is defined as slopes 40% (21.8°) and above, and areas identified within WADNR mapped historic landslides.

Table 10-6
Potential Building Losses in Landslide Risk Area

Jurisdiction	Estimated 2017 Population (1)	Estimated Building Count (2)	Total Building Value (Structure and contents in $) (2)	Steep Slope Hazard (3) — Buildings Exposed to 40% or Greater Slope: Estimated Buildings Exposed (2)	Building Structure Value Exposed to Landslide (2)	Building Content Value Exposed to Landslide (2)	Sum of Structure and Contents Exposed to Landslide (2)	% of Total Value
Cusick	205	115	$8,135,247	0	$0	$0	$0	0.0%
Ione	445	265	$25,582,201	0	$0	$0	$0	0.0%
Metaline	170	104	$11,460,141	1	$53,111	$26,556	$79,667	0.7%
Metaline Falls	240	135	$17,305,898	0	$0	$0	$0	0.0%
Newport	2,170	839	$181,801,463	2	$274,577	$137,288	$411,865	0.2%
Kalispel Tribe	275	102	$98,614,681	0	$0	$0	$0	0.0%
Unincorporated County	10,140	6,897	$1,086,351,621	154	$13,355,987	$6,697,999	$20,053,986	1.8%
Total	**13,645**	**8,457**	**$1,429,251,252**	**157**	**$13,683,675**	**$6,861,843**	**$20,545,518**	**1.44%**

Source: (1) 2017 State of Washington, Office of Financial Management Estimated Populations; (2) Exposure numbers were estimated using Pend Oreille County Parcel and Assessor data; (3) Slope created from USGS 30 Meter Digital Elevation Model.

10.3.4 Impact on Critical Facilities and Infrastructure

Exposure analysis identifies that only one identified critical facility lies within the landslide hazard zone as defined by the 40 percent slope – the Diversion Dam. While no additional critical facilities are directly exposed to the identified slope element of a landslide, that does not mean that structures cannot be impacted by a landslide.

Several types of infrastructure are exposed to mass movements, including transportation facilities, airports, bridges, and water, sewer, and power infrastructure. Highly susceptible areas include mountain and coastal roads and transportation infrastructure. All infrastructure and transportation corridors identified as exposed to the landslide hazard are considered vulnerable until more information becomes available. Significant infrastructure in the planning region exposed to mass movements includes the following:

- **Roads**—Access to major roads is crucial to life-safety after a disaster event and to response and recovery operations. Landslides can block egress and ingress on roads, causing isolation for neighborhoods, traffic problems and delays for public and private transportation. This can result in economic losses for businesses.
- **Bridges, Marinas, and Boat/Ferry Docks**—Landslides can significantly impact road bridges, marinas, and boat/ ferry docks. Mass movements can knock out bridge and dock abutments, causing significant misalignment and restricting access and usages, as well as significantly weaken the soil supporting the structures, making them hazardous for use.
- **Power Lines**—Power lines are generally elevated above steep slopes, but the towers supporting them can be subject to landslides. A landslide could trigger failure of the soil beneath a tower, causing it to collapse and ripping down the lines. Power and communication failures due to landslides can create problems for vulnerable populations and businesses.

10.3.5 Impact on Economy

A landslide can have catastrophic impact on both the private sector and governmental agencies. Economic losses include damage costs as well as lost revenue and taxes. Damaged bridges, roadways, marinas, boat docks, municipal airports all can have a significant impact on the economy. Damages in this capacity could have a significant economic impact on not only Pend Oreille County, but also other areas of the state.

The impact on commodity flow from a significant landslide shutting down major access routes would not only limit the resources available for citizens' use, but also would cause economic impact on businesses in the area and statewide. Debris could impact cargo staging areas and lands needed for business operations. With US Route 2, SR 20, 31 and 211 serving as a primary transportation routes in the area, use of the highways reduce travel time between the primary economic hubs between Canada, Washington, and Idaho. If such routes become impacted requiring vehicles to travel much greater distances around the area, impact to the economy would be felt at many levels, and in different states. Historic evidence has shown that slides, due to their size, require assistance to clear because the incident may be too dangerous for individuals to access to begin cleanup activities. In addition, such type impacts would also significantly reduce the tourism industry within the County.

10.3.6 Impact on Environment

Environmental problems as a result of mass movements can be numerous. Landslides that fall into water bodies, wetlands or streams may significantly impact fish and wildlife habitat, as well as affecting water quality. Hillsides that provide wildlife habitat can be lost for prolonged periods of time due to landslides. With impact already occurring due to increased sediment loads in the floodplain, landslides could cause additional impact within the County's watersheds.

10.4 FUTURE DEVELOPMENT TRENDS

Under the Growth Management Act, the County is required to address geologic hazards within its Critical Areas Ordinance, which it does. Continued application of land use and zoning regulations, as well as implementation of the International Building Codes, will assist in reducing the risk of impact from landslide hazards for new construction permits, as well as extensive renovations. Since completion of the 2011 plan, while landslides have occurred, no residential structures were impacted.

Pend Oreille County has experienced minimal growth over the past 10 years, with some areas experiencing a decline. The region continues to attempt to expand its business base, which will increase economic vitality by providing businesses that stimulate retail sales and services and increased tourism. As a higher-than-average retirement and tourist destination for Washington, continued land use supported by regulatory authority which supports economic growth, but practices smart planning will be vital. All planning partners are committed to assessing the landslide risk and developing mitigation efforts to reduce impact or enhance resiliency. There are four basic strategies to mitigate landslide risk:

- Stabilization
- Protection
- Avoidance
- Maintenance and monitoring.

Stabilization seeks to counter one or more key failure mechanisms necessary to prevent slope failure. The other three strategies seek to avoid, protect against or limit associated impacts. Development of this mitigation plan creates an opportunity to enhance and develop wise land use decision-making policies. It allows for the expansion of capital improvement plans to sustain future growth through the use of these four basic strategies.

Climate change may impact storm patterns, increasing the probability of more frequent, intense storms with varying duration which can saturate soils beyond capacity. Increase in global temperature could further exacerbate this by affecting the snowpack and its ability to hold and store water, further raising sea levels, and increasing beach erosion along the County's coastline. Warming temperatures also could increase the occurrence and duration of droughts, which would increase the probability of wildfire, reducing the vegetation that helps to support steep slopes. As parts of the County maintain fairly dense forested areas, such an incident would be significant. All of these factors would increase the probability of landslides.

10.5 ISSUES

Landslides throughout the County occur as a result of soil conditions that have been affected by severe storms, groundwater, or human development. The worst-case scenario for landslide hazards in the planning area would generally correspond to a severe storm that had heavy rain and caused flooding. Landslides are most likely during late fall or early spring —months when the water tables are high. After heavy rains during October to April, soils become saturated with water. As water seeps downward through upper soils that may consist of permeable sands and gravels and accumulates on impermeable silt, it will cause weakness and destabilization in the slope. A short intense storm could cause saturated soil to move, resulting in landslides. As rains continue, the groundwater table rises, adding to the weakening of the slope. Gravity, a small tremor or earthquake, poor drainage, steep bank cutting, a rising groundwater table, and poor soil exacerbate hazardous conditions.

Mass movements are becoming more of a concern as development moves outside of urban centers and into areas less developed in terms of infrastructure. While most mass movements would be isolated events affecting specific areas, the areas impacted can be very large. It is probable that private and public property, including infrastructure, will be affected. Mass movements could affect bridges that pass over landslide prone ravines. Road obstructions caused by mass movements would create isolation problems for residents and businesses in sparsely developed areas, and impact commodity flows. Property owners exposed to steep slopes may suffer damage to property or structures. Landslides carrying vegetation such as shrubs and trees may cause a break in utility lines, cutting off power and communication access to residents; they may block ingress and egress to areas of the County, especially for areas with limited roadways.

Important issues associated with landslides throughout Pend Oreille County include the following:

- There are existing homes in landslide risk areas throughout the County. The degree of vulnerability of these structures depends on the codes and standards the structures were constructed to. Information to this level of detail is not currently available.
- Future development could lead to more homes in landslide risk areas.
- Portions of the County are surrounded by fairly steep banks and cliffs. Erosion causes landslides as the ground washes away.
- Mapping and assessment of landslide hazards are constantly evolving. As new data and science become available, assessments of landslide risk should be re-evaluated. LiDAR data will greatly enhance the ability to determine landslide hazards, as well as other hazards.
- While the impact of climate change on landslides in general is uncertain, the impact of sea level rise caused by increased temperatures has already enhanced coastal erosion within the planning area. As climate change continues to impact atmospheric conditions, the exposure to landslide risks is likely to increase.
- Landslides cause many negative environmental consequences, including water quality degradation, degradation of fish spawning areas, and destruction of vegetation along waterways, ultimately impacting the flow of water bodies.
- The risk associated with the landslide hazard overlaps the risk associated with other hazards such as earthquake, flood, and wildfire. This provides an opportunity to seek mitigation goals with multiple objectives that can reduce risk for multiple hazards.

10.6 RESULTS

Based on review and analysis of the data, the Planning Team has determined that the probability for impact from a landslide throughout the area is possible, although limited in nature. The area experiences some level of landslides almost annually. The mountainous areas within the unincorporated areas of the County have identifiable landslide risk. While there are areas where no landslide risk areas are identified, landslides can nonetheless occur on fairly low slopes, and areas with no slopes can be impacted by slides at a distance. In addition, the removal of vegetation as a result of wildfires also increases the landslide risk throughout the County. Construction in critical areas, which includes geologically sensitive areas such as landslide areas, is regulated; however, beyond the structural impact, secondary impact to infrastructure causing isolation or commodity shortages also has the potential to impact the region as major thoroughfares have and will continue to be impacted. While the County has only one critical facilities and very limited other structures in the actual landslide hazard area as defined by Washington DNR, based on the potential impact to roadways, the Planning Team determined the CPRI score to be 2.30, with overall vulnerability determined to be a medium level.

CHAPTER 11.
SEVERE WEATHER

11.1 INTRODUCTION

Severe weather refers to any dangerous meteorological phenomena with the potential to cause damage, serious social disruption, or loss of human life. It includes thunderstorms, downbursts, wind, tornadoes, waterspouts, and snowstorms. Severe weather differs from extreme weather, which refers to unusual weather events at the extremes of the historical distribution.

General severe weather covers wide geographic areas; localized severe weather affects more limited geographic areas. The severe weather event that most typically impacts the planning area is a damaging windstorm, which causes storm surges exacerbating coastal erosion. Flooding and erosion associated with severe weather are discussed in their respective hazard chapters. Snow historically does not accumulate in great amounts in the area, although even small amounts can impact the area through traffic-related issues and safety for citizens walking in areas of snow accumulation or ice. Excessive heat and cold, while they have occurred, have never resulted in a disaster declaration for either type of event.

Severe Winter Storms was reported as one of the top five hazard threats in Pend Oreille County in the Local Mitigation Plan of 2004. Severe Winter Storms are a significant risk to life and property in all areas of the County. These storms may create conditions that disrupt essential regional systems, such as public utilities, telecommunications, and transportation routes. These storms may also produce rain, freezing rain, ice, snow, cold temperatures, and wind. Ice storms accompanied by high winds can have destructive impacts, especially to trees, power lines, and utility services.

11.2 WEATHER PATTERNS

The County generally experiences seasonable weather patterns characteristic of Eastern Washington. Warm, dry summers are usually experienced, although heavy rain and hail infrequently accompany thunderstorm activity. Mid-summer temperatures range in the middle and upper 80s; winter highs are usually in the 30s. Extreme temperatures can range from 110ºF to -30ºF.

DEFINITIONS

Freezing Rain—The result of rain occurring when the temperature is below the freezing point. The rain freezes on impact, resulting in a layer of ice up to an inch thick. In a severe ice storm, an evergreen tree 60 feet high and 30 feet wide can be burdened with up to six tons of ice, creating a threat to power and telephone lines and transportation routes.

Hail Storm—Any thunderstorm which produces hail that reaches the ground is known as a hailstorm. Hail has a diameter of 0.20 inches or more. Hail is composed of transparent ice or alternating layers of transparent and translucent ice at least 0.04 inches thick. Although the diameter of hail is varied, in the United States, the average observation of damaging hail is between 1 inch and golf ball-sized 1.75 inches. Stones larger than 0.75 inches are usually large enough to cause damage.

Severe Local Storm—"Microscale" atmospheric systems, including tornadoes, thunderstorms, windstorms, ice storms and snowstorms. These storms may cause a great deal of destruction and even death, but their impact is generally confined to a small area. Typical impacts are on transportation infrastructure and utilities.

Thunderstorm—A storm featuring heavy rains, strong winds, thunder, and lightning, typically about 15 miles in diameter and lasting about 30 minutes. Hail and tornadoes are also dangers associated with thunderstorms. Lightning is a serious threat to human life. Heavy rains over a small area in a short time can lead to flash flooding.

Tornado— Most tornadoes have wind speeds less than 110 miles per hour, are about 250 feet across, and travel a few miles before dissipating. The most extreme tornadoes can attain wind speeds of more than 300 miles per hour, stretch more than two miles across, and stay on the ground for dozens of miles They are measured using the Enhanced Fujita Scale, ranging from EF0 to EF5.

Windstorm—A storm featuring violent winds. Southwesterly winds are associated with strong storms moving onto the coast from the Pacific Ocean. Southern winds parallel to the coastal mountains are the strongest and most destructive winds. Windstorms tend to damage ridgelines that face into the winds.

Eastern Washington climate is a function of maritime and continental influences. The Cascade and marine influence is most noticeable in winter when the prevailing westerly winds are strongest and most persistent. The area is also subject to "chinook" winds, which produce a rapid rise in temperature.

Weather patterns in Pend Oreille County can be harsh, with Severe Winter Storms having historically hit the County on a regular basis. Air from the lower elevations, along the Columbia Basin, moves east toward the Selkirk Mountains resulting in a gradual increase in precipitation in the higher elevations in the County. This frequently causes storms that are accompanied by large amounts of ice, snow, and high winds. Late fall and winter brings winds and snowfall, which average 49.43 a year. In the spring, snow continues, along with much stronger winds and hail. 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. 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. Temperatures in the mountains decrease three to five degrees Fahrenheit with each 1,000 feet increase in elevation. The average date of the last freezing temperatures can be expected in the colder valleys by the first of September and before mid-October in the warmer areas.

11.2.1 Thunderstorms

A thunderstorm is a rain event that includes thunder and lightning. A thunderstorm is classified as "severe" when it contains one or more of the following: hail with a diameter of three-quarter inch or greater, winds gusting in excess of 50 knots (57.5 mph), or tornado. Thunderstorms have three stages (see Figure 11-1):

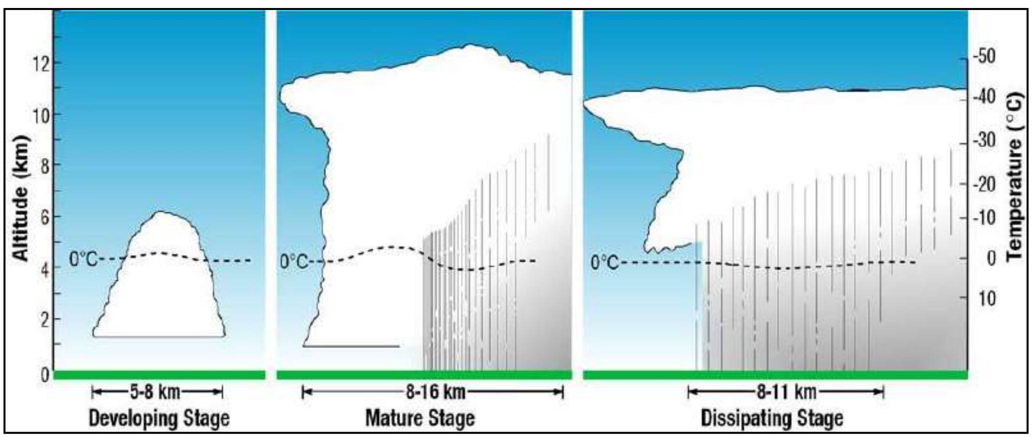


Figure 11-1 The Thunderstorm Life Cycle

Three factors cause thunderstorms: moisture, rising unstable air (air that keeps rising once disturbed), and a lifting mechanism to provide the disturbance. The sun heats the surface of the earth, which warms the air above it. If this warm surface air is forced to rise (hills or mountains can cause rising motion, as can the interaction of warm air and cold air or wet air and dry air) it will continue to rise as long as it weighs less and stays warmer than the air around it. As the air rises, it transfers heat from the earth surface to the upper atmosphere (the process of convection). The water vapor it contains begins to cool and it condenses into a cloud. The cloud eventually grows upward into areas where the temperature is below freezing. Some of the water vapor turns to ice and some of it turns into water droplets. Both have electrical charges. Ice particles usually have positive charges, and rain droplets usually have negative charges. When the charges build up enough, they are discharged in a bolt of lightning, which causes the sound heard as thunder. There are four types of thunderstorms:

- **Single-Cell Thunderstorms—**Single-cell thunderstorms usually last 20 to 30 minutes. A true single-cell storm is rare, because the gust front of one cell often triggers the growth of another. Most single-cell storms are not usually severe, but a single-cell storm can produce a brief severe weather event. When this happens, it is called a pulse severe storm.
- **Multi-Cell Cluster Storm—**A multi-cell cluster is the most common type of thunderstorm. The multi-cell cluster consists of a group of cells, moving as one unit, with each cell in a different phase of the thunderstorm life cycle. Mature cells are usually found at the center of the cluster and dissipating cells at the downwind edge. Multi-cell cluster storms can produce moderate-size hail, flash floods and weak tornadoes. Each cell in a multi-cell cluster lasts only about 20 minutes; the multi-cell cluster itself may persist for several hours. This type of storm is usually more intense than a single cell storm.
- **Multi-Cell Squall Line—**A multi-cell line storm, or squall line, is a long line of storms with a continuous well-developed gust front at the leading edge. The storms can be solid or have gaps and breaks in the line. Squall lines can produce hail up to golf-ball size, heavy rainfall, and weak tornadoes, but they are best known as the producers of strong downdrafts. Occasionally, a strong downburst will accelerate a portion of the squall line ahead of the rest of the line. This produces what is called a bow echo. Bow echoes can develop with isolated cells as well as squall lines. Bow echoes are easily detected on radar but are difficult to observe visually.
- **Super-Cell Storm—**A super-cell is a highly organized thunderstorm that poses a high threat to life and property. It is similar to a single-cell storm in that it has one main updraft, but the updraft is extremely strong, reaching speeds of 150 to 175 miles per hour. Super-cells are rare. The main characteristic that sets them apart from other thunderstorms is the presence of rotation. The rotating updraft of a super-cell (called a mesocyclone when visible on radar) helps the super-cell to produce extreme weather events, such as giant hail (more than 2 inches in diameter), strong downbursts of 80 miles an hour or more, and strong to violent tornadoes.

As Figure 11-2 illustrates (most recent data available), Washington ranks 50th nationwide in deaths associated with lightning strikes, having five deaths during the time period 1959-2016. Washington ranks 49th with respect to cloud-to-ground flash densities during the time period 2007-2016.[48] Annually, 30 percent of all power outages nationwide are lightning related, with total costs approaching $1 billion dollars (CoreLogic, 2015). Lightning starts approximately 4,400 house fires each year, with estimated losses exceeding $280 million.

[48] NOAA Lightning Safety. Accessed 14 August 2017. http://www.lightningsafety.noaa.gov/stats/59-16_State_Ltg_Fatality+Fatality_Rate_Maps.pdf

Source: Vaisala, 2017

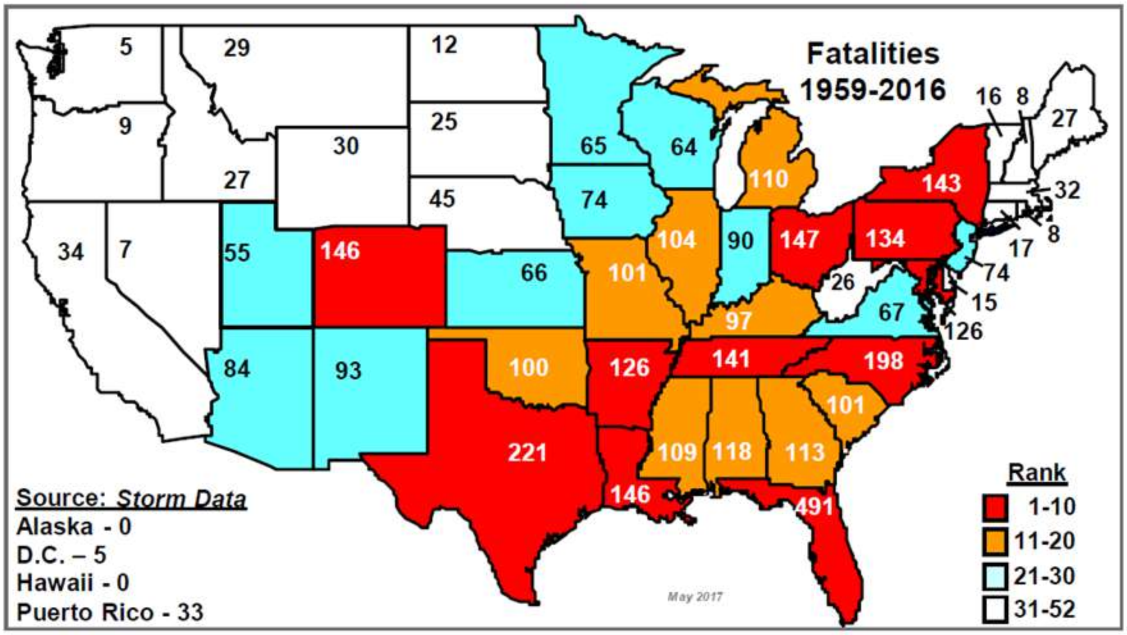


Figure 11-2 Lightning Fatalities by State, 1959-2016

11.2.2 Damaging Winds

Damaging winds are classified as those exceeding 60 mph. Damage from such winds accounts for half of all severe weather reports in the lower 48 states and is more common than damage from tornadoes. Wind speeds can reach up to 100 mph and can produce a damage path extending for hundreds of miles. There are seven types of damaging winds:

- **Straight-line winds —**Any thunderstorm wind that is not associated with rotation; this term is used mainly to differentiate from tornado winds. Most thunderstorms produce some straight-line winds as a result of outflow generated by the thunderstorm downdraft.
- **Downdrafts —**A small-scale column of air that rapidly sinks toward the ground.
- **Downbursts—**A strong downdraft with horizontal dimensions larger than 2.5 miles resulting in an outward burst or damaging winds on or near the ground. Downburst winds may begin as a microburst and spread out over a wider area, sometimes producing damage similar to a strong tornado. Although usually associated with thunderstorms, downbursts can occur with showers too weak to produce thunder.
- **Microbursts—**A small concentrated downburst that produces an outward burst of damaging winds at the surface. Microbursts are generally less than 2.5 miles across and short-lived, lasting only 5 to 10 minutes, with maximum wind speeds up to 168 mph. There are two kinds of microbursts: wet and dry. A wet microburst is accompanied by heavy precipitation at the surface. Dry microbursts, common in places like the high plains and the intermountain west, occur with little or no precipitation reaching the ground.
- **Gust front—**A gust front is the leading edge of rain-cooled air that clashes with warmer thunderstorm inflow. Gust fronts are characterized by a wind shift, temperature drop, and gusty

winds out ahead of a thunderstorm. Sometimes the winds push up air above them, forming a shelf cloud or detached roll cloud.

- **Derecho—**A derecho is a widespread thunderstorm wind caused when new thunderstorms form along the leading edge of an outflow boundary (the boundary formed by horizontal spreading of thunderstorm-cooled air). The word “derecho” is of Spanish origin and means “straight ahead.” Thunderstorms feed on the boundary and continue to reproduce. Derechos typically occur in summer when complexes of thunderstorms form over plains, producing heavy rain and severe wind. The damaging winds can last a long time and cover a large area.
- **Bow Echo—**A bow echo is a linear wind front bent outward in a bow shape. Damaging straight-line winds often occur near the center of a bow echo. Bow echoes can be 200 miles long, last for several hours, and produce extensive wind damage at the ground.

11.2.3 Hail Storms

Hail occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they freeze into ice. Recent studies suggest that super-cooled water may accumulate on frozen particles near the back side of a storm as they are pushed forward across and above the updraft by the prevailing winds near the top of the storm. Eventually, the hailstones encounter downdraft air and fall to the ground.

Hailstones grow two ways: by wet growth or dry growth. In wet growth, a tiny piece of ice is in an area where the air temperature is below freezing, but not super cold. When the tiny piece of ice collides with a super-cooled drop, the water does not freeze on the ice immediately. Instead, liquid water spreads across tumbling hailstones and slowly freezes. Since the process is slow, air bubbles can escape, resulting in a layer of clear ice. Dry growth hailstones grow when the air temperature is well below freezing and the water droplet freezes immediately as it collides with the ice particle. The air bubbles are “frozen” in place, leaving cloudy ice.

11.2.4 Ice and Snow Storms

The National Weather Service defines an ice storm as a storm that results in the accumulation of at least 0.25 inches of ice on exposed surfaces. Ice storms occur when rain falls from a warm, moist, layer of atmosphere into a below freezing, drier layer near the ground. The rain freezes on contact with the cold ground and exposed surfaces, causing damage to trees, utility wires, and structures (see Figure 11-3).

Precipitation falls as snow when air temperature remains below freezing throughout the atmosphere. In many climates, precipitation that forms in wintertime clouds starts out as snow because the top layer of the storm is usually cold enough to create snowflakes. Snowflakes are just collections of ice crystals that cling to each other as they fall toward the ground. Precipitation continues to fall as snow when the temperature remains at or below 0 degrees Celsius from the cloud base to the ground. The following are used to define snow events:

- Snow Flurries. Light snow falling for short durations. No accumulation or light dusting is all that is expected.
- Snow Showers. Snow falling at varying intensities for brief periods of time. Some accumulation is possible.
- Snow Squalls. Brief, intense snow showers accompanied by strong, gusty winds. Accumulation may be significant. Snow squalls are best known in the Great Lakes Region.

- Blowing Snow. Wind-driven snow that reduces visibility and causes significant drifting. Blowing snow may be snow that is falling and/or loose snow on the ground picked up by the wind.
- Blizzards. Winds over 35mph with snow and blowing snow, reducing visibility to 1/4 mile or less for at least 3 hours.

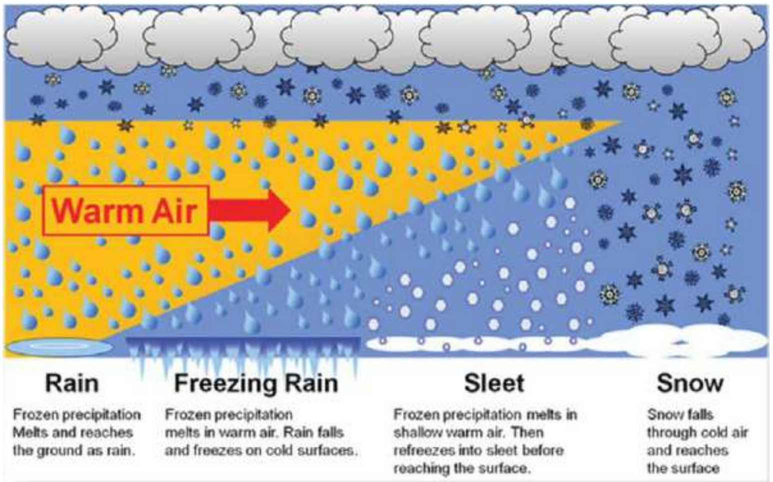


Figure 11-3 Types of Precipitation

The National Weather Service (NWS) has rated Pend Oreille County one of the areas of the state most vulnerable to blizzards (2010 HMP). Winter season snowfall in the valleys in the area 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 elevation 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.[49]

November 19, 1996, produced one of the region's worst ice storms in 60 years. Before the freezing rain hit, there was already snow on the ground around the planning area. During the day, up to an inch and a half of freezing rain fell, coating trees, roads, buildings, vehicles, and power lines in a dense slippery glaze. Official weather stations located at the Spokane International Airport recorded a high temperature of only 33°F and 1.24 inches of precipitation, which fell in the form of rain, freezing rain, freezing drizzle, snow, and mist. The station also reported freezing fog in the area that day.

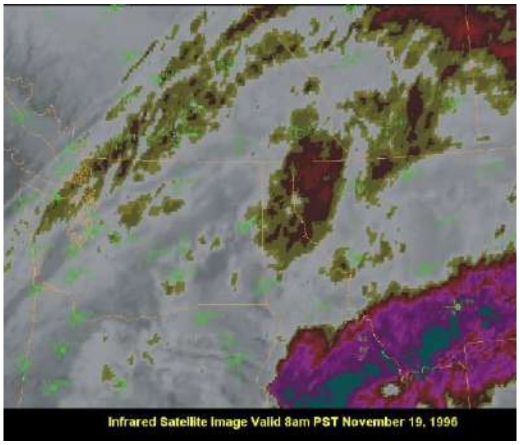


Figure 11-4 November 19, 1996 Satellite Image of Cloud Cover

[49] https://wrcc.dri.edu/narratives/WASHINGTON.htm

As the weather front pushed through (see figure right), trees came crashing down under the immense weight of the ice.[50] Pend Oreille County was declared in January for damages sustained (DR 1152). Electrical lines once built through nearly inaccessible terrain were relocated to county road rights-of-way for easy access for future repairs. Some citizens who lost power in Pend Oreille County as a result of the record-breaking event remained without power for weeks as major electrical distributions systems were damaged or destroyed. The PUD received approximately $400,000 from state and federal disaster funds for relocation of electrical lines damaged by the ice storm.[51] Several people throughout the state and neighboring states lost their lives, and damages were estimated at over $22 million (1996 dollars). This ice storm remains one of the most severe on record for the area.

11.2.5 Extreme Temperatures

Extreme temperature includes both heat and cold events, which can have a significant impact on human health, commercial/agricultural businesses, and primary and secondary effects on infrastructure (e.g., burst pipes and power failure). What constitutes "extreme cold" or "extreme heat" can vary across different areas of the country, based on what the population is accustomed to within the region (CDC, 2014).

Extreme Cold

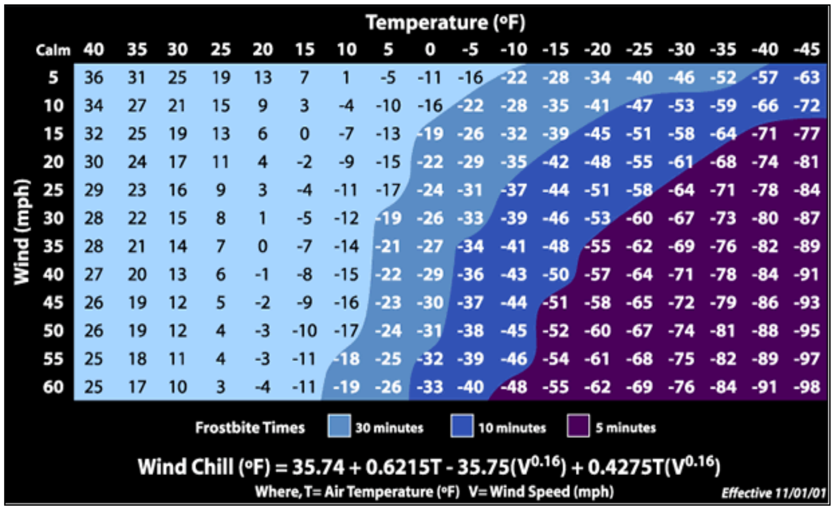
Extreme cold events are when temperatures drop well below normal in an area. In regions relatively unaccustomed to winter weather, near freezing temperatures are considered "extreme cold." Extreme cold can often accompany severe winter storms, with winds exacerbating the effects of cold temperatures by carrying away body heat more quickly, making it feel colder than is indicated by the actual temperature (known as wind chill). Figure 11-5 demonstrates the value of wind chill based on the ambient temperature and wind speed.

Exposure to cold temperatures, whether indoors or outside, can lead to serious or life-threatening health problems such as hypothermia, cold stress, frostbite or freezing of the exposed extremities such as fingers, toes, nose, and ear lobes. Hypothermia occurs when the core body temperature is <95ºF. If persons exposed to excessive cold are unable to generate enough heat (e.g., through shivering) to maintain a normal core body temperature of 98.6ºF, their organs (e.g., brain, heart, or kidneys) can malfunction. Extreme cold also can cause emergencies in susceptible populations, such as those without shelter, those who are stranded, or those who live in a home that is poorly insulated or without heat. Infants and the elderly are particularly at risk, but anyone can be affected.

Extremely cold temperatures often accompany a winter storm, so individuals may have to cope with power failures and icy roads. Although staying indoors as much as possible can help reduce the risk of car crashes and falls on the ice, individuals may also face indoor hazards. Many homes will be too cold—either due to a power failure or because the heating system is not adequate for the weather. The use of space heaters and fireplaces to keep warm increases the risk of household fires and carbon monoxide poisoning.

[50] https://www.wrh.noaa.gov/images/otx/cases/19Nov1996/sat.jpg

[51] https://www.fema.gov/news-release/2000/10/31/powerline-placement-reduces-disaster-damage-update



Temperature (°F)

Wind (mph) Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes, 10 minutes, 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

Figure 11-5 NWS Wind Chill Index

During cold months, carbon monoxide may be high in some areas because the colder weather makes it difficult for car emission control systems to operate effectively. Carbon monoxide levels are typically higher during cold weather because the cold temperatures make combustion less complete and cause inversions that trap pollutants close to the ground (USEPA, 2009).

Extreme Heat[52]

Temperatures that hover 10 degrees or more above the average high temperature for the region and last for several days or weeks are defined as extreme heat (FEMA, 2006; CDC, 2006). An extended period of extreme heat of three or more consecutive days is typically called a heat wave and is often accompanied by high humidity (Ready America, Date Unknown; NWS, 2005). There is no universal definition of a heat wave because the term is relative to the usual weather in a particular area. The term heat wave is applied both to routine weather variations and to extraordinary spells of heat which may occur only once a century (Meehl and Tebaldi, 2004). A basic definition of a heat wave implies that it is an extended period of unusually high atmosphere-related heat stress, which causes temporary modifications in lifestyle and which may have adverse health consequences for the affected population (Robinson, 2000). Figure 11-6 also identifies some of those consequences and associated temperatures. [53]

Certain populations are considered vulnerable or at greater risk during extreme heat events. These populations include but are not limited to the elderly age 65 and older, infants and young children under five years of age, pregnant woman, the homeless or poor, the overweight, and people with mental illnesses, disabilities, and chronic diseases (NYS HMP, 2008).

[53] NCDC, 2000

Relative Humidity (%) \ Temperature (°F)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Category	Heat Index	Health Hazards
Extreme Danger	130 °F – Higher	Heat Stroke / Sunstroke is likely with continued exposure.
Danger	105 °F – 129 °F	Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity.
Extreme Caution	90 °F – 105 °F	Sunstroke, muscle cramps, and/or heat exhaustions possible with prolonged exposure and/or physical activity.
Caution	80 °F – 90 °F	Fatigue possible with prolonged exposure and/or physical activity.

Figure 11-6 Heat Stress Index

Wind-Chill Factor Chart (in Fahrenheit)

Wind Speed in mph

Air Temperature	Calm	5	10	15	20	25	30	35	40
40	40	36	34	32	30	29	28	28	27
30	30	25	21	19	17	16	15	14	13
20	20	13	9	6	4	3	1	0	-1
10	10	1	-4	-7	-9	-11	-12	-14	-15
0	0	-11	-16	-19	-22	-24	-26	-27	-29
-10	-10	-22	-28	-32	-35	-37	-39	-41	-43

Comfortable for out door play Caution Danger

Heat Index Chart (in Fahrenheit %)

Relative Humidity (Percent)

Air Temperature (F)	40	45	50	55	60	65	70	75	80	85	90	95	100
80	80	80	81	81	82	82	83	84	84	85	86	86	87
84	83	84	85	86	88	89	90	92	94	96	98	100	103
90	91	93	95	97	100	103	105	109	113	117	122	127	132
94	97	100	103	106	110	114	119	124	129	135			
100	109	114	118	124	129	130							
104	119	124	131	137									

Figure 11-7 Temperature Index for Children

Figure 11-8 illustrates the number of weather fatalities based on 10-year and 30-year averages.[54] Review of the data provides the following information:

- Extreme heat is the number one weather-related cause of death in the U.S. over the 30-year average. Flood ranked second highest in causes of weather related deaths for the 30-year average, followed by tornadoes, which ranked the third highest for the 30-year average (2008-2017).
- Flood was the number one cause of weather-related fatalities for 2017, followed by heat and rip currents.
- Tornado, heat, and flood were the number one causes of weather related fatalities when averaged over a 10-year period (2008-2017).

[54] NOAA, 2017 (http://www.nws.noaa.gov/om/hazstats.shtml) (Most recently available at time of update.)

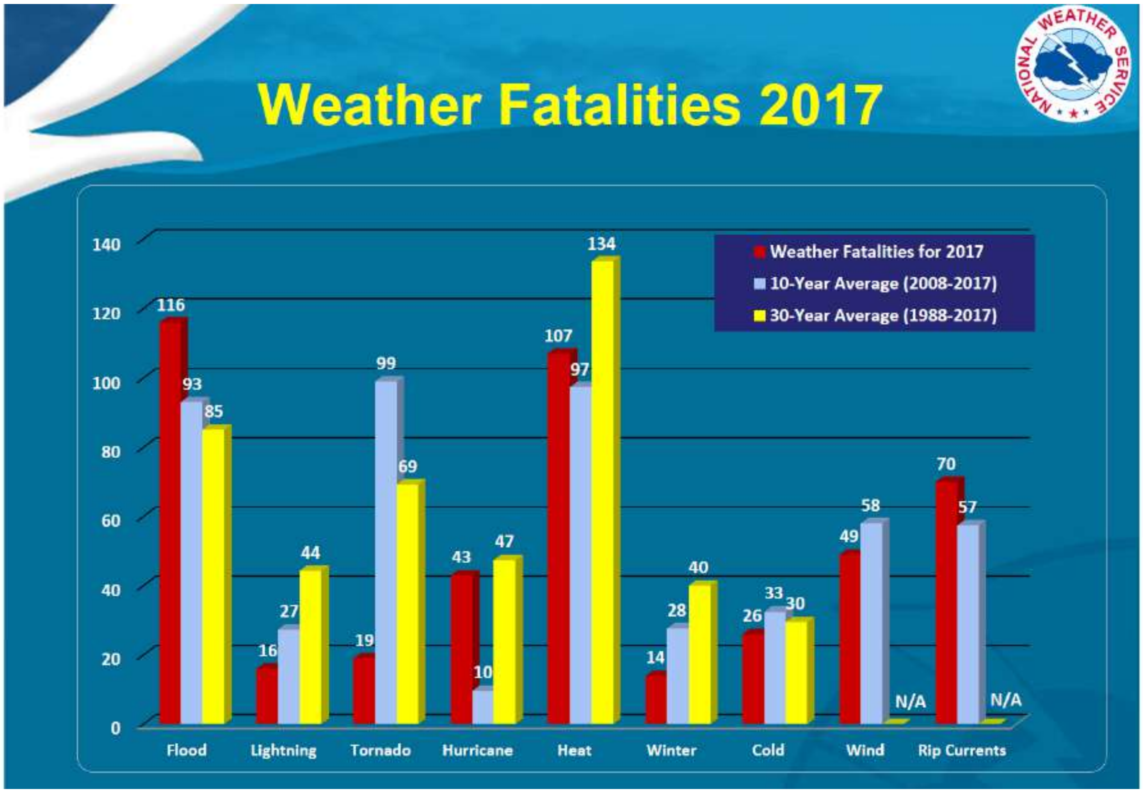


Figure 11-8 Average Number of Weather Related Fatalities in the U.S.

Depending on severity, duration, and location, extreme heat events can create or provoke secondary hazards including, but not limited to: dust storms, droughts, wildfires, water shortages and power outages (FEMA, 2006; CDC, 2006). This could result in a broad and far-reaching set of impacts throughout a local area or entire region. Impacts could include significant loss of life and illness; economic costs in transportation; agriculture; production; energy and infrastructure; and losses of ecosystems, wildlife habitats, and water resources (Adams, Date Unknown; Meehl and Tebaldi, 2004; CDC, 2006; NYSDPC, 2008).

11.3 HAZARD PROFILE

11.3.1 Extent and Location

The entire planning area is susceptible to the impacts of severe weather. Severe weather events customarily occur during the months of October to April, although they have occurred year round. The County has been impacted by tornadoes, strong winds, rain, snow, or other precipitation, and have experienced thunder or lightning storms. Considerable snowfall regularly occurs throughout the region.

Communities in low-lying areas next to rivers, streams or lakes are more susceptible to flooding as a result of snowmelt. Wind events have also been extensively damaging to the County. For the planning region as a whole, wind events are one of the most common weather-related incidents to occur, often times leaving the area without power, although customarily not for long extended periods.

Severe storms and weather also affect transportation. Access across certain parts of the County is unpredictable as roads are vulnerable to damage from severe storms, snow accumulation, and landslide/erosion. Severe storms also cause flooding and channel migration.

The distribution of average weather conditions for Pend Oreille County are shown in Figures 11-9 through 11-13. [55] Data reflected below are based on Washington State averages, reflecting the ranking within Washington State's 39 counties. The temperature, snow fall, and precipitation information were calculated and reported by USA Weather from the historical data of 18,000+ U.S weather stations for the period of time from 1980 to 2010. The wind speed information was calculated from data from 15,000 worldwide stations for the period of time from 1980 to 2010.[56]

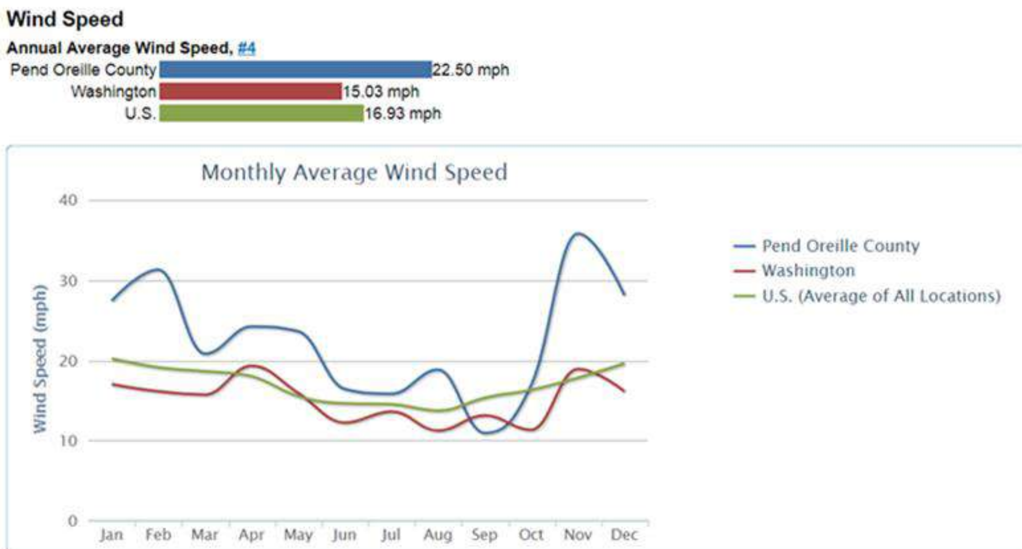


Figure 11-9 Annual Average Wind Speed by Month

[55] http://www.usa.com/pend-oreille-county-wa-weather.htm

[56] http://www.usa.com/pend-oreille-county-wa-weather.htm

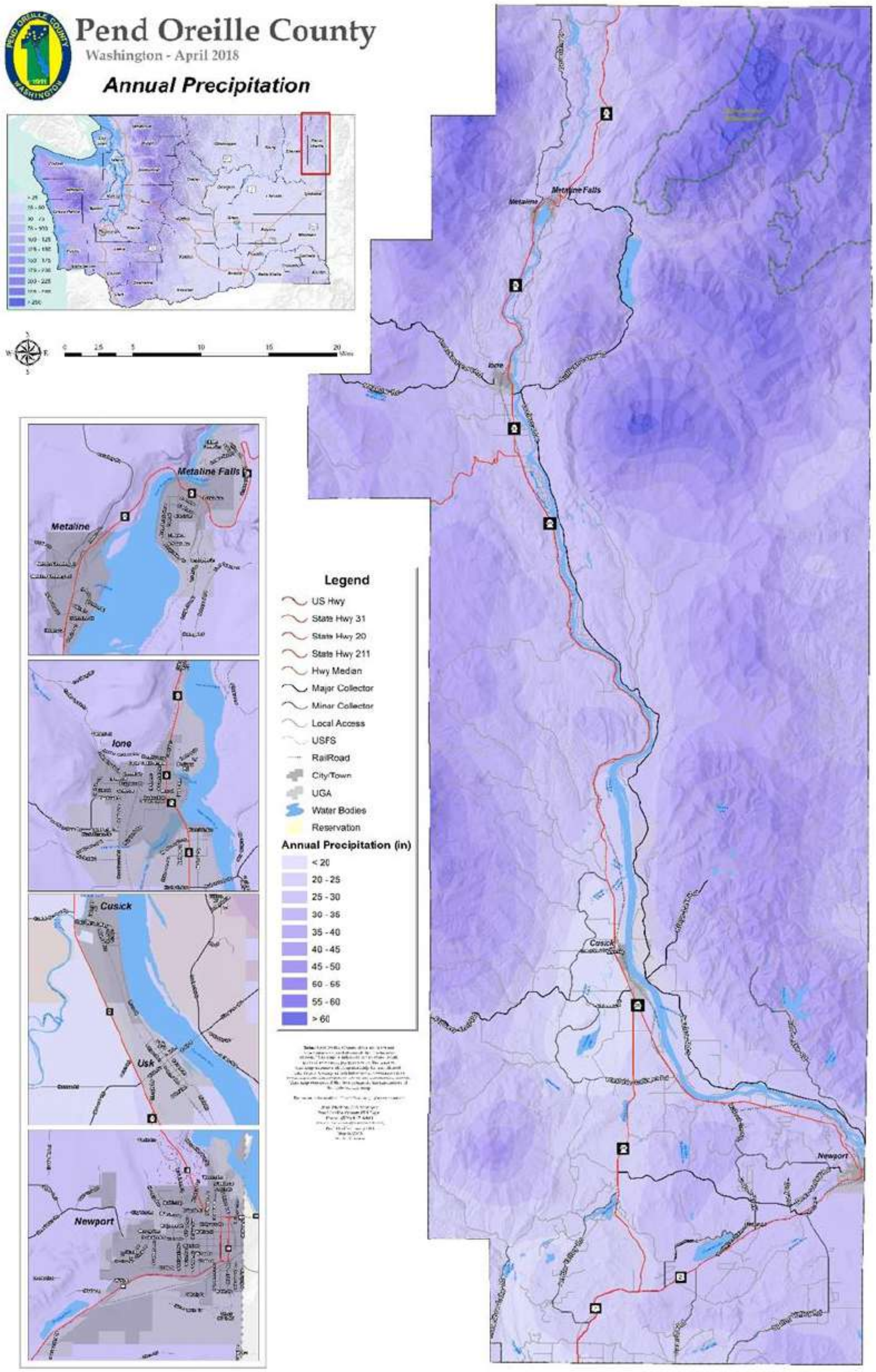


Figure 11-10 Annual Preciptation

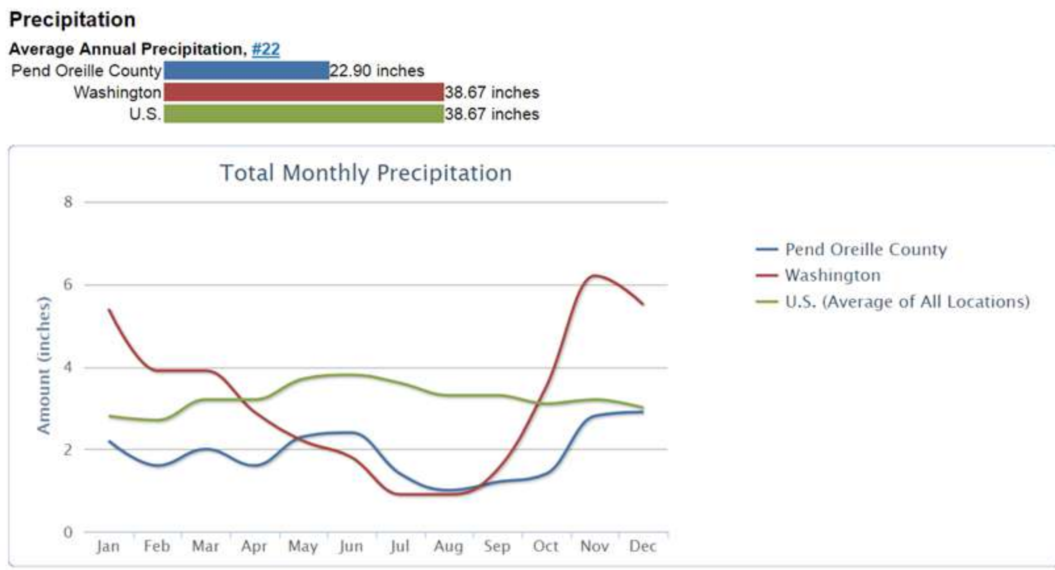


Figure 11-11 Pend Oreille County Average Annual Precipitation

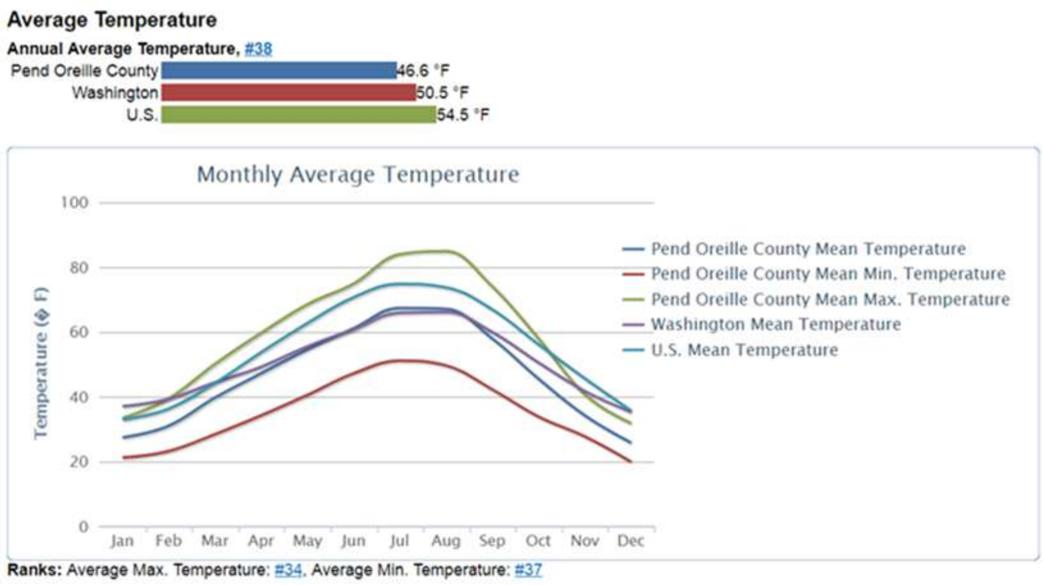


Figure 11-12 Pend Oreille County Average Temperature

Figure 11-13 Pend Oreille County Average Snowfall

Source: USA.com

11.3.2 Previous Occurrences

Table 11-1 summarizes severe weather events in Pend Oreille County since 1960, as recorded by the National Oceanic and Atmospheric Administration (NOAA), Spatial Hazard Events and Losses Database for the United States (SHELDUS), other local area plans, and FEMA websites. SHELDUS utilizes a variety of NOAA data sources and covers severe weather events from 1960 through 2000 that caused more than $50,000 in property and/or crop damage. Data obtained from the National Climatic Data Center include weather events causing more than $100,000 in property and/or crop damage from 1993 through 2003 (except June and July 1993, for which data is not available), with the following exceptions:

- Tornado information is from 1950 to 1992.
- Thunderstorm wind and hail information is from 1955 to 1992.

Review of Tornado Project data reveals that there has also been one tornado which has occurred within the planning area. That tornado was a magnitude F2, occurring on July 17, 1978 at 4:00 p.m. No deaths, injuries or damage was reported as a result of the tornado.

Table 11-1
Severe Weather Events Impacting Planning Area Since 1960

Date	Type	Deaths or Injuries	Property Damage
November 19, 1996 (Disaster 1152)	Severe Ice Storm	4 Deaths	>$22M
Description: Snow followed by freezing rain caused four deaths in the state as a result of the event. The County sustained extensive power outages throughout the area which lasted for several weeks.			
Dec. 1996—Jan. 1997 (Disaster 1159)	Severe winter storm, flooding, landslides and mudslides.	24 deaths statewide	Statewide: Stafford Act assistance $83 million; SBA $31.7 million; total losses $140 million statewide
Description: Saturated ground combined with snow, freezing rain, rain, rapid warming and high winds within a five-day period produced flooding and landslides. 37 counties were impacted, with large power outages throughout the impacted counties.			
January 2006 (Disaster 1641)	Severe winter storm, flood, landslide, mudslide, tidal surge	Unknown	Unknown
Description: Heavy rains			
December 2006 (Disaster 1682)	Severe winter storm, wind, landslides and mudslides	One fatality (in McCleary)	Unknown
Description: Severe winter storm caused landslides and mudslides throughout region. The County experienced hurricane-force winds and heavy rains on the coast causing 22,000 customers to lose power; a million were without power in the State. The "Hanukkah Eve Wind Storm of 2006" downed power lines, trees, and building debris which caused many road closures and left the county in a state of emergency.			
December 2008 (Disaster 1825)	Severe winter storm, record and near record snow	Unknown	Public Assistance to all declared counties was over $5.5 million
Description: Severe winter storm, including record and near record snowfall and heavy rains and winds.			
November 2015 (Disaster 4249)	Severe storm, straight-line winds, flooding, landslides and mudslides	Unknown	PA program only available, no IA.
Description: Severe winter storm, including record and near record snowfall and heavy rains and winds.			

11.3.3 Severity

Most of the temperature and precipitation records occurring throughout Washington State are from stations located in the valleys falling within the geographic boundary of Pend Oreille County as the weather fluctuates significantly. The average annual precipitation increases in a northeasterly direction from 17 inches in the Spokane area to 28 inches in the northeastern corner of the State.

The most common problems associated with severe storms are immobility and loss of utilities. Fatalities are uncommon but have occurred either as a direct or indirect result of the storm. Roads become impassable due to flooding, downed trees, ice or snow, or a landslide. Power lines may be downed due to high winds, and services such as water or phone may not be able to operate without power. Lightning, while it does not occur very frequently, does occur during the summer months approximately 7-10 times per year according to Planning Team members, it can cause severe damage and potential injuries, although no such injuries have been reported within Pend Oreille County. Physical damage to homes and facilities caused by wind regularly occur, although customarily are not severe. Due to the large amounts of snow customarily received in the region, accumulation can, and has, caused havoc on transportation. While the county is well-equipped to manage snow with respect to snow clearing equipment and resources within the region, it nonetheless impacts the transportation routes, especially when individuals traveling through the area are not accustomed to such driving conditions. In addition, the snow levels almost annually cause flooding in areas throughout the county. As of the update of this plan, the county is again experiencing flooding resulting from snowmelt occur more quickly than anticipated due to higher temperatures, and also the increased snowpack, which is higher than previous years (see figure below).[57]

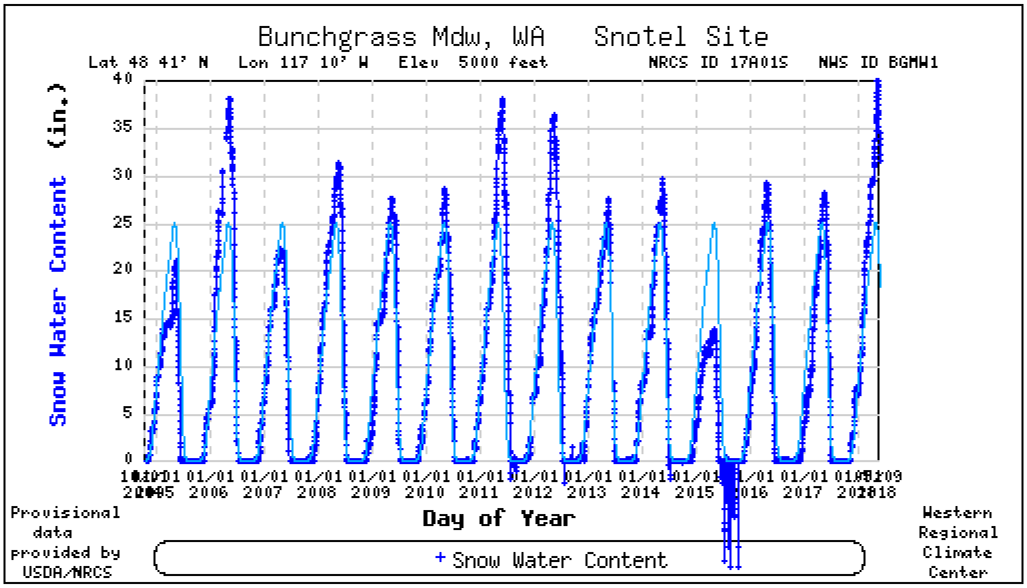


Figure 11-14 Snowpack Telemetry (SNOTEL) -Snow Depth in Pend Oreille County 2005-2018

Ice storms, especially when accompanied by high winds, can have an especially destructive impact within the planning region, with both being able to close major transportation corridors and bridges, and also its impact on the densely wooded areas. Accumulation of ice on trees, power lines, communication towers and wiring, or other utility services can be crippling, and create additional hazards for residents, motorists, and pedestrians. The County has received one disaster declaration for an ice storm event, as well as several "Severe Weather" incidents, which have included snow and wind.

Windstorms are common in the planning area, occurring many times throughout the year. The predicted wind speed given for wind warnings issued by the National Weather Service is for a one-minute average, during which gusts may be 25 to 30 percent higher. Windstorms are one of the greatest threats within the planning area, with several significant events identified. The most recent disaster declaration to occur within the county included straight-line winds, which occurred in November 2015.

Tornadoes are potentially the most dangerous of local storms, but they are not common in the planning area with one event occurring in 1978. If a major tornado were to strike within the planning area, damage could be widespread. As a result of building stock age, fatalities could be high, with many people homeless for an extended period of time. Routine services such as telephone or power could be disrupted. Businesses

[57] Western Region Climate Center - https://wrcc.dri.edu/cgi-bin/snoMAIN.pl?BGMW1

could be forced to close for an extended period, impacting commodities available for citizens. As a result of the heavily forested areas, debris accumulations would be high, causing additional difficulties with access along major arterials connecting the area to other parts of the state, further impacting logistical support and commodities.

The extent (severity or magnitude) of extreme cold temperatures are generally measured through the wind chill temperature index. Wind Chill Temperature is the temperature that people and animals feel when outside and it is based on the rate of heat loss from exposed skin by the effects of wind and cold. As the wind increases, the body is cooled at a faster rate causing the skin's temperature to drop (NWS, 2009).

On November 1, 2001, the NWS implemented a new wind chill temperature index. It was designed to more accurately calculate how cold air feels on human skin. Figure 11-5 (above) shows the new wind chill temperature index[58]. The Index includes a frostbite indicator, showing points where temperature, wind speed and exposure time will produce frostbite to humans. The chart shows three shaded areas of frostbite danger. Each shaded area shows how long a person can be exposed before frostbite develops (NWS, 2009).

The extent of extreme temperatures is generally measured through the heat index (shown above). Created by the NWS, the Heat Index accurately measures apparent temperature of the air as it increases with the relative humidity. The Heat Index can be used to determine what effects the temperature and humidity can have on the population (NCDC, 2000).

Most of the temperature and precipitation records occurring throughout Washington State are from stations located in the valleys falling within the geographic boundary of Pend Oreille County. The average annual precipitation increases in a northeasterly direction from 17 inches in the Spokane area to 28 inches in the northeastern corner of the State. The county regularly experiences hot temperatures during the spring and summer months, as well as extreme cold temperatures into negative double-digits. The County does have both cooling and heating shelters available for operation as needed.

11.3.4 Frequency

The severe weather events for Pend Oreille which have risen to the level of a federal disaster declaration shown in Table 11-1 are often related to high winds and associated other winter storm-type events such as heavy rains, flooding, landslides, snow and to a much lesser extent, ice. While incidents do not often gain a disaster declaration, the planning area nonetheless can expect to experience exposure to some type of severe weather event at least annually, and in most years, multiple times.

Since 1960, six severe weather declarations have been issued within the County; two incidents in 1996, two incidents in 2006, one in 2008, and one in 2015. The six declarations, however, are reflective only of those incidents which have risen to the level of a declaration, which would require a statewide computation of loss, and therefore does not appropriate reflect the true number of times the County and its planning partners have been impacted by severe weather events. With respect to wind incidents, the County has experienced straight-line winds which have caused significant damages as recently as 2015 (DR 4249). Washington State Department of Ecology estimates frequency intervals for wind speed as follows:

[58] NWS, 2008

WIND SPEEDS EXCEED	FREQUENCY
55 MPH	Annually
76 MPH	~ 5 years
83 MPH	~10 years
92 MPH	~25 years
100 MPH	~50 years
108 MPH	~100 years

11.4 VULNERABILITY ASSESSMENT

11.4.1 Overview

Severe weather incidents can and regularly do occur throughout the entire planning area. Similar events impact areas within the planning region differently, even though they are part of the same weather system, with topography being the primary influence for impact. While in some instances some type of advanced warning is possible, as a result of climatic differences, topographic and relative distance to the mountains in the area, the same system can be much more severe in certain areas of the County. Therefore, preparedness plays a significant contributor in the resilience of the citizens to withstand such events.

Methodology

A lack of data separating severe weather damage from flooding, windstorms, and landslide damage prevented a detailed analysis for exposure and vulnerability at the incident-type level. For planning purposes, it is assumed that the entire planning area is exposed to some extent to severe weather. Certain areas are more exposed due to geographic location, topography/elevation, and local weather patterns, as well as the response capabilities of local first responders.

Warning Time

Meteorologists can often predict the likelihood of some severe storms. In some cases, this can give several days of warning time. However, meteorologists cannot predict the exact time of onset or severity of the storm, and the rapid changes which can also occur significantly increasing the impact of a weather event.

11.4.2 Impact on Life, Health, and Safety

The entire planning area is susceptible to severe weather events. Populations living at higher elevations with large stands of trees or above-ground power lines may be more susceptible to wind damage and black out conditions, while populations in low-lying areas are at risk for possible flooding and landslides associated with the flooding as a result of heavy rains or snowmelt. This is particularly true within, and unique to, Pend Oreille County as a result of the Pend Oreille River, which is fed from mountainous regions in Montana, passing through Idaho into Washington. As such, weather patterns in each of those areas impact Pend Oreille County. Increased levels of precipitation in the form of snow also vary by area, with higher elevations being more susceptible to increased accumulations. Resultant secondary impacts from power outages during cold weather event, when combined with the high population of retired and elderly residents significantly impacts response capabilities and the risk factor associated with such weather incidents. Within the densely wooded areas, increased fire danger during extreme heat conditions increases the likelihood of fire, which increases fire danger.

Particularly vulnerable populations are the elderly and very young, low income, linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are isolated from major roads. Extreme temperature variations, either heat or cold, are of significant concern on both the elderly and the young, increasing vulnerability of those populations.

The National Severe Storms Laboratory states that of injuries related to ice and snow:[59]

    - About 70% occur in automobiles.
    - About 25% are people caught out in the storm.
    - Majority are males over 40 years old.
- Of injuries related to exposure to cold:
    - 50% are people over 60 years old.
    - Over 75% are males.
    - About 20% occur in the home.

A number of storm events have cut off primary access routes to areas of the County for days at a time – these storm events include both declared and non-declared incidents, as even minor incidents have the potential to impact ingress and egress. Such issues are of concern as a result of limited access for evacuation purposes by first responder if vital ALS is required, as well as for general evacuation purposes during a period where power is out, and individuals attempt to leave the area. Travel time can be increased significantly if alternate routes are used.

Power Loss

Pend Oreille County PUD provides electricity to the planning area. Severe weather events can and have disrupted electricity in the planning area, on average though only a few times each year. When most power outages occur, they last for only a few hours, except in extreme outlying areas. Statewide, for the 2015 windstorm incident (DR-4249), the weather event which impacted the region caused in excess of $21 million in damages, primarily to utilities.

11.4.3 Impact on Property

Currently data identifies that there are approximately 8,700 buildings in the planning area (including critical facilities and government structures not identified in Assessor data). Most of these buildings are residential. Within Pend Oreille County, slightly less than half of structures were built pre-code or early-codes, meaning a high percentage of structures in those areas could be impacted by significant weather events as many were built without the influence of a structural building code with provisions for wind loads. (See Section 3.8.2 for additional information on building stock age.)

[59] http://www.nssl.noaa.gov/education/svrwx101/winter/

For planning purposes, all properties and buildings within the planning area are considered to be exposed to the severe weather hazard, but structures in poor condition or in particularly vulnerable locations (hilltops or exposed open areas) may be at risk for the most damage. The frequency and degree of damage will depend on specific locations and severity of the weather pattern impacting the region. It is improbable to determine the exact number of structures susceptible to a weather event, and therefore emergency managers and public officials should establish a maximum threshold, or worst-case scenario, of susceptible structures.

Loss estimations for severe weather hazards are not based on modeling utilizing damage functions, as no such functions have been generated. Instead, loss estimates were developed representing 10 percent, 30 percent and 50 percent of the structure and content values of exposed structures. This allows emergency managers to select a range of economic impact based on an estimate of the percent of damage to the general building stock and associated inventory. Damage in excess of 50 percent is considered to be substantial by most building codes and typically requires total reconstruction of the structure. Table 11-2 shows loss estimates for potential severe weather risk by jurisdiction at the identified percent damages including both residential and non-residential structures.

Table 11-2
Potential Building Losses Due to Severe Weather Hazard

Jurisdiction	Estimated Building Count (2)	Total Exposed Value (Structure and Content)	Exposed Building and Content Values		
			10-, 30-, and 50 Percent		
			10 Percent	30 Percent	50 Percent
Unincorporated Pend Oreille County	6,897	$1,086,351,621	$108,635,162.10	$325,905,486.30	$543,175,810.50
Kalispel Tribe	102	$98,614,681	$9,861,468.10	$29,584,404.30	$49,307,340.50
Newport, City of	839	$181,801,463	$18,180,146.30	$54,540,438.90	$90,900,731.50
Cusick, Town of	115	$8,135,247	$813,524.70	$2,440,574.10	$4,067,623.50
Ione, Town of	265	$25,582,201	$2,558,220.10	$7,674,660.30	$12,791,100.50
Metaline, Town of	104	$11,460,141	$1,146,014.10	$3,438,042.30	$5,730,070.50
Metaline Falls, Town of	135	$17,305,898	$1,730,589.80	$5,191,769.40	$8,652,949.00
Total	**8,457**	**$1,429,251,252**	**$142,925,125.20**	**$428,775,375.60**	**$714,625,626.00**

11.4.4 Impact on Critical Facilities and Infrastructure

No loss estimation of critical facilities was performed due to the lack of established damage functions for the severe weather hazard. Therefore, it should be assumed that all critical facilities are vulnerable to some degree. As many of the severe weather events include multiple hazards, information such as that identifying facilities exposed to flooding or landslides (see Flood and Landslide profiles) are also likely exposed to severe weather. Additionally, facilities on higher ground may also be exposed to wind damage or damage from falling trees. The most common problems associated with severe weather are loss of utilities. Downed power lines can cause blackouts, leaving large areas isolated.

Within the planning region, both Pend Oreille PUD and Seattle Public Utilities each have hydroelectric dams which produce a significant amount of power to areas well outside of the planning area. Major power lines travel from those dams throughout the County, connecting to Bonneville Power Administration major transmission lines. As such, wind and ice events occurring in Pend Oreille County also have the potential to impact power supplies in large metropolitan areas well outside of the county.

In addition to power, phone, water, and sewer systems may also not function properly during severe weather events. Roads may become impassable due to ice or snow or from secondary hazards such as landslides. Incapacity and loss of roads are the primary transportation failures, most of which are associated with secondary hazards. Landslides that block roads are caused by heavy prolonged rains. High winds can cause significant damage to trees and power lines, with obstructing debris blocking roads, incapacitating transportation, isolating population, and disrupting ingress and egress. Snowstorms can impact the transportation system and the availability of public safety services. Of particular concern are roads providing access to isolated areas and to the elderly. Loss of electricity and phone connection could also result in isolation because some residents will be unable to call for assistance.

11.4.5 Impact on Economy

Prolonged obstruction of major routes due to severe weather can disrupt the shipment of goods and other commerce. Severe windstorms, downed trees, snow, and ice can create serious impacts on power and above-ground communication lines. Freezing rain/snow on power and communication lines can cause them to break, disrupting electricity and communication, further impacting business within the region. Prolonged outages would impact consumer and tax base as a result of lost revenue, (food) spoilage, lack of production, etc. Large, prolonged storms can have negative economic impacts for an entire region. All severe weather events have the potential to also impact tourism, an industry on which much of the planning region is dependent.

Accommodation, food and service occupations account for 17.4 percent of the County's economy; transportation, warehousing and utilities account for 8.1 percent; agriculture, forestry, fishing and hunting account for 4.7 percent, while retail trade accounts for 10.2 percent (Census Data). Combined, these occupation categories account for in excess of 40% of the County's economy. Each of these occupation classes are highly vulnerable to impacts from severe weather events.

11.4.6 Impact on Environment

The environment is highly exposed to severe weather events. Natural habitats such as streams and trees are exposed to the elements during a severe storm and risk major damage and destruction. Prolonged rains can saturate soils and lead to slope failure. Flooding events caused by severe weather or snowmelt can produce river channel migration or damage riparian habitat, also impacting spawning grounds and fish populations for many years. Within the planning area, there are four fish hatcheries, which, if impacted, could result in decreased numbers of salmon and trout in the area, as the hatcheries release the fish annually. Should this occur, this would impact the area for years to come due to the life-cycle of the returning salmon. Storm surges can erode beachfront bluffs and redistribute sediment loads. Extreme heat can raise temperatures of rivers, impacting oxygen levels in the water, threatening aquatic life.

11.5 FUTURE DEVELOPMENT TRENDS

All future development will be affected by severe storms. The ability to withstand impacts lies in sound land use practices and consistent enforcement of codes and regulations for new construction. The County does have land use regulations in place, which includes implementation of the International Building Codes as well as additional land use authority. These codes are equipped to deal with the impacts of severe weather incidents by identifying construction standards which address wind speed, roof load capacity, elevation and setback restrictions.

While under the Growth Management Act, public power utilities are required by law to supply safe, cost effective and equitable service to everyone in the service area requesting service, most lines in the area are above-ground, causing them to be more susceptible to high winds or other severe weather hazards. However, growth management is also a constraint, which could possibly lead to increased outages or even potential shortages, as while most new development expects access to electricity, they do not want to be in close proximity to sub stations. The political difficulty in sighting these sub-stations could make it difficult for the utility to keep up with regional growth if substations are not built.

Land use policies currently in place, when coupled with informative risk data such as that established within this mitigation plan will also address the severe weather hazard. With the land use tools currently in place, the County and its planning partners will be well-equipped to deal with future growth and the associated impacts of severe weather.

11.6 ISSUES

Important issues associated with a severe weather in the planning area include the following:

- Older building stock in the planning area is built to low code standards or none at all. These structures could be highly vulnerable to severe weather events such as windstorms.
- Redundancy of power supply must be evaluated and increased planning-region wide in order to more fully understand the vulnerabilities in this area.
- The capacity for backup power generation is limited and should be enhanced, especially in areas of potential isolation due to impact on major thoroughfares or evacuation routes.
- Isolated population centers exist.
- Climate change may increase the frequency and magnitude of winter flooding or storm surges, thus exacerbating severe winter events.
- Proximity to coastline enhances flooding potential through storm surges, as well as severe storms in general.

11.7 RESULTS

Based on review and analysis of the data, the Planning Team has determined that the probability for impact from a severe weather event throughout the area is highly likely, but the impact is more limited when removing resulting flood and landslide events from the severe weather category. The area experiences at least one severe storm event annually. Snow occurs regularly, and while the county is better prepared to handle snow events than other counties in the state, impact does occur. Ice is also a significant factor, impeding freight and travel. The more significant issue would be a severe storm which causes a landslide or flood event, isolating areas or blocking ingress and egress. Wind is a very significant factor, which can cause power outages. While the PUDs maintain excellent records for low incidents of long-term power outages, the possibility does exist. Based on the potential impact, the Planning Team determined the CPRI score to be 3.15, with overall vulnerability determined to be a high level.

CHAPTER 12.
VOLCANO

The 1,000 mile-long Cascade Mountain Range of Washington, Oregon and California is home to the five volcanoes, including: Glacier Peak, Mount Adams, Mount Baker, Mount St. Helens, and Mount Rainier. Any of these volcanoes can become active at any time with little or no warning.

The primary effect of a Cascade volcanic eruption on Pend Oreille County would be ash fall, with some disruption of service due to impact on surrounding counties.

The distribution of ash from a violent eruption is a function of wind direction and speed, atmospheric stability, and the duration of the eruption. The prevailing wind in this region is generally from the west or southwest, although late afternoons during the summertime customarily do include wind shifts. As a result of the west or southwesterly flows, ash is usually spread eastward from the volcano. Exceptions to this rule do, however, occur. Ash fall, because of its potential widespread distribution, suggests some limited volcanic hazards.

DEFINITIONS

Ash—Ash is a harsh acidic with a sulfuric odor, consisting of small bits of pulverized rock and glass, less than 2 millimeters (0.1 in) in diameter. Ash may also carry a high static charge for up to two days after being ejected from a volcano. When an ash cloud combines with rain, sulfur dioxide in the cloud combines with the rainwater to form diluted sulfuric acid that may cause minor, but painful burns to the skin, eyes, nose, and throat.

Lahar—A rapidly flowing mixture of water and rock debris that originates from a volcano. While lahars are most commonly associated with eruptions, heavy rains, and debris accumulation, earthquakes may also trigger them.

Lava Flow—The least hazardous threat posed by volcanoes. Cascades volcanoes are normally associated with slow moving andesite or dacite lava.

Stratovolcano—Typically steep-sided, symmetrical cones of large dimension built of alternating layers of lava flows, volcanic ash, cinders, blocks, and bombs, rising as much as 8,000 feet above their bases. The volcanoes in the Cascade Range are all stratovolcanoes.

Tephra—Ash and fragmented rock material ejected by a volcanic explosion

Volcano—A vent in the planetary crust from which magma (molten or hot rock) and gas from the earth's core erupts.

12.1 GENERAL BACKGROUND

Hazards related to volcanic eruptions are distinguished by the different ways in which volcanic materials and other debris are emitted from the volcano (see Figure 12-1). The molten rock that erupts from a volcano (lava) forms a hill or mountain around the vent. The lava may flow out as a viscous liquid, or it may explode from the vent as solid or liquid particles. Ash and fragmented rock material can become airborne and travel far from the erupting volcano to affect distant areas.

Monitored volcanoes generally give signs of reawakening (volcanic unrest) before an eruption because it takes time for magma to move from its storage area, several miles beneath the volcano, to the surface. As magma moves to the surface, it breaks open a pathway, which produces earthquakes; it goes from higher to lower pressures, resulting in the release of volcanic gases; and as the amount of magma decreases in the storage area and temporarily pools at shallower levels it deforms the earth. All these processes can be monitored, although none can be measured directly.

Volcanic events often differ from other natural hazards because the duration of unrest and eruptive activity are generally longer. Although volcanic unrest prior to eruptions can be only hours, these short timescales most frequently occur at volcanoes that have erupted in the recent past (years to decades). At volcanoes like Mount St. Helens, the conduit system which conveys magma to the surface has solidified and will have to be fractured and reopened for the next magma batch to reach the surface. Thus, it is anticipated that several days to weeks of warning will occur before an eruption, although hazardous events such as small steam and ash explosions and expulsion of water to form lahars may occur before an eruption begins. While Mount St. Helens has continued to emit steam on occasion since its last eruption, scientists feel that advanced warning of a significant magnitude would provide some level of advanced notice.

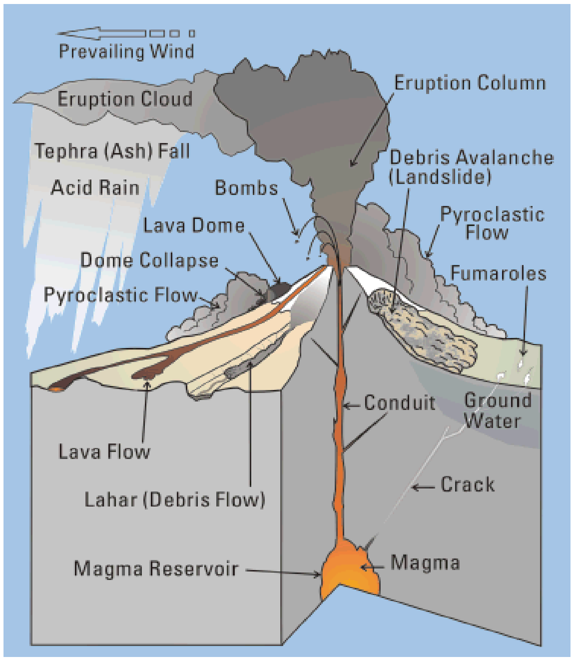


Figure 12-1 Volcano Hazard

The most recent eruption in Washington State, the eruption of Mount St. Helens in 1980, is identified as a Plinian eruption, which are the most violent of types, including violent ejection of very large columns of ash, followed by a collapse of the central portion of the volcano. It should be noted that a volcano has the potential to exhibit various styles of eruption at different intervals, changing from one form or type to another as the eruption progresses.

12.2 HAZARD PROFILE

12.2.1 Extent and Location

The Cascade Range extends more than 1,000 miles from southern British Columbia into northern California and includes 13 potentially active volcanic peaks in the U.S. Figure 12-2 shows the location of the Cascade Range volcanoes, most of which have the potential to produce a significant eruption. The straight-line distance of the major volcanoes om Washington of potential impact on the planning region are as follows:

- Mount Baker— 191.16 miles east of Pend Oreille County
- Glacier Peak— 164.66 miles east of Pend Oreille County
- Mount Rainier— 218.54 miles northeast of Pend Oreille County
- Mount Adams – 229.56 miles northeast of Pend Oreille County
- Mount St. Helens – 257.47 miles northeast of Pend Oreille County

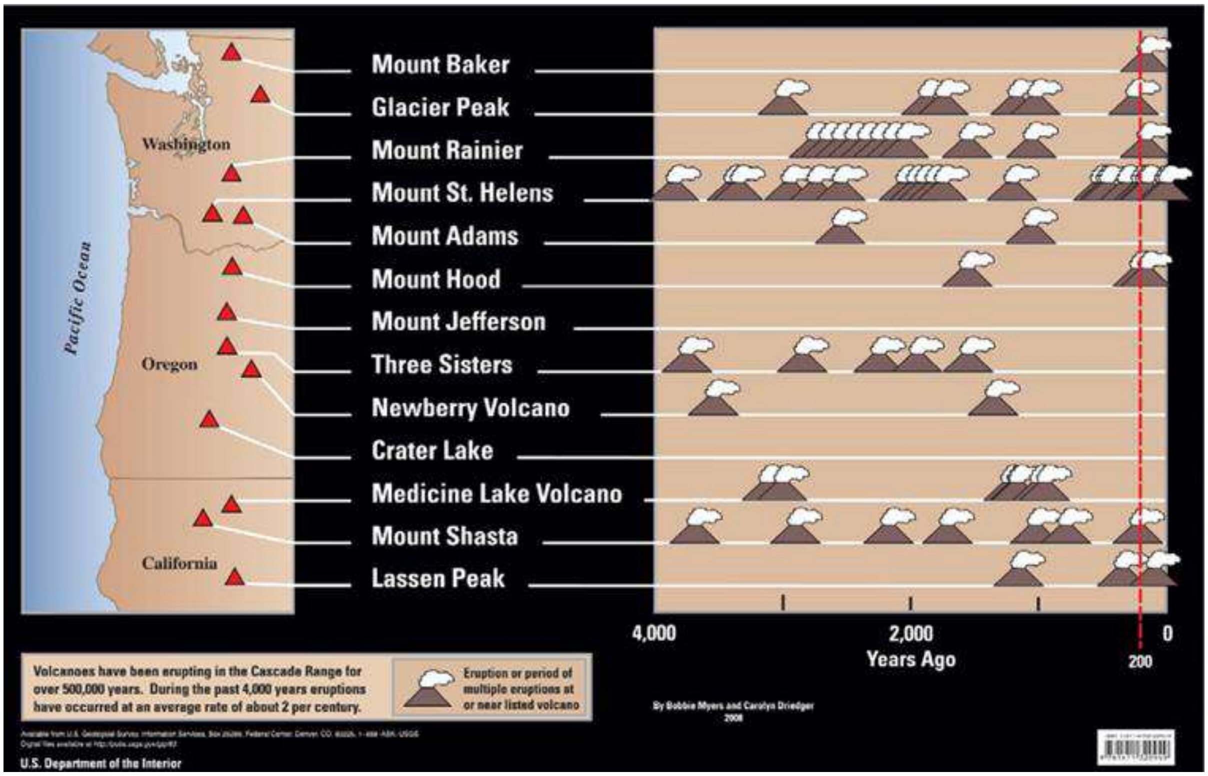


Figure 12-2 Past Eruptions of Cascade Volcanoes

Based on review of the distance between the known the volcanoes in Washington and the lahar zones, none are anticipated to cause impact to the planning area beyond ash fall, and secondary impact related to logistics and supply-chain issues. Ash fall could impact both the environment and economy of the area due to the acidic nature of the ash, and the clogging of machinery and engines.

12.2.2 Previous Occurrences

Table 12-1 summarize past eruptions in the Cascades. Pend Oreille County, like the remainder of the State of Washington, was declared in May 1980 for the eruption of Mount Saint Helens. During the 1980 Mount St. Helens eruption, 23 square miles of volcanic material buried the North Fork of the Toutle River and there were 57 human fatalities. During the last 4,000 years, Mount St. Helens (see Figure 12-3) has erupted more frequently than any other volcano in the Cascade Range.

The May 18, 1980 eruption produced the largest terrestrial landslide in recorded history, reducing Mount St. Helens' summit by 1,300 feet. Within 15 minutes of the eruption, a vertical plume of volcanic ash rose over 80,000 feet, with a dense ash cloud turning daylight into darkness. The volcanic ash cloud traveled east across the United States in three days, and encircled the entire Earth in 15 days (see Figure 12-4). Lahars (volcanic mudflows) filled rivers with rocks, sand, and mud, damaging 27 bridges and 200 homes and forcing 31 ships to remain in ports upstream. The May 18, 1980 eruption was the most economically destructive volcanic event in U.S. history (of note: as of this update, Mount Kilauea in Hawaii is currently erupting, and has already destroyed 40 homes and injuring one person). Since the 1980 eruption, Mount St. Helens again became more active during the 2004-2008 time period, when growing lava domes displaced and then divided Crater Glacier into east and west lobes, with lava oozing onto the crater floor, building domes taller than the Empire State Building and restoring 7 percent of the volume lost in 1980.[60]

Pend Oreille County did receive a significant amount of ash as a result of the St. Helens eruption; however, no impact data was captured with respect to cleanup or damages caused but Planning Team members do remember a significant amount of ash accumulation.

Figure 12-3 Shoestring Glacier on Mount St. Helens (viewed from southeast)
(Source: USGS files. Photo taken May 1965)

[60] USGS Publication accessed 11/22/17 available at: https://pubs.usgs.gov/gip/103/

Figure 12-4 Ephrata Ash Cloud - May 18, 1980 Mount St. Helens Eruption (145 miles downwind)
(Source: USGS https://volcanoes.usgs.gov/volcanoes/st_helens/st_helens_hazard_79.html)

Table 12-1
Past Eruptions in Washington

Volcano	Number of Eruptions	Type of Eruptions
Mount Adams	3 in the last 10,000 years, most recent between 1,000 and 2,000 years ago	Andesite lava
Mount Baker	5 eruptions in past 10,000 years; mudflows have been more common (8 in same time period)	Pyroclastic flows, mudflows, ash fall in 1843.
Glacier Peak	8 eruptions in last 13,000 years	Pyroclastic flows and lahars
Mount Rainier	14 eruptions in last 9000 years; also 4 large mudflows	Pyroclastic flows and lahars
Mount St Helens	19 eruptions in last 13,000 years	Pyroclastic flows, mudflows, lava, and ash fall

12.2.3 Severity

Eruption durations are quite variable, ranging from hours to decades. At present, when an eruption begins scientists cannot foretell when it will end or whether the activity will be intermittent or continuous. Worldwide, the average eruption duration is about two months, although the most recent eruptions in the Cascades have been of greater duration (Mount St. Helens, Washington: intermittent activity from 1980 to 1986 and continuous activity from late 2004 to early 2008; Lassen Peak, California: intermittent activity from 1914 to 1917).

The explosive disintegration of Mount St. Helens' north flank in 1980 vividly demonstrated the power that Cascade volcanoes can unleash. The thickness of tephra sufficient to collapse buildings depends on construction practices and on weight of the tephra (tephra is much heavier wet than dry). Past experience in several countries shows that tephra accumulation near 10 cm is a threshold above which collapses tend to escalate. A 1-inch deep layer of ash weighs an average of 10 pounds per square foot, causing danger of structural collapse.

Ash is harsh, acidic, and gritty, and it has a sulfuric odor. Ash may also carry a high static charge for up to two days after being ejected from a volcano. When an ash cloud combines with rain, sulfur dioxide in the cloud combines with the rainwater to form diluted sulfuric acid that may cause minor, but painful burns to the skin, eyes, nose, and throat. Westerly winds dominate in the Pacific Northwest sending volcanic ash east and north–eastward about 80–percent of the time, though ash can blow in any direction.

Figure 12-5 shows probabilities of tephra accumulation from Cascade volcanoes in the Pacific Northwest (tephra is fragmented rock material ejected by a volcanic explosion). Wind in western Washington blows to the west, northwest and southwest only 10 percent of the time, so tephra from eruptions of Mount St. Helens (or others) customarily would be far more likely on the east side of the volcano. Still, even a relatively small amount of ash in Pend Oreille County could have a significant impact with respect to individuals with health or breathing issues, mechanical or motorized devices, fish and other natural wildlife, and the forest and plant life. Figure 12-6 illustrates areas of the U.S. that have been covered by volcanic ash.

Figure 12-7, Figure 12-8, Figure 12-9, Figure 12-10, and Figure 12-11 identify the volcano hazard zones from the five active volcanoes in Washington as identified by the USGS.[61]

[61] Source: USGS. http://volcanoes.usgs.gov/vsc/multimedia/cvo_hazards_maps_gallery.html

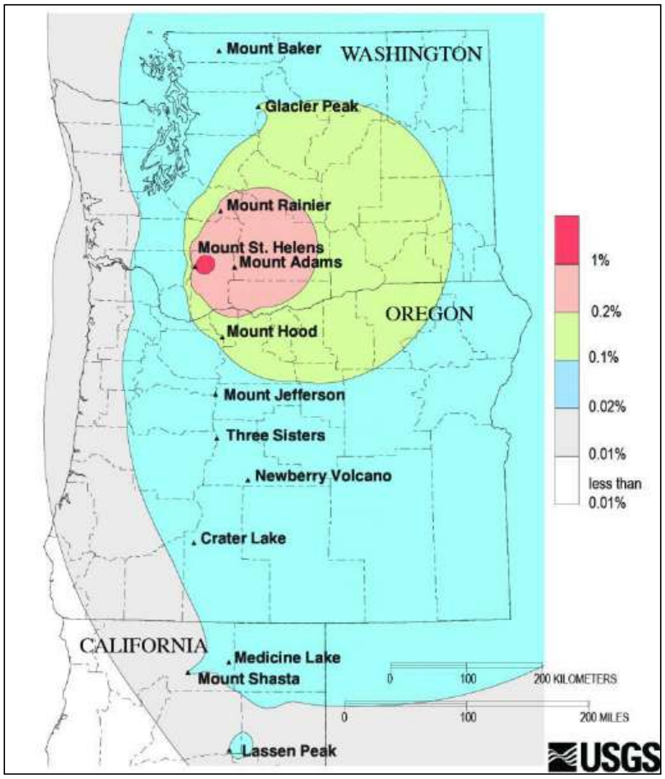


Figure 12-5 Probability of Tephra Accumulation in Pacific Northwest

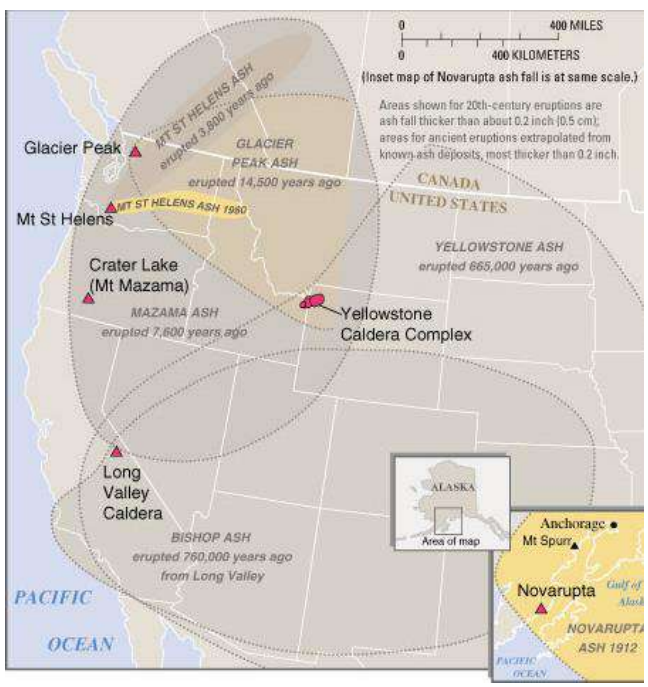


Figure 12-6 Defined Tephra Layers Associated with Historical Eruptions

Source: USGS. http://volcanoes.usgs.gov/vsc/multimedia/cvo_hazards_maps_gallery.html

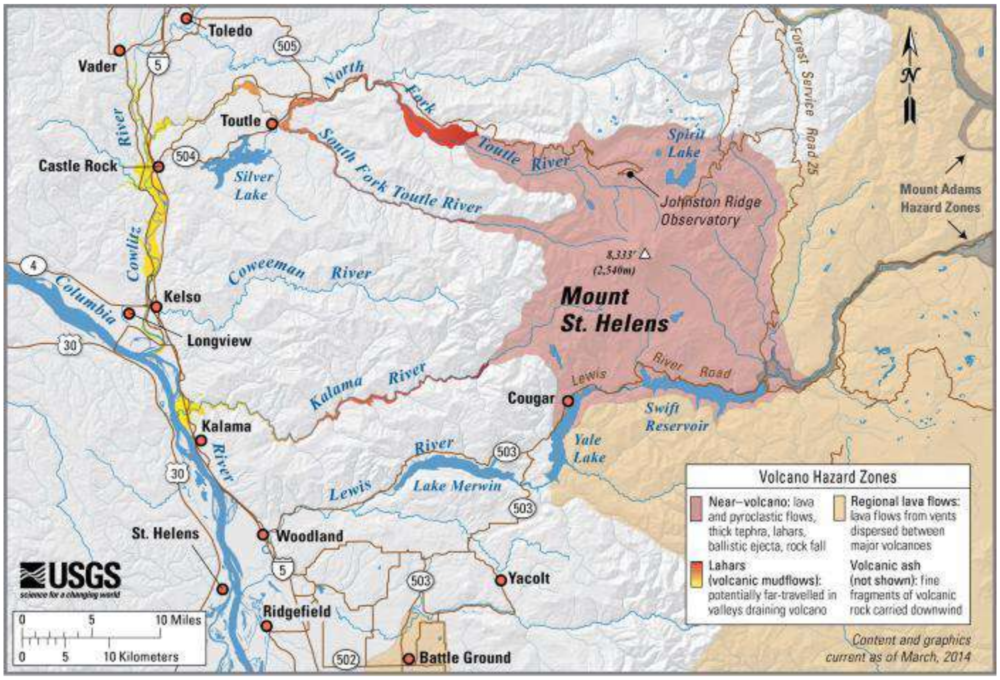


Figure 12-7 Volcano Hazard Zones From Mount St. Helens

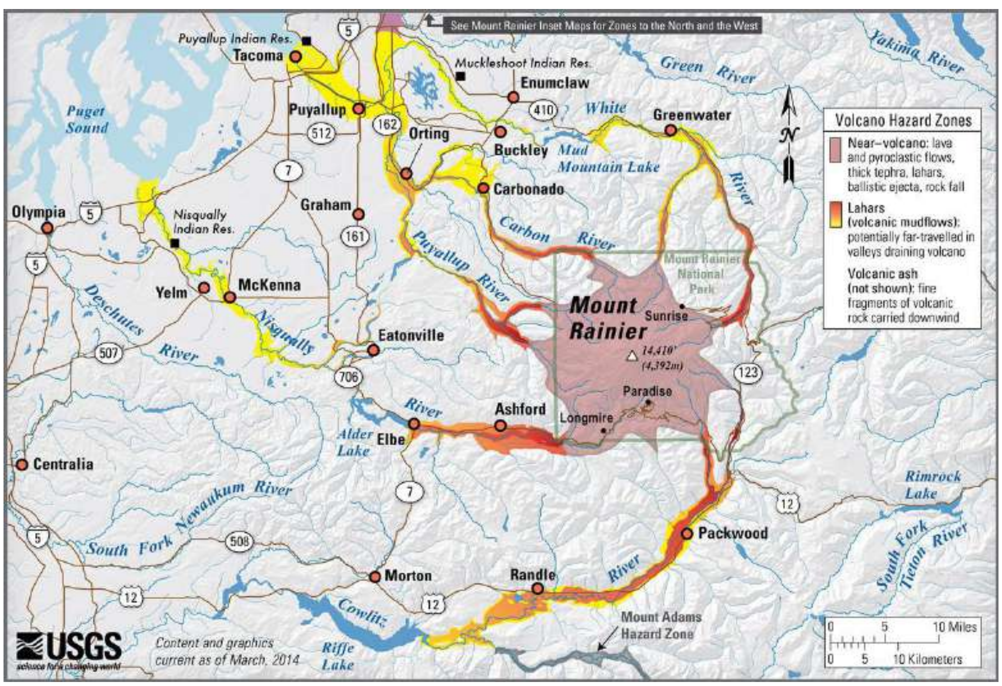


Figure 12-8 Volcano Hazard Zones from Mount Rainier

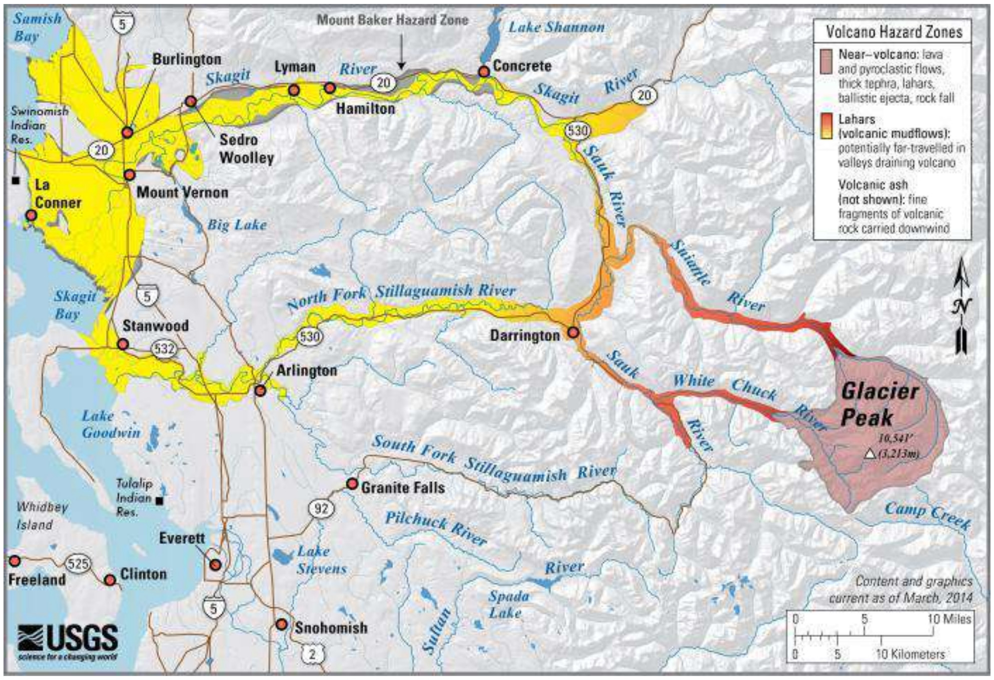


Figure 12-9 Volcano Hazard Zones from Glacier Peak

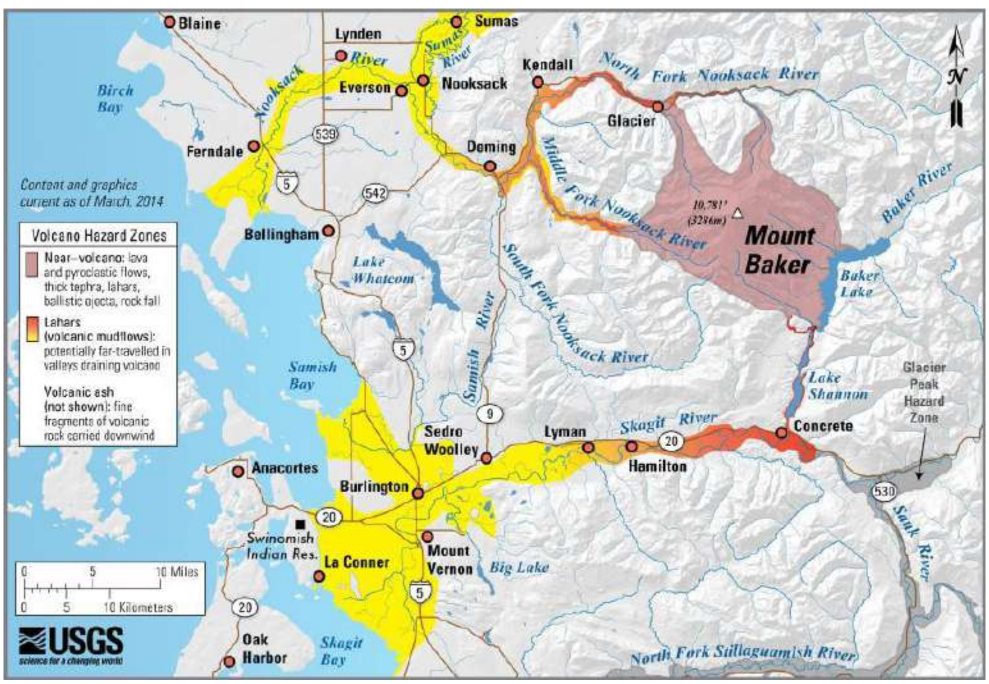


Figure 12-10 Volcano Hazard Zones from Mount Baker

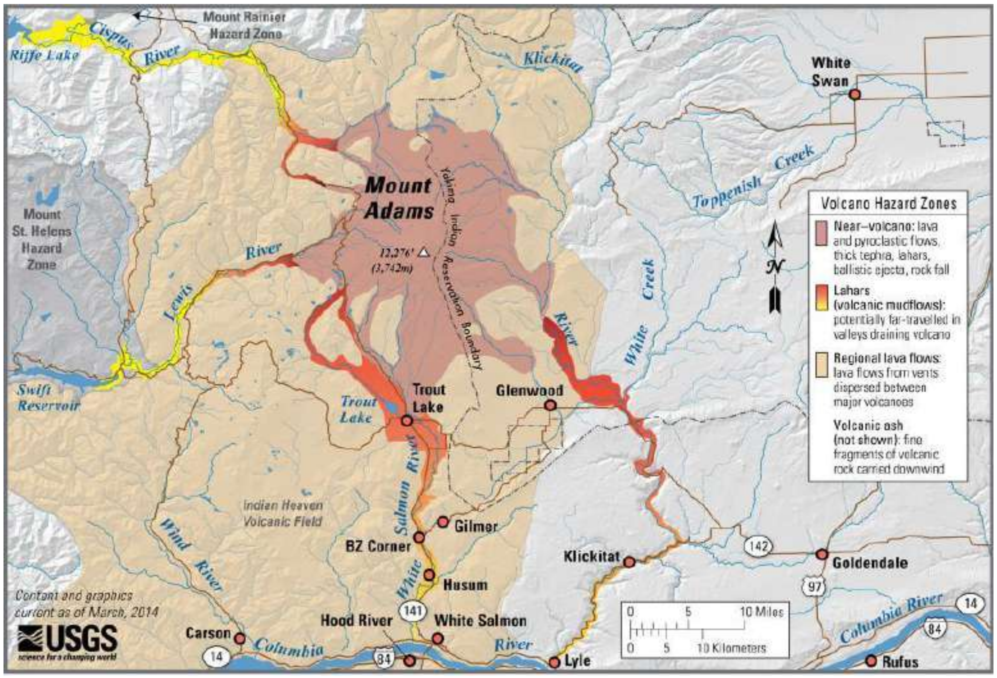


Figure 12-11 Volcano Hazard Zones from Mount Adams

12.2.4 Frequency

Many Cascade volcanoes have erupted in the recent past and will be active again in the foreseeable future. Given an average rate of one or two eruptions per century during the past 12,000 years, these disasters are not part of everyday experience; however, in the past hundred years, California's Lassen Peak and Washington's Mount St. Helens have erupted with terrifying results. The U.S. Geological Survey classifies Glacier Peak, Mt. Adams, Mt. Baker, Mt. Hood, Mt. St. Helens, and Mt. Rainier as potentially active volcanoes in Washington State. Mt. St. Helens is by far the most active volcano in the Cascades, with four major explosive eruptions in the last 515 years. There is a one (1) in 500 probability that portions of two counties in the state will receive four (4) inches or more of volcanic ash from any Cascade volcano in any given year. The probability increases to one (1) in 1,000 that parts, or all, of three or more counties will receive same quantity. There is a one (1) in 100 annual probability that small lahars or debris flows will impact river valleys below Mount Baker and Mount Rainier, with a less than 1:1,000 annual probability that the largest destructive lahars would flow down Glacier Peak, Mount Adams, Mount Baker or Mount Rainier. Based on USGS analysis (see Figure 12-12), Pend Oreille County has a less than 0.01 percent probability of ash or tephra collection in any given year from those volcanoes within Washington and Oregon; however, there is a greater risk of impact from Mt. Shasta in California at a 0.02 percent (see Figure 12-5 above).

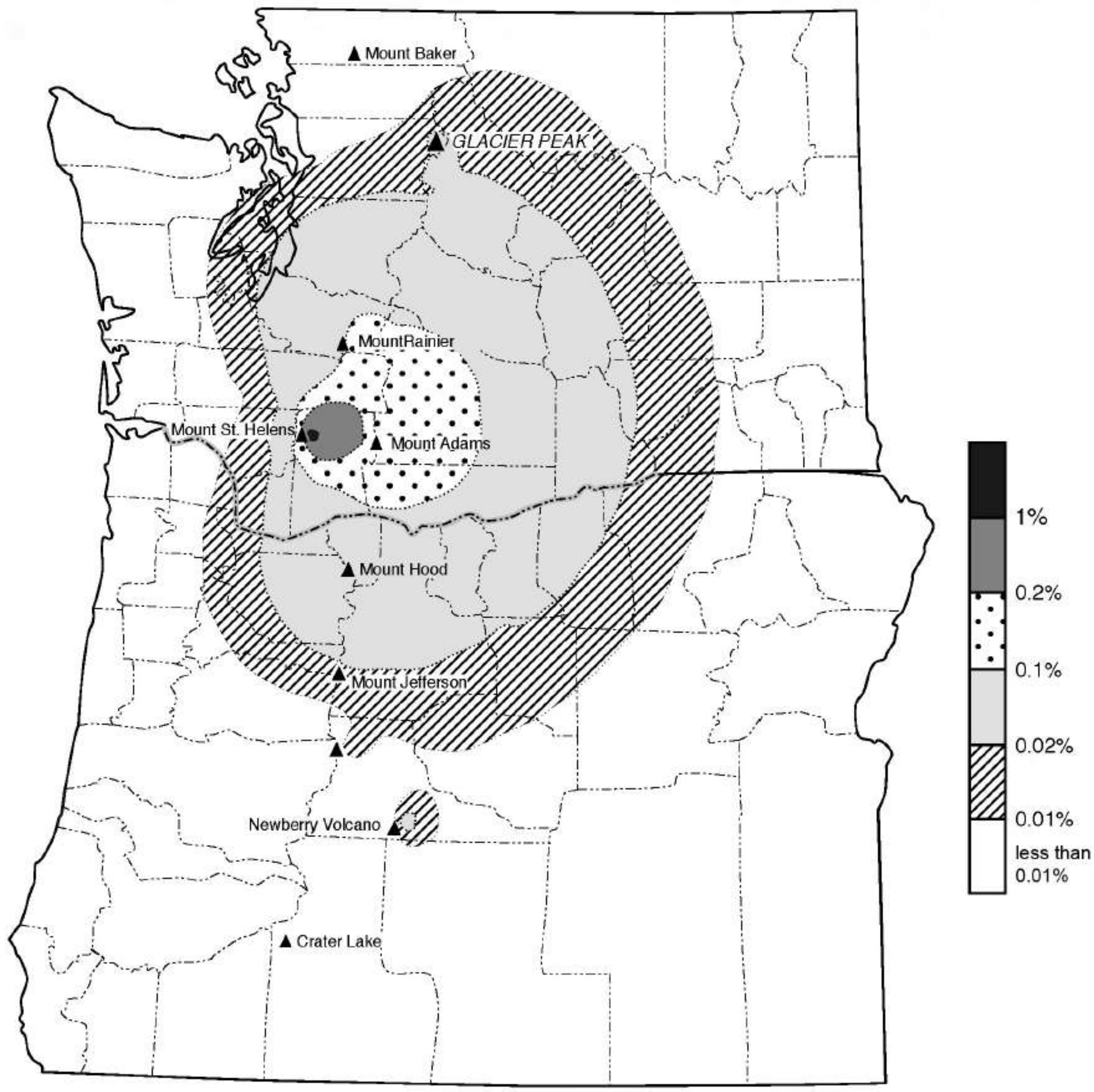


Figure 12-12 Annual Probability of >=10 cm Tephra Accumulation - Cascade Range Volcanoes

12.3 VULNERABILITY ASSESSMENT

12.3.1 Overview

The planning area did report a significant amount of ashfall as a result of Mount St. Helens' eruption. Given the acidic nature of ash, the impact to the environment was of great concern.

The closest Cascade volcanoes to the planning area are Mt. Baker and Glacier Peak. A lahar is not of primary concern for those volcanoes within the region as identified in the above graphics, but secondary impacts from ash and commodity flow could cause low to moderate issues.

According to the USGS analysis, westerly winds dominate in the Pacific Northwest sending volcanic ash east and north–eastward about 80–90 percent of the time, though ash can blow in any direction. However, even 10 percent of ash reaching Pend Oreille County or any of its waterways could have a negative impact on the natural resources and the agricultural economy. The potential for fire danger also increases as a result of static charge contained within the ash. Given the already increased fire danger when compared to other parts of the State, such impact could result in higher-than-normal fire seasons.

Ash and chemical products in the any of the rivers in the area or which filtrate through the ground into wells could contaminate water supply to the County. Transportation for ships/barges, boats, and vehicles traveling into the area could carry additional ash into the region, washing off during rains and contaminating the ground and water bodies, or potentially being impacted by ash with respect to visibility, and mechanically if large amounts of ash accumulate in engines' air intake systems.

Transportation could be impacted in one of two ways: transportation interruptions as a consequence of eruption and impact on surrounding counties could cause moderate impact on the Pend Oreille County region, as commodity flows would decrease. Alternatively depending on which volcano erupted, transportation throughout the county could increase as a result of shipping vehicles attempting to gain access to areas otherwise inaccessible, increasing not only traffic congestion, but also increasing the potential for a hazardous material release due to increased transportation of such chemicals, or even the vehicles themselves.

Likes, interruptions to power transmission, telecommunications outages, and potentially medical services could also be impacted. Residents with health issues, especially those with breathing difficulties, would also be impacted, even by small amounts of ash.

Methodology

As the planning area would have no direct impact from a lahar generated by any of the volcanos of potential concern, no dollar losses can be associated with that aspect of the hazard. No historical data was available specifically for Pend Oreille County with respect to impact and losses associated with the eruption of Mount St. Helens on which an assessment could be based. In addition, there are currently no generally accepted damage functions for volcanic hazards in risk assessment platforms such as Hazus-MH or any GIS system for the ash fall associated with the hazard. There would also be too many variables to associate with any type of plume modeling for ash. Therefore, for planning purposes, it is assumed that the entire planning area is exposed to some extent to ash accumulations, and those structures could collapse under excessive weight of ash/tephra and rainfall. Certain areas are more exposed due to geographic location and local weather patterns, as well as the response capabilities of local first responders.

Warning Time

Constant monitoring by the USGS and the Pacific Northwest Seismograph Network (PNSN) at the University of Washington of all active volcanoes means that there will be more than adequate warning time before an event. Newly standardized Alert Levels issued by USGS volcano observatories are based on a volcano's level of activity. These levels are intended to inform people on the ground and are issued in conjunction with the Aviation Color Code. The highest two alert levels (Watch and Warning) are National Weather Service terms for notification of hazardous meteorological events, terms already familiar to emergency managers that are becoming increasingly more familiar to the public.

The U.S. Geological Survey (USGS) volcanic alert-level system provides the framework for the preparedness activities of local jurisdictions, tribal governments and state and federal agencies. The USGS ranks the level of activity at a U.S. volcano using the terms "Normal", for typical volcanic activity in a non-eruptive phase; "Advisory", for elevated unrest; "Watch", for escalating unrest or a minor eruption underway that poses limited hazards; and, "Warning", if a highly hazardous eruption is underway or imminent. These levels reflect conditions at a volcano and the expected or ongoing hazardous volcanic phenomena. When an alert level is assigned by an observatory, accompanying text will give a fuller explanation of the observed phenomena and clarify hazard implications to affected groups. The USGS Cascade Volcano Observatory works in conjunction with PNSN to provide constant monitoring and notification when activities increase. Figure 12-13 depicts one of the sensors used by USGS and PNSN for monitoring purposes. Figure 12-14 identifies the various types of remote sensing devises available.

Since 1980 and 2004, Mount St. Helens has settled into a pattern of intermittent, moderate, and generally non-explosive activity, and the severity of tephra, explosions, and lava flows have diminished. All episodes, except for one very small event in 1984, have been successfully predicted several days to three weeks in advance. However, scientists remain uncertain as to whether the volcano's current cycle of explosivity ended with the 1980 explosion. The possibility of further large-scale events continues for the foreseeable future.

Figure 12-13 Monitoring Equipment

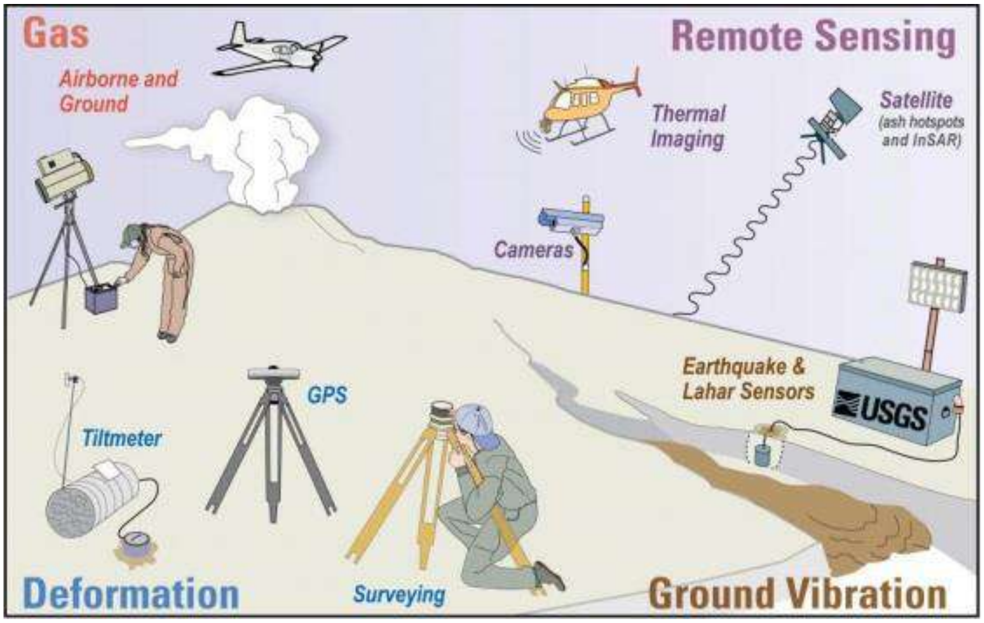


Figure 12-14 Remote Sensing Devices

12.3.2 Impact on Life, Health, and Safety

The entire population of the planning area, as well as any tourists traveling through to the various tourist attractions could be exposed to ash and its side effects. When an ash cloud combines with rain, sulfur dioxide in the cloud combines with the rainwater to form diluted sulfuric acid that may cause minor, but painful burns to the skin, eyes, nose, and throat. Given the high amount of annual rainfall and the constant mist from the ocean waves, this increases the potential impact on the population. The elderly, very young and those who experience ear, nose and throat problems are especially vulnerable to the tephra hazard, as well as the ash itself causing respiratory issues. In addition, the high number of tourists who annually visit the area would potentially increase the number of people to which the region would have to provide emergency services, housing, and associated support.

12.3.3 Impact on Property

All of the planning area to some degree would be exposed to ash fall and tephra accumulation in the event of a volcanic eruption. The age of the current building stock does not lend itself to be able to withstand large amounts of accumulation of ash on rooftops, as a one-inch deep layer of ash weighs an average of 10 pounds per square foot. This added weight to the aged buildings would increase the danger of structural collapse. Additionally, ash is harsh, acidic, and gritty, and may carry a high static charge for up to two days after being ejected from a volcano. This static charge has the potential for igniting forest fires in the densely forested areas.

As indicated, loss estimations for the volcano hazard could not be based on modeling utilizing damage functions, as no such functions have been generated. Instead, loss estimates were developed representing 10-, 30-, and 50-percent of the assessed value of all structures within the geographic boundaries of the municipal planning partners. This allows emergency managers to select a range of economic impact based on an estimate of the percent of damage to the building stock. Damage in excess of 50 percent is considered to be substantial by most building codes and typically requires total reconstruction of the structure. Table 12-2 identifies the structural loss by count and assessed value (including content), at the identified percentages.

Table 12-2
Potential Structure Impact From Ash Accumulation

Jurisdiction	Estimated Building Count (2)	Total Exposed Value (Structure and Content)	Exposed Building and Content Values 10-, 30-, and 50 Percent		
			10 Percent	30 Percent	50 Percent
Unincorporated Pend Oreille County	6,897	$1,086,351,621	$108,635,162.10	$325,905,486.30	$543,175,810.50
Kalispel Tribe	102	$98,614,681	$9,861,468.10	$29,584,404.30	$49,307,340.50
Newport, City of	839	$181,801,463	$18,180,146.30	$54,540,438.90	$90,900,731.50
Cusick, Town of	115	$8,135,247	$813,524.70	$2,440,574.10	$4,067,623.50
Ione, Town of	265	$25,582,201	$2,558,220.10	$7,674,660.30	$12,791,100.50
Metaline, Town of	104	$11,460,141	$1,146,014.10	$3,438,042.30	$5,730,070.50
Metaline Falls, Town of	135	$17,305,898	$1,730,589.80	$5,191,769.40	$8,652,949.00
Total	**8,457**	**$1,429,251,252**	**$142,925,125.20**	**$428,775,375.60**	**$714,625,626.00**

12.3.4 Impact on Critical Facilities and Infrastructure

None of the critical facilities within the planning region would be exposed to lahar inundation, but all would be exposed to the weight of ash, and, because of the age of the building stock, may fail to withstand the weight of the ash. All transportation routes in the area would be exposed to ash fall and tephra accumulation, which could create hazardous driving conditions on roads and highways and hinder evacuations and response. Utilities, including water treatment plants and wastewater treatment plants are vulnerable to contamination from ash fall, as well as impact from the ash itself that could damage motors.

12.3.5 Impact on Economy

Economic impact could result from potential agricultural losses, the loss of tourism due to suspended travel and visitors to the area, structural losses, including businesses and governmental offices/buildings. Lost tax revenues from businesses disrupted by structural damage or as a result of fewer patrons would impact the area’s economy. The tourism industry could also be impacted for a substantial amount of time if ash impacts the fishing industry.

12.3.6 Impact on Environment

The environment is highly exposed to the effects of a volcanic eruption. Even if the related ash fall from a volcanic eruption were to fall elsewhere, the watersheds, lakes, rivers and tributaries are vulnerable to damage due to ash fall since ash fall can be carried throughout the County by its rivers. A volcanic blast would expose the local environment to other effects, such as lower air quality, and many elements that could harm local vegetation and water quality, adversely impact wildlife and fish habitat. The sulfuric acid contained in volcanic ash could be very damaging to area vegetation, increasing the risk of wildfire danger, as well as wildlife.

12.4 FUTURE DEVELOPMENT TRENDS

Under the GMA, the County and its planning partners utilize the most recent building codes adopted by the State of Washington, which requires more stringent regulations with respect to support and payload structuring of facilities. Land use development has little influence as the area is not directly impacted by a Lehar zone. However, building codes with respect to load capacity does influence the ability to withstand impact. Pend Oreille County and its planning partners have adopted current IBC standards, which address the load capacity.

12.5 ISSUES

In the event of a volcanic eruption, there would probably not be any direct loss of life in the planning area as a direct result of the eruption. However, there could be significant health issues related to ash fall and health concern (especially for the young, elderly and those with breathing issues). In addition, there is also the potential for the increased potential for motor vehicle accidents; and potential structural damage if large amounts of ash accumulate as a result of the weight of the ash on structures. The potential exists for impact on the agricultural community, which would have an economic impact on the planning region. There would also be the possibility of severe environmental impacts due to ash within area lakes and streams, with the water supply potentially impacted by ash. A large area could be affected by this, and it is felt that the most severe impacts would be on the planning area’s environment and the water supply.

12.6 RESULTS

Based on review and analysis of the data, the Planning Team has determined that the probability for impact from Volcanic eruption throughout the area is low, with impact limited. The area did experience ashfall with the last eruption of Mount St. Helens. Implementation of mitigation strategies which help increase load capacities on roofs could potentially help reduce the number of structures at risk, but the environmental and economic impact cannot be so easily mitigated. Only one incident has occurred since 1980; however, economic impact in actual dollar figures were not captured as a result of that event. With the high dependency on agriculture for the economy, the potential impact from ash is a factor which was considered by the Planning Team. Based on the potential impact, the Planning Team determined the CPRI score to be 1.45, with overall vulnerability determined to be a low level.

CHAPTER 13.
PEND OREILLE COUNTY COMMUNITY WILDFIRE PROTECTION PLAN

This section of the plan serves dual purposes, serving both as the County's Wildfire Profile and also as the County's Community Wildfire Protection Plan (CWPP). As such, additional data and information has been incorporated within this profile to meet the needs of both planning efforts.

A wildfire is any uncontrolled fire occurring on undeveloped land that requires fire suppression. Wildfires can be ignited by lightning or by human activity such as smoking, campfires, equipment use, and arson. The wildfire season in Washington usually begins in April, picks up in early July, and generally ends in late September; however, wildfires have occurred every month of the year. Drought, snow pack, and local weather conditions can expand the length of the fire season.

People start most wildfires; major causes include arson, recreational fires that get out of control, smoker carelessness, debris burning, and children playing with fire. Wildfires started by lightning burn more state-protected acreage than any other cause, an average of 10,866 acres annually; human caused fires burn an average of 4,404 state-protected acres each year. Fires during the early and late shoulders of the fire season usually are associated with human-caused fires; fires during the peak period of July, August and early September often are related to thunderstorms and lightning strikes.

13.1 GENERAL BACKGROUND

Wildland-Urban Interface Areas

In 2001, Congress mandated the establishment of a Federal Register which identifies all urban wildland interface communities within the vicinity of Federal lands, including Indian trust and restricted lands that are at high-risk from wildfire. The list assimilated information provided from States and Tribes and is intended to identify those communities considered at risk.

The wildland urban-interface (WUI) is the area where development meets wildland areas. This can mean structures built in or near natural forests, or areas next to active timber and rangelands. The federal definition of a WUI community is an area where development densities are at least three residential, business, or public building structures per acre. For less developed areas, the wildland-intermix community has development densities of at least one structure per 40 acres. Review of the 2013 Washington State Enhanced Hazard Mitigation Plan does designate portions of Pend Oreille County as having WUI Communities. Review of the Federal Registry lists several communities within Pend Oreille County at high-risk within the vicinity of Federal lands.[62]

When identifying areas of fire concern, in addition to the Federal Register, the Washington Department of Natural Resources and its federal partners also determine communities at risk based on fire behavior potential, fire protection capability, and risk to social, cultural and community resources. These risk factors include areas with fire history, the type and density of vegetative fuels, extreme weather conditions, topography, number and density of structures and their distance from fuels, location of municipal watersheds, and likely loss of housing or business. The criteria for making these determinations are the

[62] https://www.federalregister.gov/documents/2001/01/04/01-52/urban-wildland-interface-communities-within-the-vicinity-of-federal-lands-that-are-at-high-risk-from

same as those used in the National Fire Protection Association's *NFPA 299 Standard for Protection of Life and Property from Wildfire*. Based on these criteria, Pend Oreille County has areas considered to be at high and medium risk (see Figure 13-1 [Headwaters, 2018] through Figure 13-4).[63], [64]

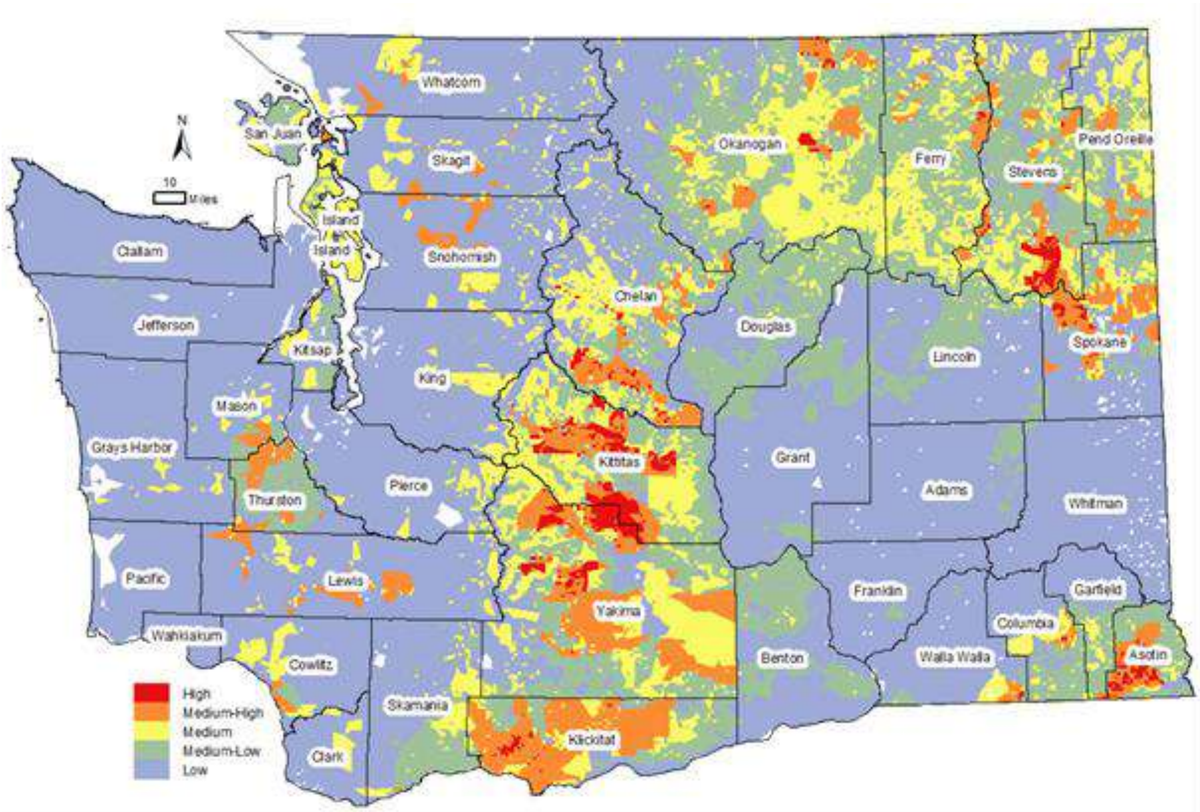


Figure 13-1 Level of Risk for Wildland Urban Interface Communities

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[63] http://mil.wa.gov/uploads/pdf/HAZ%20MIT%20PLAN/Wildland_Fire_Hazard_Profile.pdf
[64] Washington State 2018 Enhanced Hazard Mitigation Plan

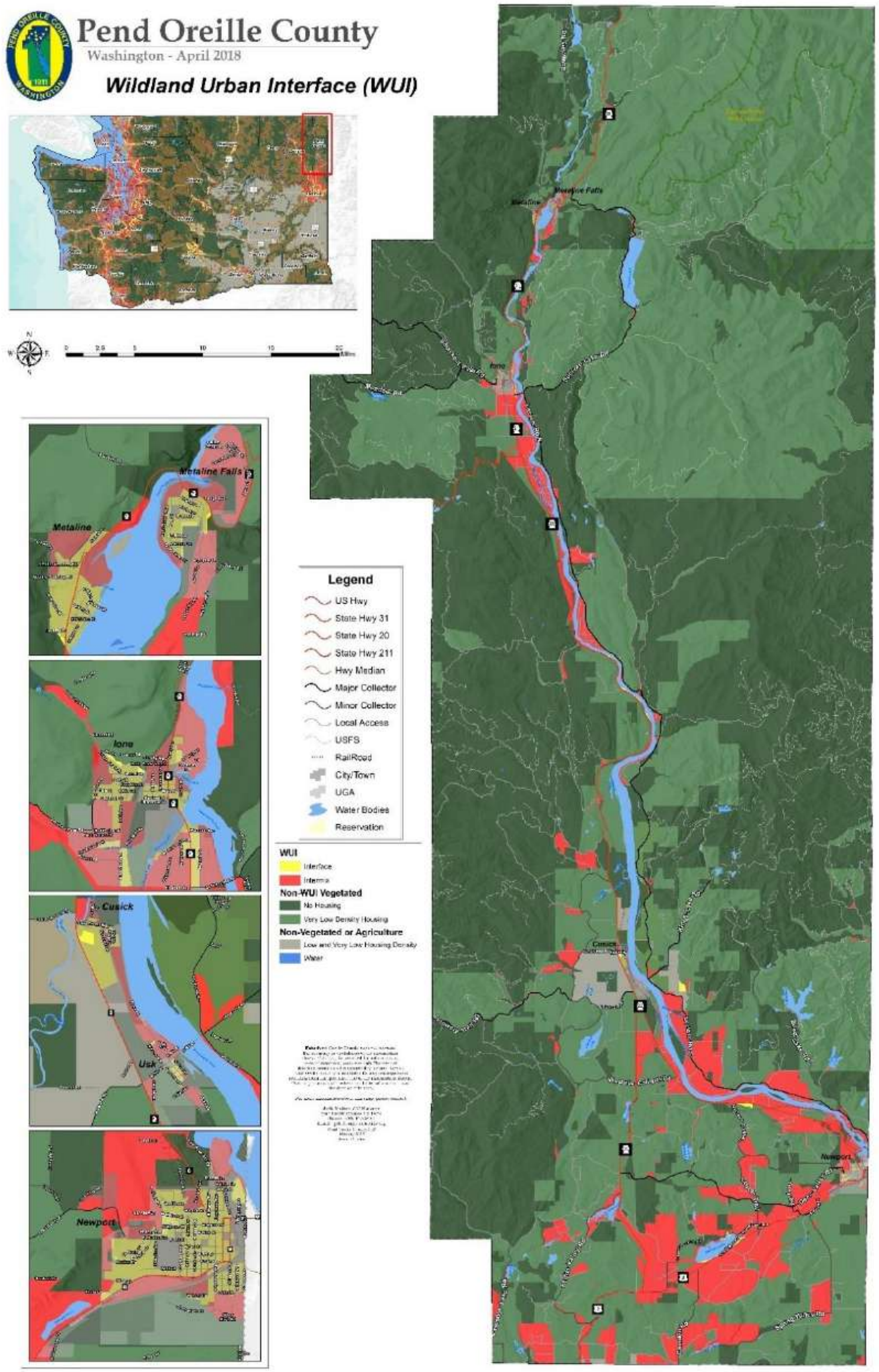


Figure 13-2 Pend Oreille County WUI Areas

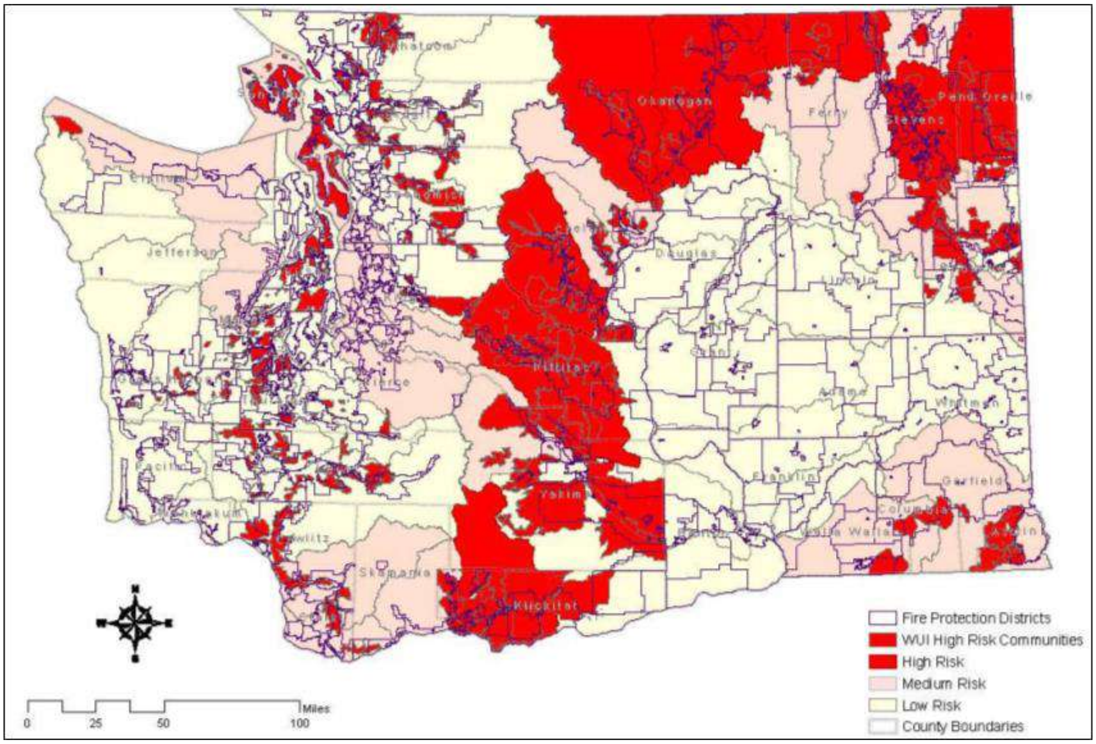


Figure 13-3 Washington WUI Communities Land Use Development, July 2011

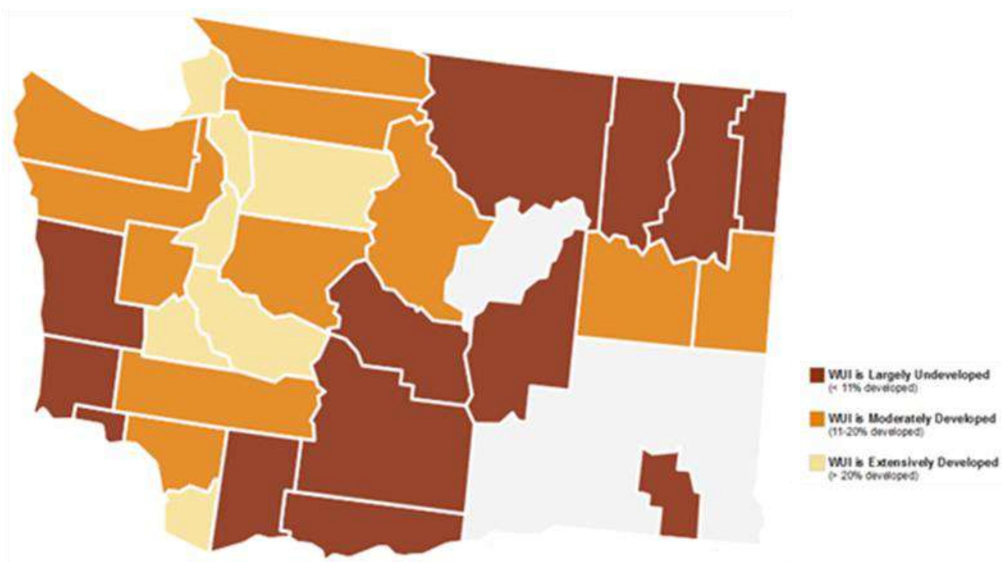
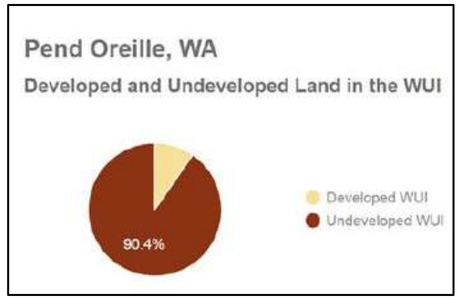


Figure 13-4 Washington WUI Communities Land Use Development (July 2011)



Headwater Economics (see graphic right) has indicated that Pend Oreille County currently has 16 square miles of developed WUI area, and 146 square miles of undeveloped WUI area, equating to 90.4 percent undeveloped WUI area, or 10 percent developed area, on which 3,681 homes are situated. Of those 3,681 homes, 39 percent are second homes, not primary residences.[65]

13.1.1 Wildfire Behavior

The wildfire triangle (see Figure 13-5; DeSisto et al., 2009) is a simple graphic used in wildland firefighter training courses to illustrate how the environment affects fire behavior. Each point of the triangle represents one of three main factors that drive wildfire behavior: weather, vegetation type (which firefighters refer to as "fuels"), and topography. The sides represent the interplay between the factors. For example, drier and warmer weather combined with dense fuel loads (e.g., logging slash) and steeper slopes will cause more hazardous fire behavior than light fuels (e.g., short grass fields) on flat ground.

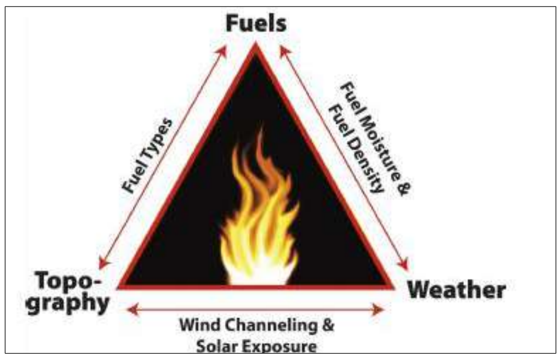


Figure 13-5 Wildfire Behavior Triangle

The following are key factors affecting wildfire behavior:

- **Fuel**—Lighter fuels such as grasses, leaves and needles quickly expel moisture and burn rapidly, while heavier fuels such as tree branches, logs and trunks take longer to warm and ignite. Snags and hazard trees—those that are diseased, dying, or dead—are larger but less prolific west of the Cascades than east of the Cascades.
- **Weather**— Relevant weather conditions include temperature, relative humidity, wind speed and direction, cloud cover, precipitation amount and duration, and the stability of the atmosphere. Of particular importance for wildfire activity are wind and thunderstorms:
  - Strong, dry winds produce extreme fire conditions. Such winds generally reach peak velocities during the night and early morning hours. East wind events can persist up to 48 hours, with wind speed reaching 60 miles per hour. Being a coastal community, the County experiences significant winds on a fairly regular basis during all times of the year.

[65] https://headwaterseconomics.org/dataviz/wui-development-and-wildfire-costs/

  - The thunderstorm season typically begins in June with wet storms and turns dry with little or no precipitation reaching the ground as the season progresses into July and August.
- **Topography—**Topography includes slope, elevation, and aspect. The topography of a region influences the amount and moisture of fuel; the impact of weather conditions such as temperature and wind; potential barriers to fire spread, such as highways and lakes; and elevation and slope of land forms (fire spreads more easily uphill than downhill).
- **Time of Day**—A fire's peak burning period generally is between 1 p.m. and 6 p.m.
- **Forest Practices—**In densely forested areas, stands of mixed conifer and hardwood stands that have experienced thinning or clear-cut provide an opportunity for rapidly spreading, high-intensity fires that are sustained until a break in fuel is encountered.

Fires can be categorized by their fuel types as follows:

- **Smoldering**—Involves the slow combustion of surface fuels without generating flame, spreading slowly and steadily. Smoldering fires can linger for days or weeks after flaring has ceased, resulting in potential large quantities of fuel consumed. They heat the duff and mineral layers, affecting the roots, seeds, and plant stems in the ground. These are most common in peat bogs, but are not exclusive to that vegetation.
- **Crawling**—Surface fires that consume low-lying grass, forest litter and debris.
- **Ladder—**Fires that consume material between low-level vegetation or forest floor debris and tree canopies, such as small trees, low branches, vines, and invasive plants.
- **Crown**—Fires that consume low-level surface fuels, transition to ladder fuels, and also consume suspended materials at the canopy level. These fires can spread rapidly through the top of a forest canopy, burning entire trees, and can be extremely dangerous (sometimes referred to as a "Firestorm").

Wildfires may spread by jumping or spotting, as burning materials are carried by wind or firestorm conditions. Burning materials can also jump over roadways, rivers, or even firebreaks and start distant fires. Updraft caused by large wildfire events draws air from surrounding area, and these self-generated winds can also lead to the phenomenon known as a firestorm.

13.1.2 Wildfire Impact

Short-term loss caused by a wildfire can include the destruction of timber, wildlife habitat, scenic vistas, and watersheds. Long-term effects include smaller timber harvests, reduced access to affected recreational areas, and destruction of cultural and economic resources and community infrastructure. Vulnerability to flooding increases due to the destruction of watersheds. The potential for significant damage to life and property exists in WUI areas, where development is adjacent to densely vegetated areas (DeSisto et al., 2009).

Forestlands in the planning area are susceptible to disturbances such as logging slash accumulation, forest debris due to weather damage, and periods of drought and high temperature. Forest debris from western red cedar, western hemlock, and Sitka spruce can be especially problematic and at risk to wildfires when slash is accumulated on the forest floor, because such debris resists deterioration. When ignited, these fuels can be explosive and serve as ladder fuels carrying fire from the surface to the canopy.

13.1.3 Identifying Wildfire Risk

Risk to communities is generally determined by the number, size and types of wildfires that have historically affected an area; topography; fuel and weather; suppression capability of local and regional resources; where and what types of structures are in the WUI; and what types of pre-fire mitigation activities have been completed. Identifying areas most at risk to fire or predicting the course a fire will take requires precise science. The following data sets are most useful in assessing risk in the area:

- **Topography (slope and aspect) and Vegetation (fire fuels)**—These are two of the most important factors driving wildfire behavior.
- **Weather**—Regional and microclimate variations can strongly influence wildfire behavior. Because of unique geographic features, weather can vary from one neighborhood to another, leading to very different wildfire behavior.
- **Critical Facilities/Asset Location**—A spatial inventory of assets—including homes, roads, fire stations, and natural resources that need protection—in relation to wildfire hazard helps prioritize protection and mitigation efforts.

13.1.4 Community Wildfire Protection Plan

In response to several significant fires occurring throughout the United States from 1995 to 2000, Congress implemented the National Fire Plan—now called the National Cohesive Wildland Fire Management Strategy (Cohesive Strategy)—to seek national solutions for wildfire management. To participate, a community must identify its WUIs and then develop strategies to reduce their impact. This often includes development of a Community Wildfire Protection Plan (CWPP). Many communities also elect to become a Firewise Community (discussed below).

This portion of the Pend Oreille County Hazard Mitigation Plan serves as the County's 2018 Update to its Community Wildfire Protection Plan as all elements of the CWPP are incorporated into the HMP. A CWPP identifies: communities at risk, prioritizes hazardous fuel treatments, and recommends ways to reduce structural ignitability. This plan also reviewed and updated its goals and objectives, and reviewed existing strategies, while also identifying new strategies to be addressed during the lifecycle of the CWPP and HMP 2018 Update. As such, adoption by the various Planning Team Members constitutes adoption of this document as their respective CWPP.

Firewise Communities USA™

The NFPA's Firewise USA program encourages local solutions for safety by involving homeowners in taking individual responsibility for preparing their homes from the risk of wildfire. Firewise is a key component of Fire Adapted Communities – a collaborative approach that connects all those who play a role in wildfire education, planning, and action with comprehensive resources to help reduce risk. All of the Fire Departments throughout the County encourage the Firewise Program.[66]

[66] http://www.firewise.org/usa-recognition-program/state-listing-of-partcipants.aspx

13.1.5 Secondary Hazards

Wildfires can generate a range of secondary effects, which in some cases may cause more widespread and prolonged damage than the fire itself. Fires can cause direct economic losses in the reduction of harvestable timber and indirect economic losses in reduced tourism. Wildfires cause the contamination of reservoirs, destroy transmission lines, and contribute to flooding. They strip slopes of vegetation, exposing them to greater amounts of runoff. This in turn can weaken soils and cause failures on slopes. Major landslides can occur several years after a wildfire. Most wildfires burn hot and for long durations that can bake soils, especially those high in clay content, thus increasing the imperviousness of the ground. This increases the runoff generated by storm events, thus increasing the chance of flooding.

13.2 HAZARD PROFILE

13.2.1 Extent and Location

The Washington State HMP does identify Pend Oreille County as being medium- to high-risk to wildfire danger. This is also confirmed by Washington State Department of Natural Resources, and all of the County’s fire agencies. Significant wildfire events over the course of the last several years, while diminished in actual number of fires, increased significantly in acres burned and the personnel and equipment needed to manage the events. This, in large part, is due to the type of vegetation and available fuels in the region.

Vegetation

The bottomlands of the Pend Oreille River Valley are well suited for both grassland and agricultural vegetation. Over the past century, much of the “native riparian vegetation” has been replaced with agricultural fields and areas for livestock grazing and feed crops, such as hay. Hay is the primary crop grown in the County. Coniferous forest vegetation, associated with national forests, cover over 80 percent of the County. Ponderosa Pine and Douglas Fir typically cover the lower timberline area on the hills and low mountains. A mix of Douglas Fir, Grand Fir, Lodge Pole Pine, Western Red Cedar and Western Larch dominate the mid-elevations. The higher elevations are home to Subalpine Fir and Engelmann Spruce. The native vegetation is mainly conifers, shrubs, forbs, and grasses.

Given the County’s rural land use complexity, densely wooded areas, and its proximity to the various large park systems (both federal and state), the entire region is susceptible to impact from wildfire, either as a direct result, or as a secondary result from health or economic impact.

13.2.2 Previous Occurrences

According to the National Interagency Coordination Center (2017), 2017 resulted well above the five year average and slightly higher than the 10 year national average of wildfires reported. The number of acres burned were also well above both the five and ten year national averages (see

).[67] Wildfires have been a common occurrence throughout Washington as a whole for thousands of years. Evidence from tree rings or fire-scarred trees indicates cycles of prehistoric fires burned in many locations in both Eastern and Western Washington. Natural fire occurrence is directly related, but not proportional, to lightning incidence levels. It is rare for a summer to pass without at least one period of lightning activity. Lightning incidence is greatest during July and August, though storms capable of igniting fires have occurred from early spring to mid-October. Lightning storms generally track across the park in a southwest to northeast direction. At a national level, lightning starts over 4,000 house fires each year, which can ignite wildland fires through ember ignition and as a result of proximity to wildland areas. Lightning-caused fires cause over 10 times more acreage damage than human-caused fires, requiring great resource allocation. According to the National Interagency Fire Center, each year, more than 10,143 lightning-caused fires are reported, burning in excess of 4.2 million acres (2018).[68] Washington wildfires in 2017 represented four percent of the national total (see Figure 13-7).

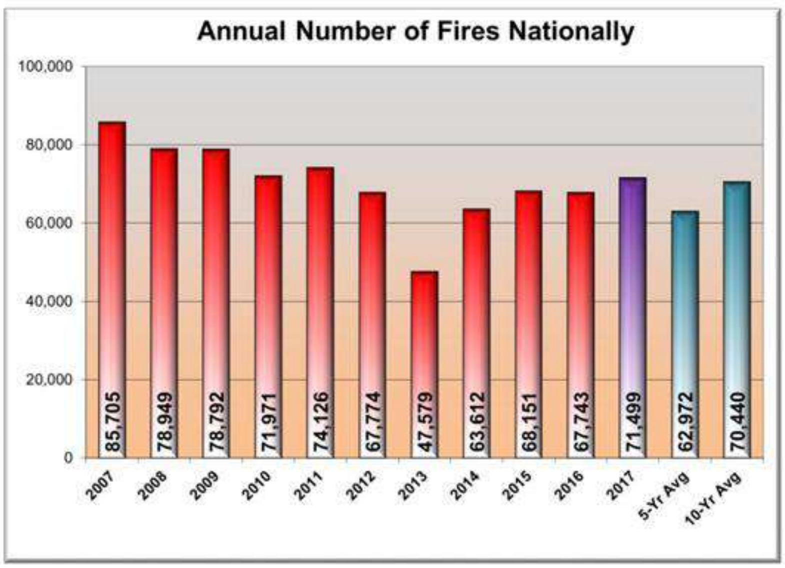


Figure 13-6 Annual Number of Fires Nationally

67 https://www.predictiveservices.nifc.gov/intelligence/2017_statssumm/annual_report_2017.pdf
68 https://www.nifc.gov/fireInfo/fireInfo_stats_lightng.html

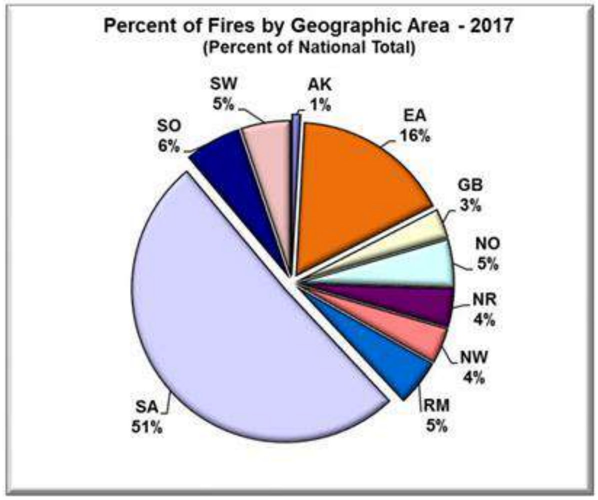


Figure 13-7 Percent of Fires by Geographic Area – 2017

Within Washington, lightning storms are typically followed by light to moderate amounts of precipitation. The rainfall may extinguish the fires, while high fuel moisture inhibits spread. However, prolonged periods of warm, dry weather, especially in combination with east winds, often reveal numerous latent "sleepers." While most lightning fires are less than a quarter acre in size, occasional large fires during dry periods account for most of the burned acreage.

Review of the Washington State Enhanced Hazard Mitigation Plan (2013) and FEMA disaster declaration records (2017), Pend Oreille County has received two federal disaster declarations for fires – one in October 1991 and the other in August 2015. However, the County and its planning partners experience wildfires many times over the course of each year.

During the time period 2004-2017, based on available data, Pend Oreille County as a whole has experienced in excess of 350 wildfires, burning over 27,000 acres. Table 13-1 identifies the total number of fires and acres burned.[69] Fires for the period 2010-2017 are illustrated in Figure 13-8.

[69] Source: Washington State DNR, Washington State Enhanced Hazard Mitigation Plan Wildfire Profile (2014), and Pend Oreille County.

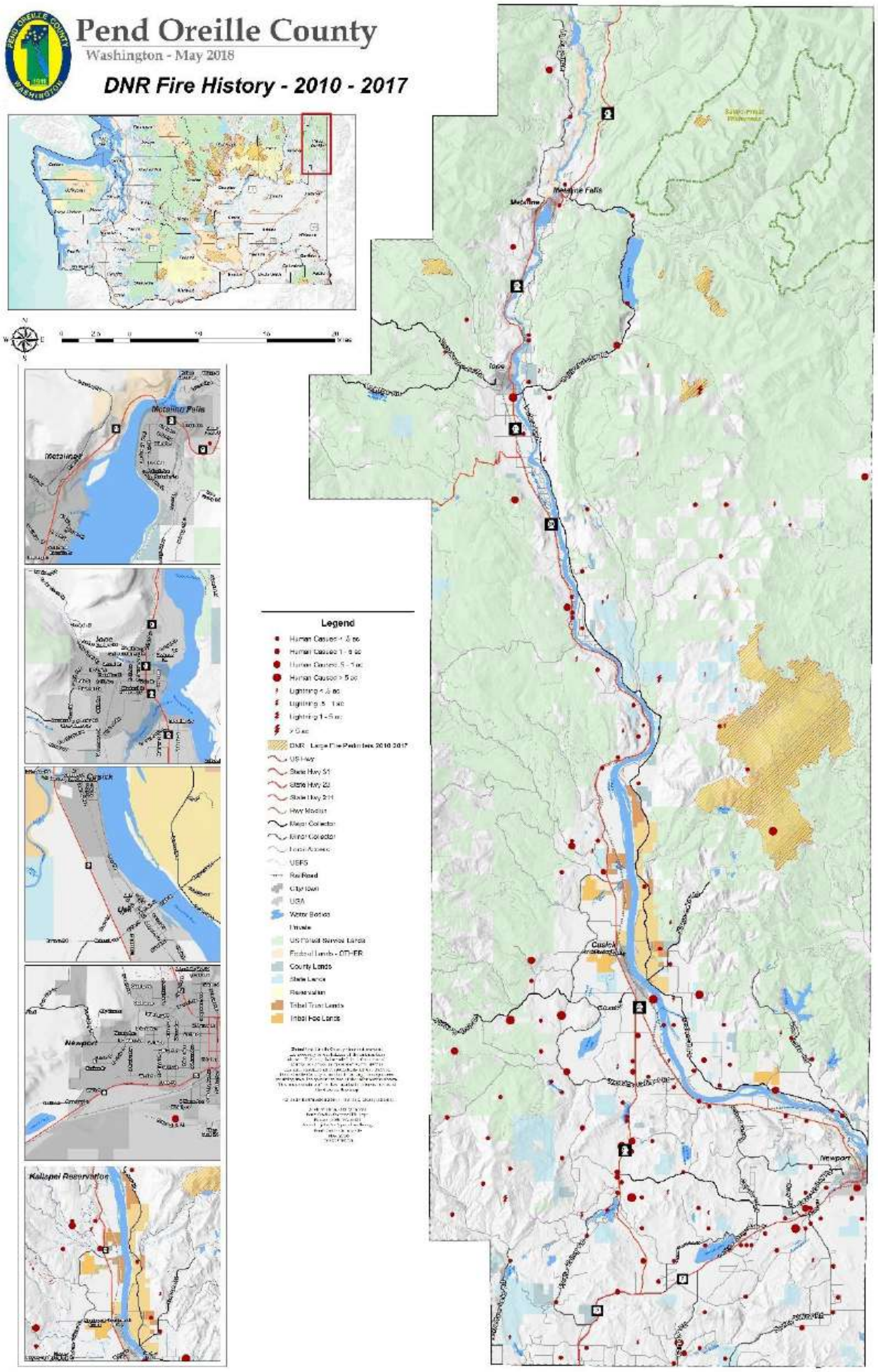


Figure 13-8 Pend Oreille County Wildfire History 2010-2017

Table 13-1
Total Number Wildfire Events 2004-2017

Year	Total Number of Wildland Fires	Total Acres Burned
2004	30	3.80
2005	24	10.9
2006	66	18.5
2007	40	15.21
2008	41	26.91
2009	52	19.08
2010	35	60.67
2011	29	14.39
2012	28	26.18
2013	14	8.38
2014	25	39.38
2015	45	26,992.76
2016	24	18.66
2017	29	28.85
Total	482	27,283.67

Additional large historic fires include the following:

- The great fire of 1910 burned over 150,000 acres of land in Spokane and Pend Oreille Counties, while taking over 200 lives. It is considered one of the nation's historically significant fires.[70]
- 1926 – 31: A large number of fires burned thousands of acres in Pend Oreille, Stevens, and Ferry Counties. Over half of the Coleville national forest was burnt. A drought coupled with wind aggravated these fires.[71]
- 1943: A series of small wildfires burned large portions of the Coleville National Forest.[72]
- The 1991 Fire Storm destroyed 114 homes and 40 other buildings in Ferry, Lincoln, Stevens, Spokane, Pend Oreille, and Whitman Counties. At least 2 fatalities were reported. The primary cause of the 93 separate fires was due to arcing electrical connections from downed power lines

[70] 2004 Pend Oreille County Hazard Mitigation Plan.
[71] 2004 Pend Oreille County Hazard Mitigation Plan.
[72] 2004 Pend Oreille County Hazard Mitigation Plan.

caused by high winds. The winds precipitated the spread of the fires[73]. Federal Disaster Declaration #922 was declared in October 1991.

Figure 13-9 Tower Fire 2015

- August – September 2015 – The Kaniksu Complex Fires (pictured right), which consisted of the Tower Fire, Onata Creek Fire, Grease Creek Fire, Hall Mountain Fire, Slate Creek and South Fork Slate Creek Trails Fire, and Baldy Fire burned in excess of 26,000 acres, lasting for several weeks in both Washington and Idaho. IMTs and responding firefighters from as far away as Boston assisted in battling the fires. Evacuation orders were issued in both Washington and Idaho. Occurring simultaneous with the Kaniksu Complex Fire was the Okanogan Complex Fire (see figure below).[74] Combined, the two taxed fire resources nationwide, with 2015 being cited as the worst year on record for Washington state.

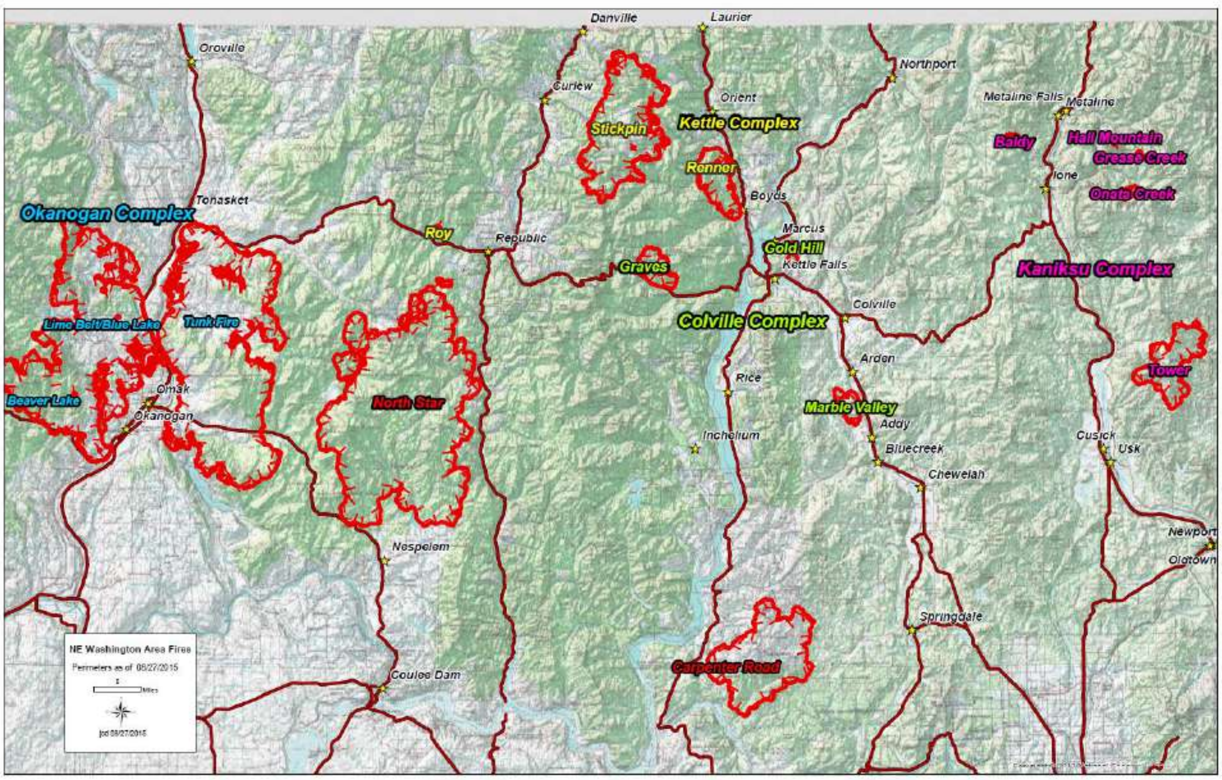


Figure 13-10 Complex Fires August 27, 2015

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[73] 2004 Pend Oreille County Hazard Mitigation Plan.
[74] Washington State Department of Natural Resources: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3852389.pdf

- July - August 2017 – Noisy Creek Fire burned over 4,000 acres near Metaline Falls. The fire was caused by a lightning strike which occurred on July 15, 2017. Impact of the fire caused evacuation orders to be issued, and roadways to be closed. No fly zones were also issued over the area. Sullivan Lake experienced rockfall and debris in the water as a result of the fire. Boaters and campers in the area were advised to be packed and ready to leave at a moment's notice.

Figure 13-11 Noisy Creek Fire 2017

13.2.3 Severity

Potential losses from wildfire include human life, structures and other improvements, and natural resources. Smoke and air pollution from wildfires can be a health hazard, especially for sensitive populations such as children, the elderly and those with respiratory and cardiovascular diseases. Wildfire may also threaten the health and safety of those fighting the fires. Wildfire can lead to ancillary impacts such as landslides in steep ravine areas and flooding due to the impacts of silt in local watersheds. A large-scale wildfire would destroy timber and logging equipment, and the natural habitat for generations.

Extreme fires, when they occur, are characterized by more intense heat and preheating of surrounding fuels, stronger flame runs, potential tree crowning, increased likelihood of significant spot fires, and fire-induced weather (e.g., strong winds, lightning cells). Extreme fire behavior is significantly more difficult to combat and suppress and can drastically increase the threat to homes and communities.

Due to many years of fire suppression, logging, and other human activities, the forests and rangelands of planning area have changed. Areas that historically experienced frequent, low-severity wildfires now burn with much greater intensity due to the build-up of understory brush and trees. At times, this equates to fires which are larger and more severe, killing the trees and vegetation at all levels. The combination of steep slopes, canyons, open rangeland, and fuel type have a history and potential for fast moving and fast spreading wildfires.

The fire season of 2015 is noted as one of the most significant wildfire years in history for Washington State, and Pend Oreille County was significantly impacted during that year, with almost 27,000 acres of burnt lands and 45 fires recorded. The 2017 fire season year was also significant (29 fires reported), with an increase in the number of fires reported from 2016 (24 fires reported) as well as the number of acres burned (28.85 and 18.66 respectively), although the number of acres was not nearly as significant as 2015.

The Pend Oreille County planning area is extremely vulnerable to wind-driven fires, whose embers could ignite grasses and weeds, and cause spot fires in more populated areas. While the County has a history of spring/summer flooding due to snowmelt, areas not impacted by the flooding dry out quickly when temperatures increase. Typical summer conditions prove to be problematic due to fires moving uphill from a structure fire on a lower slope, or from a wildland fire pushing upslope through the trees on a windy day. As a result, large destructive fires have, and will continue to occur. In many instances, Level 1 evacuation orders are issued, providing residents short notice of an approaching fire. With a fairly large agricultural base including crops and animal herds which may require evacuation, economic impact could also be severe.

Based on Washington Department of Natural Resources reports, much of the county is classified as "wildland-urban interface communities" susceptible to high fire risk (see Figure 13-2 above). For certain areas, this is even more pronounced, such as Fire District #5, in which almost every structure is in the WUI. The combination of mountainous steep terrain and heavy wooded areas make it a prime target for a major wild fire. Several homes reside on these hillsides with little access which makes it almost impossible to save homes or get residents out safely (CWPP, 2011).

13.2.4 Frequency

As previously indicated, the number of fires in the county have increased over the course of the last several years not only within the County, but nationally. Fires historically burn on a regular cycle, recycling carbon and nutrients stored in the ecosystem, and strongly affecting species within the ecosystem. The burning cycle in western Washington is approximately every 100 to 150 years; however, that has not been the case within Pend Oreille County, as areas are experiencing burns much more frequently.

Historically, drought patterns are related to large-scale climate patterns in the Pacific and Atlantic oceans. The El Niño–Southern Oscillation varies on a 5- to 7-year cycle, the Pacific Decadal Oscillation varies on a 20- to 30-year cycle, and the Atlantic Multidecadal Oscillation varies on a 65- to 80-year cycle. As these large-scale ocean climate patterns vary in relation to each other, drought conditions in the U.S. shift from region to region. El Niño years bring drier conditions to the Pacific Northwest and more fires. This pattern has remained consistent within Pend Oreille County.

Historic Fire Regime

Many ecosystems are adapted to historical patterns of fire. These patterns, called “fire regimes,” include temporal attributes (e.g., frequency and seasonality), spatial attributes (e.g., size and spatial complexity), and magnitude attributes (e.g., intensity and severity), each of which have ranges of natural variability. A fire regime refers to the frequency and intensity of natural fires occurring in various ecosystem types. Alterations of historical fire regimes and vegetation dynamics have occurred in many landscapes in the U.S., including Pend Oreille County through the combined influence of land management practices, fire exclusion, insect and disease outbreaks, climate change, and the invasion of non-native plant species. Anthropogenic influences on wildfire occurrence have been witnessed through arson, incidental ignition from industry (e.g., logging, railroad, sporting activities), and other factors. Likewise, wildfire abatement practices have reduced the spread of wildfires after ignition, in theory reducing the risk to both the ecosystem and the urban populations living in or near forestlands.

The LANDFIRE Project produces maps of simulated historical fire regimes and vegetation conditions using the LANDSUM landscape succession and disturbance dynamics model. The LANDFIRE Project also produces maps of current vegetation and measurements of current vegetation departure from simulated historical reference conditions. These maps support fire and landscape management planning outlined in the goals of the National Fire Plan, Federal Wildland Fire Management Policy, and the Healthy Forests Restoration Act. The simulated historical mean fire return interval data layer quantifies the average number of years between fires under the presumed historical fire regime. This data is derived from simulations using LANDSUM. LANDSUM simulates fire dynamics as a function of vegetation dynamics, topography, and spatial context, in addition to variability introduced by dynamic wind direction and speed, frequency of extremely dry years, and landscape-level fire characteristics.

The historical fire regime groups simulated in LANDFIRE are based on data from the area, and categorize mean fire return intervals and fire severities into five regimes defined in the Interagency Fire Regime Condition Class Guidebook:

- Regime 1: 0-35 year frequency, low to mixed severity
- Regime II: 0-35 year frequency, replacement severity

- Regime III: 35-200 year frequency, low to mixed severity
- Regime IV: 35 -200 year frequency, replacement severity
- Regime V: 200+ year frequency, any severity

The use of this data helps determine the vulnerability of the forest area based on the criteria used by LANDFIRE in establishing the various regimes.

Large wildfires regularly occur within Eastern Washington as a whole, including Pend Oreille County. Due to firefighting efforts, many wildfires have been contained with limited impact on acreage burned or structure loss.

Fire regimes in Pend Oreille County are illustrated in Figure 13-12. All fire regime categories exist in the county, although the majority fall within regime groups 3 (130 acres), 1 (48 acres), and 2 and 4 (7 acres each) when viewing data by level of impact to structures. The regime groups identify the burn frequencies and severities in the area.

The Mean Fire Return Interval (MFRI) layer quantifies the average period between fires under the presumed historical fire regime. MFRI is intended to describe one component of historical fire regime characteristics. As illustrated, the average Mean Fire Return Interval for the majority of Pend Oreille County fall within the 35- to 200-year frequency, with the majority of the area falling within the <80-year return interval (see Figure 13-13). Washington State Department of Natural Resource's latest assessment and identification of fire regime groups also illustrates the majority of Pend Oreille County's frequency to be 35-200 years (Figure 13-14).

The existing Vegetation Condition Class (VCC) is identified in Figure 13-15. VCC represents a simple categorization of the associated Vegetation Departure (VDEP) layer and indicates the general level to which current vegetation is different from the simulated historical vegetation. The classes of variation range are low, medium, and high. The variation of vegetation class directly influences fire, as vegetation itself influences the rate of burn, intensity of the burn, and the frequency of burns. Some vegetation is much more vulnerable to ignition (shiny-leave vegetation customarily contains more oils, making them more vulnerable to ignition), while others are more difficult to contain once fire ignition occurs. Such factors contribute to the vulnerability of an area to wildfires.

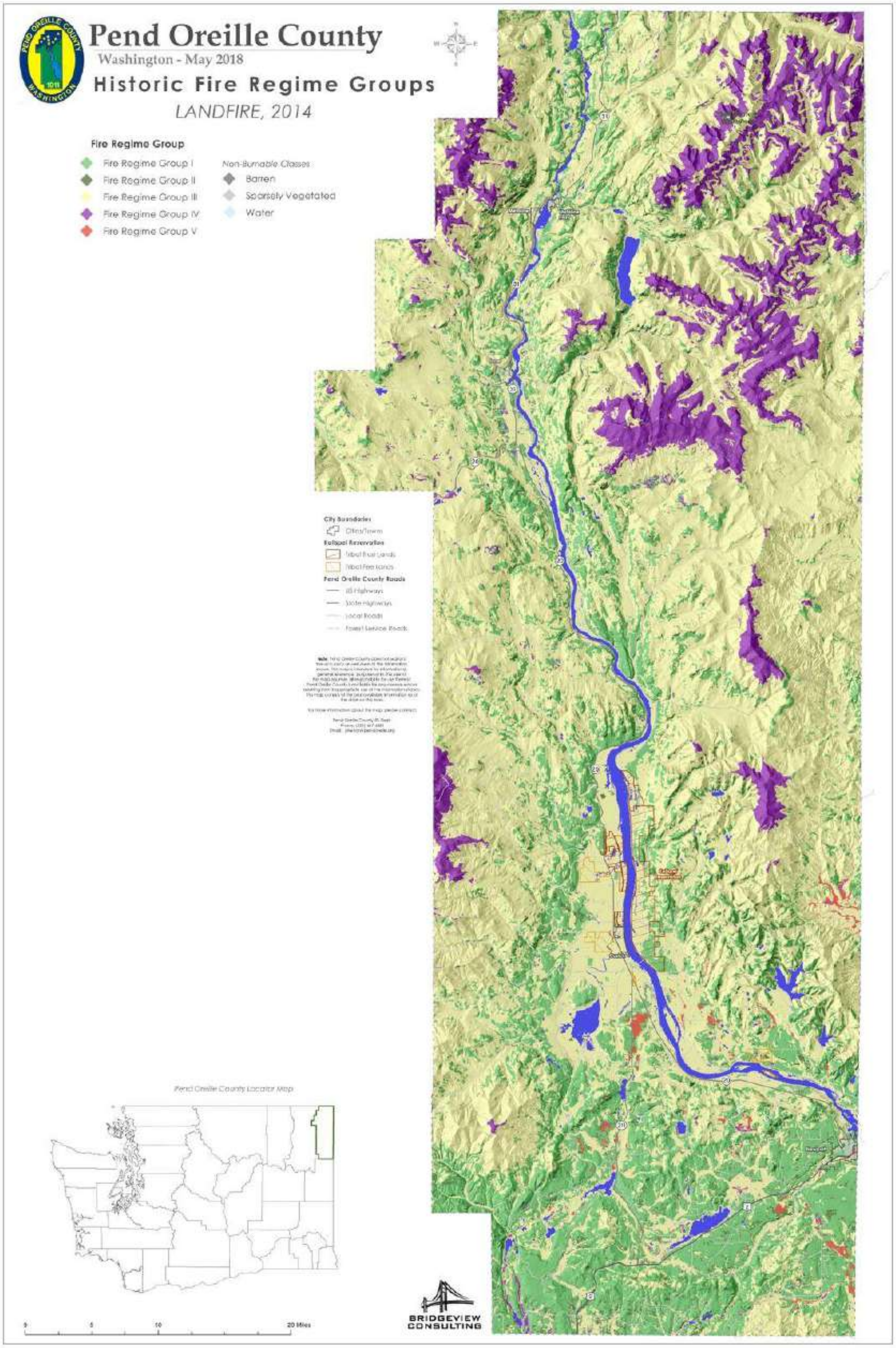


Figure 13-12 LANDFIRE Fire Regimes in Pend Oreille County

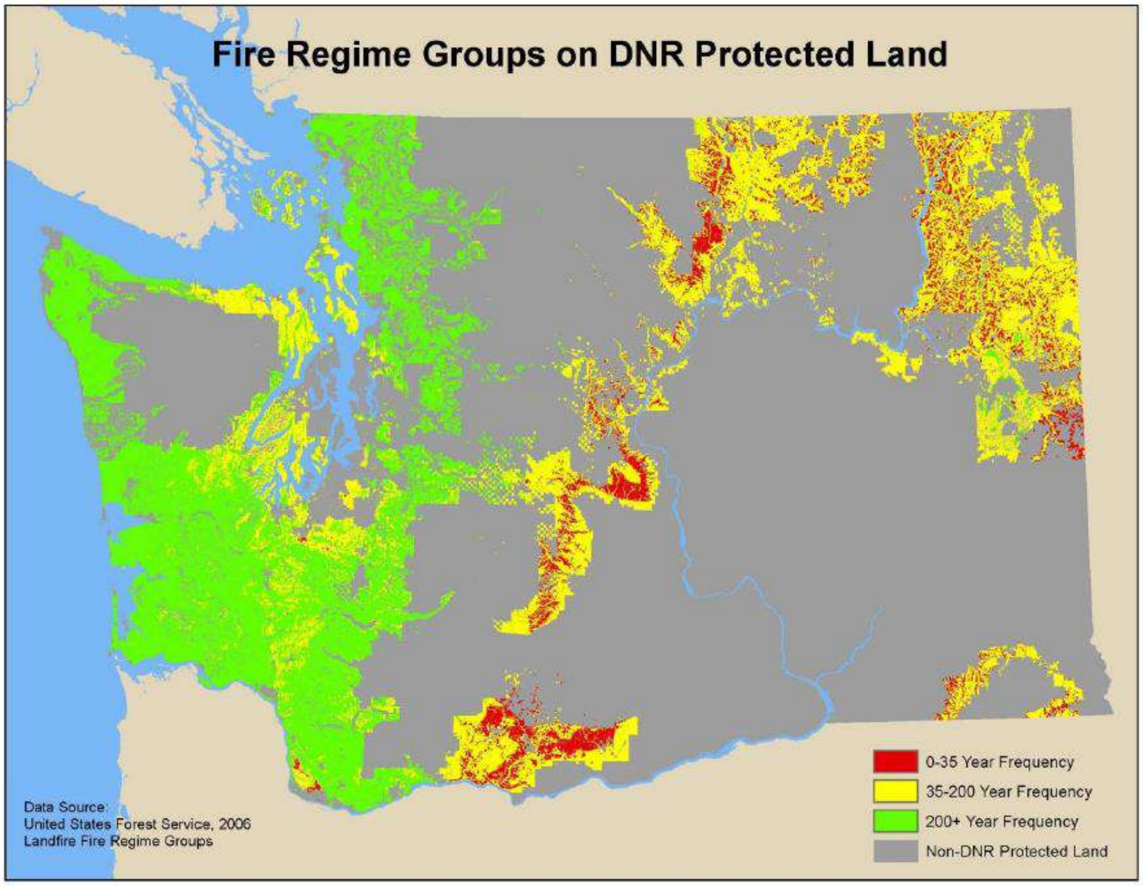


Figure 13-13 Washington State Department of Natural Resources Fire Regime Groups
Source: Washington State HMP, 2014

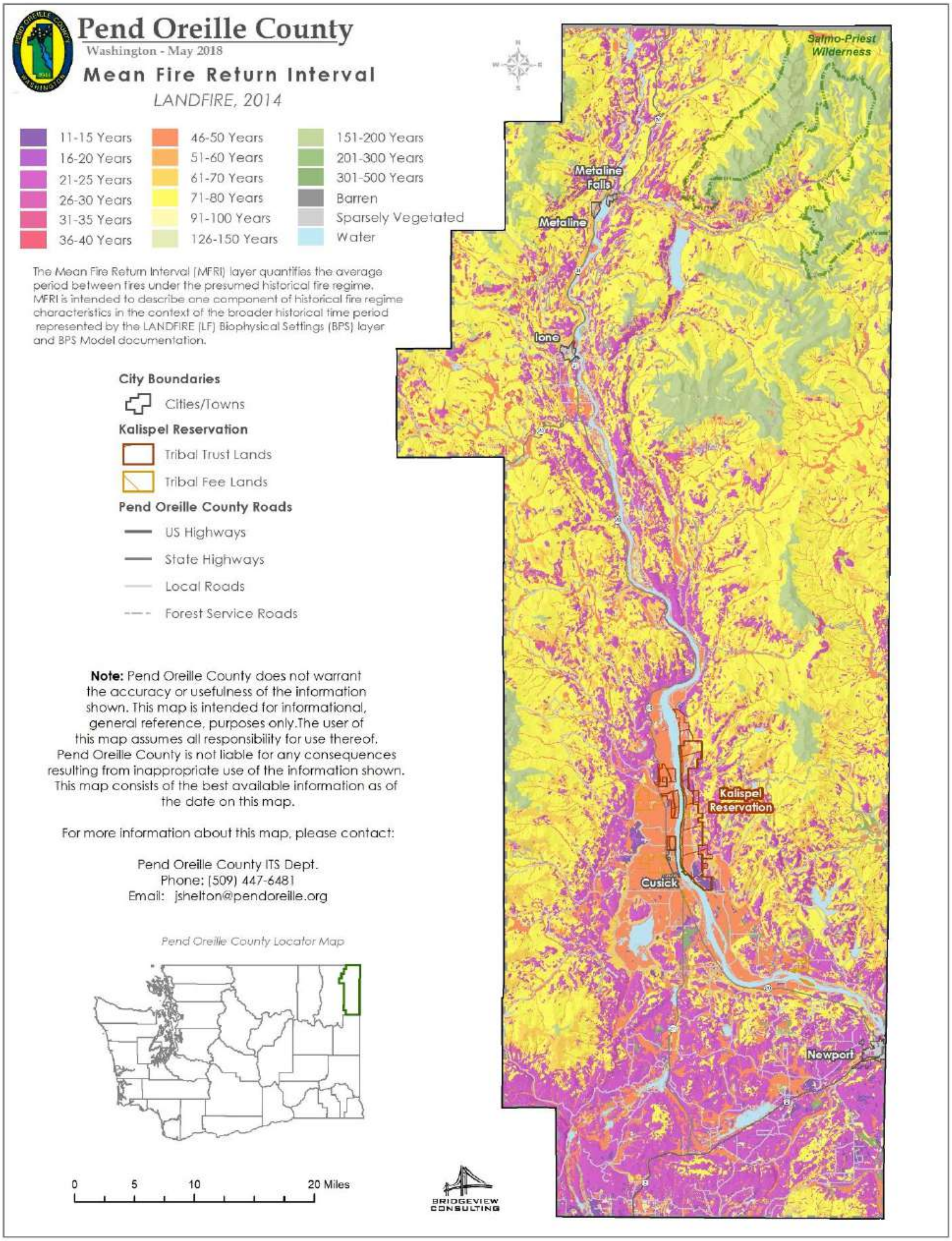


Figure 13-14 Mean Fire Return Interval

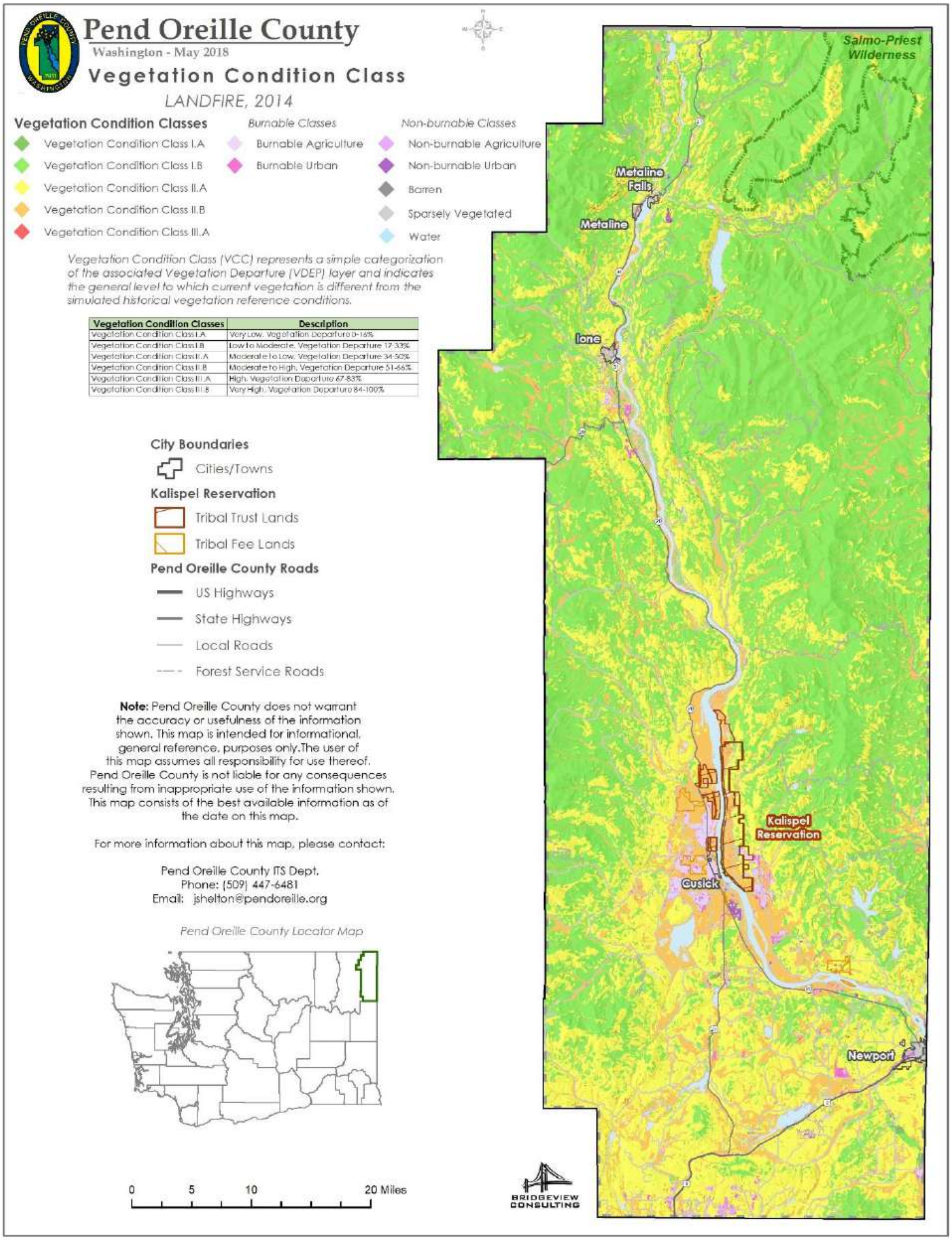


Figure 13-15 Vegetation Condition Class

13.3 VULNERABILITY ASSESSMENT

13.3.1 Overview

Structures, above-ground infrastructure, critical facilities, and natural environments are all vulnerable to the wildfire hazard.

Methodology

There is currently no validated damage function available to support wildfire mitigation planning because no such damage functions have been generated. Instead, dollar loss estimates were developed by calculating the assessed value of exposed structures identified utilizing the various LANDFIRE Fire Regime (1-5) datasets. Population impact also utilized the various Fire Regimes, with population estimated using the exposed structure count of buildings in each Fire Regime area and applying the census value of two (2) persons per household for Pend Oreille County. The Kalispel Tribe population count is calculated at 3 persons per household.

Warning Time

Wildfires are often caused by humans, intentionally or accidentally. There is no way to predict when one might break out. Since fireworks often cause brush fires, extra diligence is warranted around the Fourth of July when the use of fireworks is highest. Dry seasons and droughts are factors that greatly increase fire likelihood. Dry lightning may trigger wildfires. Severe weather can be predicted, so special attention can be paid during weather events that may include lightning. Reliable National Weather Service lightning warnings are available on average 24 to 48 hours prior to a significant electrical storm.

Understanding the relationship between weather, potential fire activity, and geographical features enhances the ability to prepare for the potential of wildfire events. This knowledge, when paired with emergency planning and appropriate mitigation measures, creates a safer environment.

Wildfire studies can analyze weather data to assist firefighters in understanding the relationship between weather patterns and potential fire behavior. Fire forecasting examines similarities between historical fire weather and existing weather and climate values. These studies have determined that for areas such as Pend Oreille County, any combination of two of the following factors can create more intense and potentially destructive fire behavior, known as extreme fire behavior:

- Sustained winds from the east
- Relative humidity less than 40 percent
- Temperature greater than 72º Fahrenheit
- Periods without precipitation greater than 14 days in duration
- 1,000-hour fuel moisture less than 17 percent.

If a fire breaks out and spreads rapidly, residents may need to evacuate within a short timeframe. The County does have an evacuation notification system in place to provide early notice to its residents if residents elect to sign up for the notification. Customarily, a fire’s peak burning period generally is between 1 p.m. and 6 p.m. In normal situations, fire alerting would commence quickly, helping to reduce the risk. However, in more remote locations of the County, or in areas where cell phone services are sporadic at times, warning time and calls for assistance may be reduced.

13.3.2 Impact on Life, Health, and Safety

While there are no recorded fatalities from wildfire in the planning area, a statistical number of the population vulnerable to impact from fire is impossible to determine with any accuracy due to the high number of variables that impact fire scenarios. The population at risk must also take into consideration tourists given the County's proximity to the campsites, parklands, and other Washington, Idaho, and Canadian high-tourist destinations. With its high tourism rate more than doubling the population during the summertime months, there is an increase in the population vulnerability to fire. Given the increase in tourism during the summer months, when fire danger is at its greatest, increased consideration must be taken into account for fire response.

Smoke and air pollution from wildfires can be a severe health hazard, especially for sensitive populations, including children, the elderly and those with respiratory and cardiovascular diseases. Pend Oreille County has a high population of retirees and individuals over 65, further increasing the potential impact on the fire hazard. Smoke generated by wildfire consists of visible and invisible emissions that contain particulate matter (soot, tar, water vapor, and minerals), gases (carbon monoxide, carbon dioxide, nitrogen oxides), and toxics (formaldehyde, benzene). Emissions from wildfires depend on the type of fuel, the moisture content of the fuel, the efficiency (or temperature) of combustion, and the weather. Public health impacts associated with wildfire include difficulty in breathing, odor, and reduction in visibility. Wildfire also threatens the health and safety of those fighting fires. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke.

Exposure to wildfire in Pend Oreille County is dependent upon many factors. The maps used in the analysis show areas of relative importance in determining fire risk, though they do not provide sufficient data for a statistical estimation of exposed population. The other significant variable for which no additional data exists is the deviation from historic vegetation as a result of previous wildfires which have impacted the area, the most significant of which occurred in 2015, burning over 26,000 acres. When combined with additional fires that have impacted the vegetation in the area, the existing LANDFIRE Vegetation Class is less reliable, although currently represents the best available data. The County does recognize this deficiency and will seek out grant opportunities to help obtain a more accurate vegetation layer for future risk assessments through either some type of field analysis, or LiDAR.

For purposes of this assessment, the various Fire Regimes were used with population estimated using the structure count of buildings exposed within the various Fire Regime areas and applying the census value of 2 persons per household for Pend Oreille County, and 3 persons per household for the Kalispel Reservation. These estimates are shown below (Table 13-2). Not calculated within the potential impact is the number of tourists who may be visiting the area at any given time.

Table 13-2
Residential Structures and Population County Within Fire Regimes

Jurisdiction	Regime 1 Residential Structures	Population	Regime 2 Residential Structures	Population	Regime 3 Residential Structures	Population	Regime 4 Residential Structures	Population	Regime 5 Residential Structures	Population
Unincorporated Pend Oreille County	1,913	3,826	323	646	3,846	7,692	54	108	58	116
Kalispel Reservation	9	27	12	36	69	207	0	0	0	0
Newport, City of	532	1,064	14	28	128	256	2	4	94	188
Cusick, Town of	2	4	5	10	165	330	0	0	0	0
Ione, Town of	158	316	4	8	186	372	1	2	0	0
Metaline, Town of	0	0	0	0	97	194	0	0	0	0
Metaline Falls, Town of	50	100	40	80	49	98	0	0	0	0
Total	2,664	5,337	398	808	4,540	9,149	57	114	152	304

*Residential structures represent single and multi-family dwellings, with averages considered for multi-family based on Assessor data. Institutional dormitories (i.e. jails, group housing for military or colleges) were counted as a single structure based on varied occupancy.

13.3.3 Impact on Property

Property damage from wildfires can be severe and can significantly alter entire communities. The potential exposure of the structures in the County should a fire occur is high depending on the area, with the unincorporated county and all planning partners having some degree of exposure to wildfire hazards. Details on the number of critical facilities, acres, and the number and value of structures exposed to applicable LANDFIRE Wildfire Regimes are identified in Table 13-3 and **Error! Reference source not found.**.

Table 13-3
Pend Oreille County Acres in Wildfire Regime Groups

Jurisdiction	Barren	Fire Regime Group					Snow/ Ice	Sparsely Vegetated	Water	Total
		I	II	III	IV	V				
Unincorporated Pend Oreille County	135.60	196,847.10	11,848.50	598,737.60	74,347.60	3,742.60	1.10	1.10	18,922.80	904,584.00
Kalispel Reservation	0.67	1,755.96	88.39	6,092.80	21.78	0.00	0.00	0.00	518.51	8,478.11
Newport, City of	0.00	856.65	28.82	405.71	5.56	87.97	0.00	0.00	13.30	1,398.01
Cusick, Town of	0.00	22.99	9.45	757.32	2.87	0.00	0.00	0.00	45.31	837.94
Ione, Town of	0.00	343.29	38.24	443.68	1.10	0.45	0.00	0.00	42.91	869.67
Metaline, Town of	0.00	0.00	0.00	193.49	0.00	0.00	0.00	0.00	8.49	201.97
Metaline Falls, Town of	0.00	79.63	37.35	174.21	0.89	0.00	0.00	0.00	30.42	322.51
Total	**136.27**	**199,905.62**	**12,050.75**	**606,804.82**	**74,379.81**	**3,831.02**	**1.10**	**1.10**	**19,581.74**	**916,692.22**

Table 13-4
Pend Oreille County Structures Exposed to Wildfire Regime Groups 1-5

			LANDFIRE Fire Regime Groups (3)				
			Buildings Exposed Fire Regime 1				
Estimated 2017 Population (1)	Estimated Building Count (2)	Total Building Value (Structure and contents in $) (2)	Estimated Buildings Exposed (2)	Building Structure Value Exposed (2)	Building Content Value Exposed (2)	Sum of Structure and Contents Exposed (2)	% of Total Value
205	115	$8,135,247	3	$227,452	$208,726	$436,178	5.36%
445	265	$25,582,201	102	$5,577,405	$3,136,837	$8,714,242	34.06%
170	104	$11,460,141	0	$0	$0	$0	0.00%
240	135	$17,305,898	51	$4,282,206	$2,385,251	$6,667,457	38.53%
2,170	839	$181,801,463	562	$77,014,446	$50,361,842	$127,376,288	70.06%
275	102	$98,614,681	7	$1,024,646	$762,320	$1,786,966	1.81%
10,140	6,897	$1,086,351,621	2,081	$186,126,110	$97,399,101	$283,525,211	26.10%
13,645	**8,457**	**$1,429,251,252**	**2,806**	**$274,252,265**	**$154,254,077**	**$428,506,342**	**29.98%**

				LANDFIRE Fire Regime Groups (3)				
				Buildings Exposed Fire Regime 2				
Jurisdiction	Estimated 2017 Population (1)	Estimated Building Count (2)	Total Building Value (Structure and contents in $) (2)	Estimated Buildings Exposed (2)	Building Structure Value Exposed (2)	Building Content Value Exposed (2)	Sum of Structure and Contents Exposed (2)	% of Total Value
Cusick	205	115	$8,135,247	4	$240,652	$120,325	$360,977	4.4%
Ione	445	265	$25,582,201	1	$32,210	$16,105	$48,315	0.2%
Metaline	170	104	$11,460,141	0	$0	$0	$0	0.0%
Metaline Falls	240	135	$17,305,898	39	$3,001,328	$1,851,398	$4,852,726	28.0%
Newport	2,170	839	$181,801,463	15	$2,298,501	$1,238,630	$3,537,131	1.9%
Kalispel Tribe	275	102	$98,614,681	14	$4,783,844	$3,170,252	$7,954,096	8.1%
Unincorporated County	10,140	6,897	$1,086,351,621	372	$38,351,084	$22,589,274	$60,940,358	5.6%
Total	**13,645**	**8,457**	**$1,429,251,252**	**445**	**$48,707,619**	**$28,985,984**	**$77,693,603**	**5.44%**

				LANDFIRE Fire Regime Groups (3)				
				Buildings Exposed Fire Regime 3				
Jurisdiction	Estimated 2017 Population (1)	Estimated Building Count (2)	Total Building Value (Structure and contents in $) (2)	Estimated Buildings Exposed	Building Structure Value Exposed (2)	Building Content Value Exposed (2)	Sum of Structure and Contents Exposed (2)	% of Total Value
Cusick	205	115	$8,135,247	108	$4,709,681	$2,628,411	$7,338,092	90.2%
Ione	445	265	$25,582,201	160	$10,340,165	$6,129,680	$16,469,845	64.4%
Metaline	170	104	$11,460,141	103	$7,480,105	$3,920,281	$11,400,386	99.5%
Metaline Falls	240	135	$17,305,898	45	$3,622,605	$2,163,110	$5,785,715	33.4%
Newport	2,170	839	$181,801,463	122	$17,778,466	$10,086,929	$27,865,395	15.3%
Kalispel Tribe	275	102	$98,614,681	79	$49,007,700	$34,218,193	$83,225,893	84.4%
Unincorporated County	10,140	6,897	$1,086,351,621	4,173	$438,421,514	$265,992,646	$704,414,160	64.8%
Total	13,645	8,457	$1,429,251,252	4,790	531,360,236	325,139,250	856,499,486	59.93%

				LANDFIRE Fire Regime Groups (3)				
				Buildings Exposed Fire Regime 4				
Jurisdiction	Estimated 2017 Population (1)	Estimated Building Count (2)	Total Building Value (Structure and contents in $) (2)	Estimated Buildings Exposed	Building Structure Value Exposed (2)	Building Content Value Exposed (2)	Sum of Structure and Contents Exposed (2)	% of Total Value
Cusick	205	115	$8,135,247	0	$0	$0	$0	0.0%
Ione	445	265	$25,582,201	1	$60,210	$30,105	$90,315	0.4%
Metaline	170	104	$11,460,141	0	$0	$0	$0	0.0%
Metaline Falls	240	135	$17,305,898	0	$0	$0	$0	0.0%
Newport	2,170	839	$181,801,463	2	$183,761	$91,880	$275,641	0.2%
Kalispel Tribe	275	102	$98,614,681	2	$2,979,081	$2,668,645	$5,647,726	5.7%
Unincorporated County	10,140	6,897	$1,086,351,621	54	$5,231,505	$2,615,750	$7,847,255	0.7%
Total	13,645	8,457	$1,429,251,252	59	8,454,557	5,406,380	13,860,937	0.97%

				LANDFIRE Fire Regime Groups (3)				
				Buildings Exposed Fire Regime 5				
Jurisdiction	Estimated 2017 Population (1)	Estimated Building Count (2)	Total Building Value (Structure and contents in $) (2)	Estimated Buildings Exposed	Building Structure Value Exposed (2)	Building Content Value Exposed (2)	Sum of Structure and Contents Exposed (2)	% of Total Value
Cusick	205	115	$8,135,247	0	$0	$0	$0	0.0%
Ione	445	265	$25,582,201	0	$0	$0	$0	0.0%
Metaline	170	104	$11,460,141	0	$0	$0	$0	0.0%
Metaline Falls	240	135	$17,305,898	0	$0	$0	$0	0.0%
Newport	2,170	839	$181,801,463	138	$13,279,102	$9,467,906	$22,747,008	12.5%
Kalispel Tribe	275	102	$98,614,681	0	$0	$0	$0	0.0%
Unincorporated County	10,140	6,897	$1,086,351,621	60	$4,116,706	$2,071,773	$6,188,479	0.6%
Total	13,645	8,457	$1,429,251,252	198	17,395,808	11,539,679	28,935,487	2.02%

Sources: (1) 2017 State of Washington, Office of Financial Management Estimated Populations; (2) Exposure numbers were estimated using Pend Oreille County Parcel and Assessor data; (3) The Historical Fire Regime Groups data layer categorizes simulated mean fire return intervals and fire severities into five fire regimes defined in the Interagency Fire Regime Condition Class Guidebook.

Density and the age of building stock in Pend Oreille County are contributing factors in assessing property vulnerability to wildfire. Many of the buildings in the planning area are of significant age, with many being constructed with wood frames and shingle roofs. As actively engaged Community Wildfire Fire Protection Planning partners, each of the Fire Districts and Firewise Communities have identified building materials as potential mitigation measures which can be taken to reduce the impact of wildfires on the communities. When granting opportunities avail themselves, the jurisdictions do look for funding opportunities to assist homeowners in such efforts.

13.3.4 Impact on Critical Facilities and Infrastructure

Critical facilities of wood frame construction are especially vulnerable during wildfire events. In the event of wildfire, there would likely be little damage to most infrastructure. Most roads and railroads would be without damage except in the worst scenarios. Fueling stations could be significantly impacted. Power lines are also significantly at risk from wildfire because most poles are made of wood and susceptible to burning. Fires can create conditions that block or prevent access and can isolate residents and emergency service providers. Wildfire in Pend Oreille County could also impact wood-structured bridges, peers, and docks, which are utilized to moor watercraft, launch search and rescue vessels, dam safety inspections, fishing vessels, or other private boats associated with tourism. Table 13-5 and Table 13-6identifies critical facilities exposed to the wildfire hazard.

Hazardous Material Involved Fire Impact on Critical Facilities and Infrastructure

Currently there are in 12 registered Tier II hazardous material containment sites throughout Pend Oreille County (based on 2017 reporting to Washington State Dept. of Ecology). Four each in both Newport and Metaline Falls, and one each in Metaline, Ione, Usk and Cusick. During a wildfire event, hazardous material storage containers could rupture due to excessive heat and act as fuel for the fire, causing rapid spreading and escalating the fire to unmanageable levels. In addition, the materials could leak into surrounding areas, saturating soils, and seeping into surface waters, having a disastrous effect on the environment.

Table 13-5
Critical Facilities and Infrastructure Exposed to Fire Regime Areas

	Regime 1	Regime 2	Regime 3	Regime 4	Regime 5
Medical and Health Services	12	0	2	0	0
Government Function	11	2	11	3	0
Schools	8	1	7	0	0
Protective Function	6	2	19	0	0
Hazmat	6	2	4	0	1
Other Critical Function	0	0	32	2	0
Water	2	0	17	0	0
Wastewater	2	1	1	1	0
Power	3	0	11	0	2
Communications	1	0	3	1	0
Transportation	2	0	26	0	1
Other Critical Infrastructure	0	0	1	0	0
Total	**53**	**8**	**134**	**7**	**4**

Table 13-6
Pend Oreille County Critical Facilities by Jurisdiction in Wildfire Regime Groups

Jurisdiction	Barren	Fire Regime Group					Snow/ Ice	Sparsely Vegetated	Water	Total
		I	II	III	IV	V				
Unincorporated Pend Oreille County	0	11	6	94	5	1	0	0	10	127
Kalispel Reservation	0	2	2	23	2	0	0	0	0	29
Newport, City of	0	35	0	2	0	3	0	0	0	40
Cusick, Town of	0	1	0	8	0	0	0	0	0	9
Ione, Town of	0	2	0	3	0	0	0	0	0	**5**

Table 13-6
Pend Oreille County Critical Facilities by Jurisdiction in Wildfire Regime Groups

Jurisdiction	Barren	Fire Regime Group					Snow/ Ice	Sparsely Vegetated	Water	Total
		I	II	III	IV	V				
Metaline, Town of	0	0	0	1	0	0	0	0	0	1
Metaline Falls, Town of	0	2	0	3	0	0	0	0	0	5
Total	**0**	**53**	**8**	**134**	**7**	**4**	**0**	**0**	**9**	**216**

13.3.5 Impact on Economy

The Pend Oreille County economy is largely dependent on the forest industry, with wood- and paper-related products falling within the top 10 industrial companies. A large-scale wildfire would destroy timber and logging equipment. The economy could suffer from loss of supply for local industries dependent on raw logs to process for plywood, paper, and pulp, etc. Tourism would also be impacted, as wildfire impact on the economy can be far reaching, ranging from damage to transportation routes to non-use of park facilities and campsites, to loss of structures influencing tax base from lost revenue.

Secondary impacts include erosion on burned slopes leading to runoff and contributing to flooding, landslides, and impacts to salmon-bearing streams. Wildfires in dune grass could destroy homes, hotels, restaurants, and other tourist facilities while wildfires in farmlands could destroy crops, farms, and structures.

13.3.6 Impact on Environment

Fire is a natural and critical ecosystem process in most terrestrial ecosystems, dictating in part the types, structure, and spatial extent of native vegetation. However, wildfires can cause severe environmental impacts:

- Destroyed Endangered Species Habitat—Catastrophic fires can have devastating consequences for endangered species. The County is home to one of the last herds of Caribou, which could be significantly impacted as a result of a fire.
- Damaged Fisheries—Critical fisheries can suffer from increased water temperatures, sedimentation, and changes in water quality.
- Soil Erosion—The protective covering provided by foliage and dead organic matter is removed, leaving the soil fully exposed to wind and water erosion. Accelerated soil erosion occurs, causing landslides and threatening aquatic habitats.
- Spread of Invasive Plant Species—Non-native woody plant species frequently invade burned areas. When weeds become established, they can dominate the plant cover over broad landscapes, and become difficult and costly to control.
- Disease and Insect Infestations—Unless diseased or insect-infested trees are swiftly removed, infestations and disease can spread to healthy forests and private lands. Timely active management actions are needed to remove diseased or infested trees.

- Soil Sterilization—Topsoil exposed to extreme heat can become water repellant, and soil nutrients may be lost. It can take decades or even centuries for ecosystems to recover from a fire. Some fires burn so hot that they can sterilize the soil.

13.4 FUTURE DEVELOPMENT TRENDS

The County is optimistic that increased population growth will occur throughout the region. As areas of the County become more urbanized, the potential exists that the fire risk may increase as urbanization tends to alter the natural fire regime, and the growth will expand the urbanized areas into undeveloped wildland areas. However, the County feels that this expansion of the wildland-urban interface can be managed with strong land use and building codes. With continued expansion of the Community Wildfire Protection Plan strategies and continued community involvement, the number of wildfires and impact therefrom will not continue to grow.

Historic records indicate the increase in the acres burned since the 2011 plan was adopted, but a decrease in the overall number of annual wildfires. Population has remained fairly consistent, with a relatively low number of building permits issued for residential structures. Since completion of the last plan, most residential construction has occurred around Diamond and Sacheen Lakes, along the Pend Oreille River, and along the major county roads in the southern portion of the county. These are also areas of high tourist areas, which would increase the potential for evacuees during fires, as well as potentially increasing the population which could ultimately cause wildfires.

The largest variable between the two plans is not with respect to development trends as much as the rate at which the various vegetation has been removed from vegetation classes due to fires in 2015 and 2017. As population increases, this will also potentially increase re-burns, further removing the vegetation classes.

A growing body of research suggests that "the only effective home protection treatment is treatment in, on, and around the house (see Figure 13-16); homeowners must be responsible for protecting that property" (Nowicki 2001, p. 1:3). U.S. Forest Service research scientist, Jack Cohen has stated that "home ignitions are not likely unless flames and firebrand ignitions occur within 40 meters [131 feet] of the structure; the WUI fire loss problem primarily depends on the home and its immediate site." The CWPP community in Pend Oreille County actively works to support individual homeowners' efforts with respect to removing or reducing ignition sources, as well as actively training to ensure wildfire fighting capabilities by both volunteers and employees.

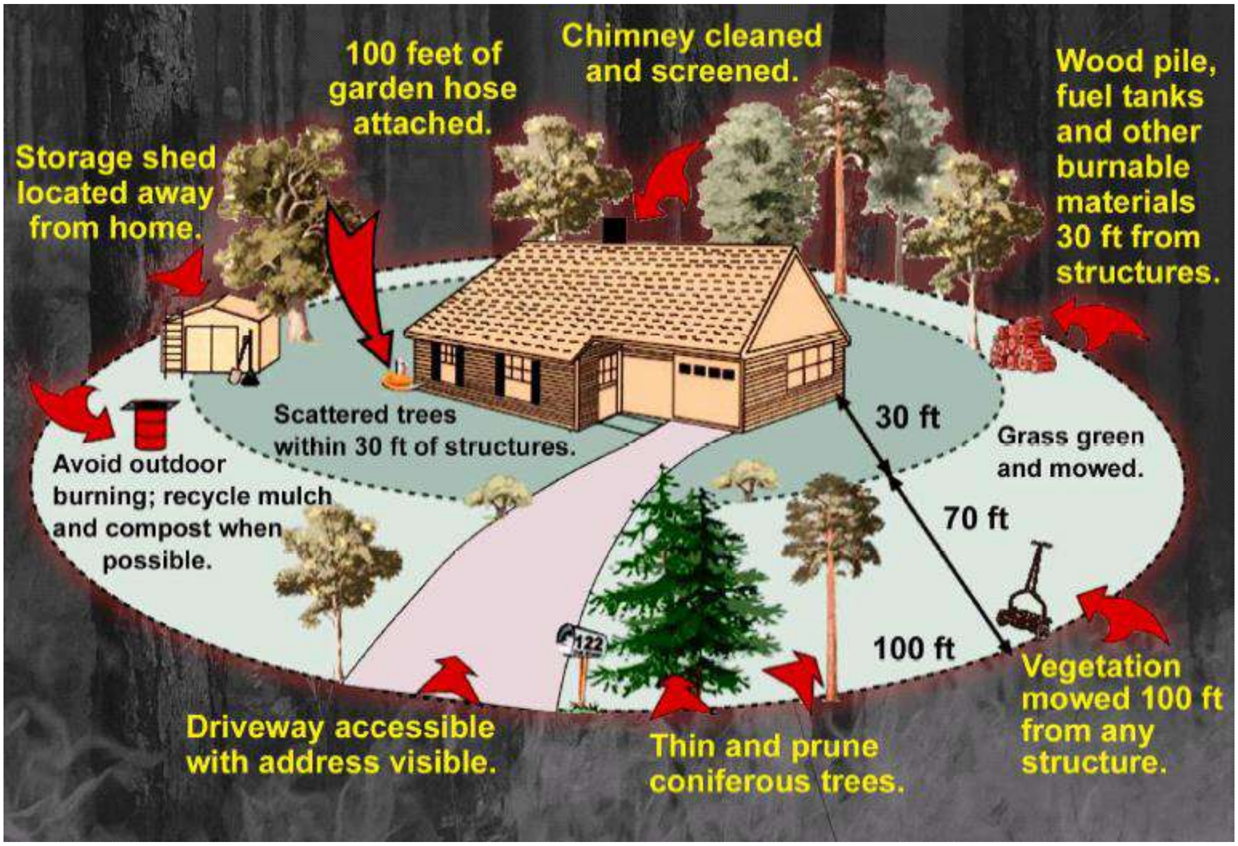


Figure 13-16 Measures to Protect Homes from Wildfire

13.5 ISSUES

The major issues for wildfire in Pend Oreille County are the following:

- Public education and outreach to people living in or near the fire hazard zones should include information about and assistance with mitigation activities such as defensible space, and advance identification of evacuation routes and safe zones. The local Conservation District works with all of the local fire agencies and community organizations to help ensure adequately and accurate information is disseminated, as well as helping the local fire agencies seek out and apply for grants to assist in mitigation activities.
- Vegetation management activities should include enhancement through expansion of target areas as well as additional resources. Due to large historic-level fires occurring over the last several years, a new, updated vegetation layer is necessary to help determine wildfire vulnerability due to deviation from historic vegetation classes, many of which may be more susceptible to, or increase the vulnerability of, wildfires.
- Wildfires could cause landslides as a secondary natural hazard.
- Climate change will affect the wildfire hazard.
- Future growth into interface areas should continue to be managed.
- Building code standards need to be enhanced, including items such as residential sprinkler requirements and prohibitive combustible roof standards.

- Increased fire department water supply is needed in high-risk wildfire areas.
- Obtain and maintain certifications and qualifications for fire department personnel.
- Ensure that firefighters are trained in basic wildfire behavior, basic fire weather, and that company officers and chief level officers are trained in the wildland command and strike team leader level.

A worst-case scenario would include an active fire season throughout the American west, spreading resources thin. Firefighting teams would be exhausted or unavailable. Many federal assets would be responding to other fires that started earlier in the season. While local fire districts outside of the planning area would be extremely useful in the urban interface areas, many districts have limited wildfire capabilities or experience, and they would have a difficult time responding to the ignition zones. Even though the existence and spread of the fire is known, it may not be possible to respond to it adequately, so an initially manageable fire can become out of control before resources are dispatched.

To further complicate the problem, heavy rains could follow, causing flooding and landslides and releasing tons of sediment into rivers, permanently changing floodplains, and damaging sensitive habitat and riparian areas. Such a fire followed by rain could release millions of cubic yards of sediment into streams for years, creating new floodplains and changing existing ones. With the forests removed from the watershed, stream flows could easily double. Flood that could be expected every 50 years may occur every couple of years. With the streambeds unable to carry the increased discharge because of increased sediment, the floodplains and the flood elevations would increase.

13.6 RESULTS

Based on review and analysis of the data, the Planning Team has determined that the probability for impact from Wildfire throughout the area is highly likely, with the impact becoming more widely dispersed, such as the 2015 and 2017 wildfire seasons which burned thousands of acers. The area experiences some level of wildfires annually, with the number of acres burnt and the severity of the fires increasing. With densely wooded areas throughout the County, the impact of climate changes and drought also continues to increase fire danger, with the wooded areas becoming more susceptible as a result of lack of soil moisture, infestation of unhealthy forests resulting from drought and the degradation of the health of the vegetation. Deviation from normal vegetation classes resulting from previous fires also increases the fire danger and risk. With the impact of climate change also modifying weather patterns, the potential exists for increased lightning strikes, which can cause fires to ignite and burn for days before detection in remote locations. Construction into the wildfire hazard areas undoubtedly will continue to expand, thereby continuing to increase the risk of fires.

Implementation of mitigation strategies which help reduce wildfire risk, such as landscaping regulations, chipping programs, maintaining defensible space, and mandatory sprinkler systems could potentially help reduce the number of structures at risk. Likewise, continued partnerships such as those between the Conservation District, DNR, USFS, BLM, and local communities continues to be an asset in the region, but resources to fight fires continue to be limited due to funding. As was the case over the course of the last several years, resources nationwide were significantly depleted during the wildfire season due to the number of fires burning nationwide. Such active seasons reduce response personnel and equipment availability to the area. Based on the potential impact, the Planning Team determined the CPRI score to be 4.0 with overall vulnerability determined to be a very high level.

CHAPTER 14.
HAZARD RANKING

14.1 CALCULATED PRIORITY RISK INDEX

In ranking the hazards, the Planning Team completed a Calculated Priority Risk Index worksheet for each hazard identified below. The index examines five criteria for each hazard as discussed in Chapter 4 (probability, magnitude/severity, extent/location, warning time, and duration), defines a risk index for each according to four levels, then applies a weighting factor. The result is a score that has been used to rank the hazards at the County level. All planning partners also completed their own hazard rankings, using the same process. Table 14-1 presents the results of the Calculated Priority Risk Index scoring for all hazards impacting the County. Table 14-2 is a summary of the vulnerability rating for the jurisdiction planning partners. Each respective planning partners' annex also contains additional hazard information specific to their jurisdiction and/or agency, as well as their respective CPRI scores.

Table 14-1
County Calculated Priority Risk Index Ranking Scores

Hazard	Probability	Magnitude and/or Severity	Extent and Location	Warning Time	Duration	Calculated Priority Risk Index Score
Avalanche	2	1	1	4	3	1.95
Climate Change	3	2	2	1	4	2.35
Drought	2	3	3	1	4	2.35
Earthquake	1	2	2	4	1	1.85
Flood	4	3	2	1	4	2.95
Landslide	2	2	2	4	2	2.3
Severe Weather	4	3	3	1	4	3.15
Volcano	1	1	3	1	2	1.45
Wildfire	4	4	4	4	4	4.0

The Calculated Priority Risk Index scoring method has a range from 0 to 4. "0" being the least hazardous and "4" being the most hazardous situation.

Table 14-2
Countywide Vulnerability Rating

City or Town	Avalanche	Climate Change	Drought	Earth-quake	Flood	Land-slide	Severe Weather	Volcano	Wildfire
County	Medium	Medium	Medium	Medium	High	Medium	High	Low	Very High
Cusick, Town of	Low	Medium	Medium	Low	High	Low	High	Very Low	Very High
Ione, Town of	Low	Medium	Medium	Low	Very Low	Low	High	Very Low	Very High
Kalispel Tribe	Low	Medium	Medium	Low	High	Low	High	Very Low	Very High
Metaline, Town of	Medium	Medium	Medium	Low	High	Medium	High	Low	Very High
Metaline Falls, Town of									
Newport, City of	Medium	Medium	Medium	Medium	Medium	Medium	High	Low	Very High
Fire District 2	Medium	Medium	Medium	Low	Medium	Medium	High	Low	High
Fire District 4	Medium	Medium	Medium	Medium	High	Medium	High	Low	Very High
Fire District 6	Medium	Medium	Medium	Low	High	Medium	High	Low	High
Fire District 8									
South Pend Oreille Fire & Rescue	Medium	Medium	Medium	Low	Medium	Medium	High	Low	High
Health District #1 – Newport Hospital & Health Services	Low	Low	Medium	Medium	Low	Low	High	Low	High
Pend Oreille County Public Utility	Low	Medium	Medium	Low	Medium	Medium	High	Low	High
Port of Pend Oreille	Medium	Medium	Low	Low	High	Medium	High	Low	High
Cusick School District	Low	Medium	Medium	Low	High	Low	High	Very Low	Very High
Newport School District	Low	Medium	Medium	Low	Medium	Medium	High	Low	High

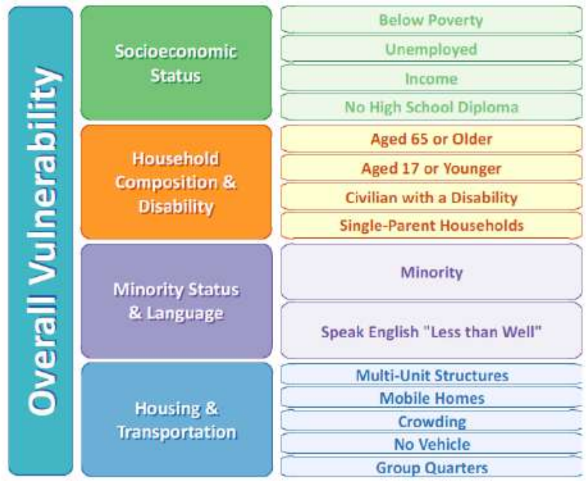
14.1.1 Calculated Priority Rate Index

CPRI Category	Degree of Risk			Assigned Weighting Factor
	Impact/ Level ID	Description	Impact Factor	
Probability	Unlikely	• Rare with no documented history of occurrences or events. • Annual probability of less than 1% (~100 years or more).	1	40%
	Possible	• Infrequent occurrences; at least one documented or anecdotal historic event. • Annual probability that is between 1% and 10% (~10 years or more).	2	
	Likely	• Frequent occurrences with at least two or more documented historic events. • Annual probability that is between 10% and 90% (~10 years or less).	3	
	Highly Likely	• Common events with a well-documented history of occurrence. • Annual probability of occurring. (1% chance or 100% Annually).	4	
Magnitude/ Severity	Negligible	• People – Injuries and illnesses are treatable with first aid; minimal hospital impact; no deaths. Negligible impact to quality of life. • Property – Less than 5% of critical facilities and infrastructure impacted and only for a short duration (less than 24-36 hours such as for a snow event); no loss of facilities, with only very minor damage/clean-up. • Economy – Negligible economic impact. • Continuity of government operating at 90% of normal operations with only slight modifications due to diversion of normal work for short-term response activity. Disruption lasts no more than 24-36 hours. • Special Purpose Districts: No Functional Downtime.	1	25%
	Limited	• People – Injuries or illness predominantly minor in nature and do not result in permanent disability; some increased calls for service at hospitals; no deaths; 14% or less of the population impacted. Moderate impact to quality of life. • Property – Slight property damage -greater than 5% and less than 25% of critical and non-critical facilities and infrastructure. • Economy – Impact associated with loss property tax base limited; impact results primarily from lost revenue/tax base from businesses shut down during duration of event and short-term cleanup; increased calls for emergency services result in increased wages. • Continuity of government impacted slightly; 80% of normal operations; most essential services being provided. Disruption lasts >36 hours, but <1 week. • Special Purpose Districts: Functional downtime 179 days or less.	2	
	Critical	• People – Injuries or illness results in some permanent disability or significant injury; hospital calls for service increased significantly; no deaths. 25% to 49% of the population impacted. • Property – Moderate property damages (greater than 25% and less than 50% of critical and non-critical facilities and infrastructure). • Economy - Moderate impact as a result of critical and non-critical facilities and infrastructure impact, loss of revenue associated with tax base, lost income. • Continuity of government ~50% operational capacity; limited delivery of essential services. Services interrupted for more than 1 week, but <1 month. • Special Purpose Districts: Functional downtime 180-364 days.	3	
	Catastrophic	• People - Injuries or illnesses result in permanent disability and death to a significant amount of the population exposed to a hazard. >50% of the population impacted. • Property – Severe property damage >50% of critical facilities and non-critical facilities and infrastructure impacted. • Economy – Significant impact - loss of buildings /content, inventory, lost revenue, lost income. • Continuity of government significantly impacted; limited services provided (life safety and mandated measures only). Services disrupted for > than 1 month. • Special Purpose Districts: Functional Downtime 365 days or more.	4	
Geographic Extent and Location	Limited	Less than 10% of area impacted.	1	20%
	Moderate	10%-24% of area impacted.	2	
	Significant	25%-49% of area impacted.	3	
	Extensive	50% or more of area impacted.	4	
Warning Time / Speed of Onset	<6 hours	Self-explanatory.	4	10%
	6 to 12 hours	Self-explanatory.	3	
	12 to 24 hours	Self-explanatory.	2	
	> 24 hours	Self-explanatory.	1	
Duration	< 6 hours	Self-explanatory.	1	5%
	< 24 hours	Self-explanatory.	2	
	<1 week	Self-explanatory.	3	
	>1 week	Self-explanatory.	4	

14.2 SOCIAL VULNERABILITY

Once the hazard ranking was completed, the Planning Team then conducted a Social Vulnerability Assessment for those priority hazards identified in Table 14-1 and Table 14-2. Several different assessments were completed with respect to social vulnerability, including both a quantitative assessment contained within each profile and summarized below, and a qualitative assignment based on the CPRI analysis.

When determining risk, it is significant to remember that risk is measured by not only the hazard, but also on how resilient a population is, or will be during the hazard. Resilience is influenced by many factors, including: age or income; available social networks, and neighborhood characteristics, all of which can be used to measure the social vulnerability of the area and its citizens. Based on a study completed by the University of North Carolina, factors that contribute to the level of vulnerability of a population are associated with four areas of impact, which, in part, are utilized within this assessment with a few modifications to the original study, as indicated:



- Socioeconomic status:
  - Below Poverty Level
  - Employment Status
  - Income level
  - No High School Diploma
- Household composition:
  - Age 65 or older
  - Age 5 or younger (the North Carolina study references age 17 or younger)
  - Disability (the North Carolina study referenced “Older than Age 5 with a Disability”)
  - Single Parent Households
- Minority Status and Language:
  - Minority – race or ethnicity
  - Language barrier (Speak English “Less than Well”
- Housing/transportation:
  - Multi-Unit Structures, including Group Quarters
  - Mobile Homes
  - Crowding
  - No Vehicle

The purpose of the classifications is to better understand whose needs are not being addressed through traditional service providers or who cannot safely access and use the standard resources offered for disaster preparedness, relief and recovery. Special focus on these groups during emergency situations is crucial because not only are they more likely to be affected by an event, but they are many times also less likely to recover.

14.2.1 Classifications

Socioeconomic status considers things such as income, poverty, employment status, and education level. Those who are economically disadvantaged will be affected by an event more significantly. The monetary value of their possessions may be less, but they represent a larger proportion of total household assets. These groups are less likely to have renters or homeowner's insurance, so their possession will be costlier to replace, and individuals are less likely to evacuate in order to ensure the protection of their belongings. In the event of injury or death, those who are unemployed will not have the benefits or the income to assist with costs for recovery. In addition, in most cases, the poor lack the assets and the resources to prepare for a disaster in advance, and once impacted, to recover.

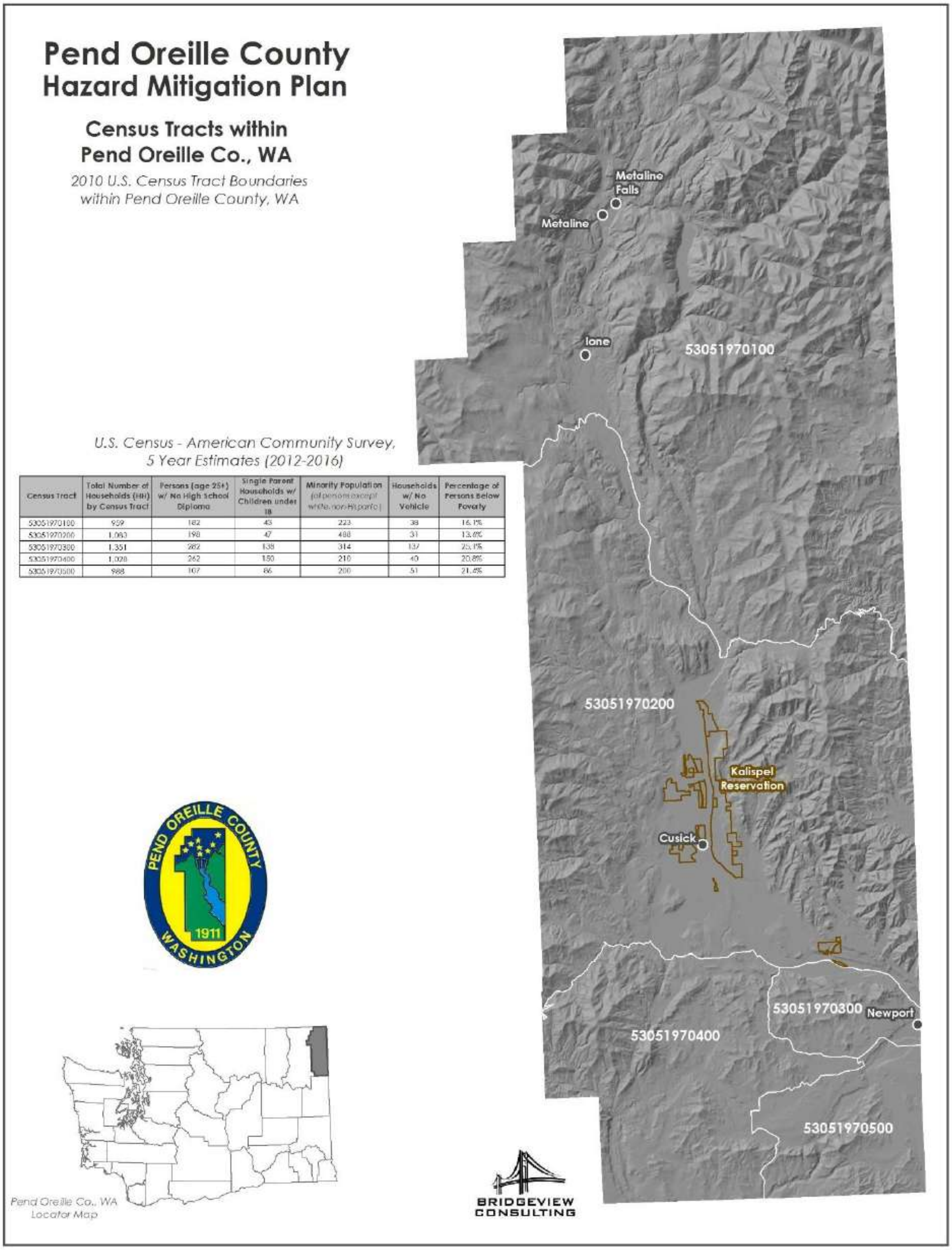
Household composition and disability grouping is comprised of age (those under the age of 5 and above the age of 65), single parent homes, and any disability. These groups are more likely to need financial support, transportation, medical care, or assistance with day to day activities during disasters. The elderly and the children, especially the younger ones often lack the resources, knowledge, or life experiences to effectively address the situation and cannot protect themselves. Elderly living alone, and people who have a physical, sensory, or cognitive challenges are more likely to be vulnerable during an incident. These groups often need a higher level of assistance than others, and may have caretakers who are less able to assist during a crisis if those caretakers have families of their own. This places a heavier burden on medical and first responders.

Minority status and language includes race, ethnicity, and proficiency of the English language. The social and economic marginalization of certain racial and ethnic groups have made these populations more likely to be vulnerable at all stages, and are automatically associated with a higher vulnerability rate. Many citizens are not fluent in English, which makes providing them with real time information difficult. Because Spanish is the most prominent second language, there are often translators available, and many times emergency notifications are provided in Spanish; however, those who speak other languages are at greater risk if notifications are not provided in the appropriate languages. These groups often rely on family, friends, neighbors and social media for information.

Housing and transportation considers the structure of the home (e.g., building codes, age of structure, etc.), crowding, and access to vehicles or public transportation. The quality of the housing is crucial when calculating vulnerability and is often tied to the person's wealth. Those who are economically disadvantaged often live in poorly constructed houses or mobile homes, neither of which are designed to withstand strong winter storms (ice and snow loads), wind events, earthquakes, or flooding. In addition, mobile homes are often located in places without easy access to highways or public transportation, are in cluster communities, and many times not tied down to a foundation, all of which add another layer of vulnerability. Multi-unit housing in densely populated areas are difficult to evacuate because of the limited amount of space and crowding. Urban areas often have a lower automobile ownership rate (e.g., walkable communities), especially in the lower income populations, which can make evacuations more challenging. Despite the lower proportion of people with vehicles, urban areas often have to deal with congestion on highways and major roads because of crowding. Group quarters are another housing situation that cause concern during evacuations, especially nursing homes and long term care facilities because many institutions are unprepared to quickly remove staff and residents, and as with private group/independent living homes, the data that such facilities exist is not publicly known and/or identified.

14.2.2 Results and Discussion

Figure 14-1 through Figure 14-6 identify the spatial distribution of the Social Vulnerability components identified above. The distribution is based on the existing five census tracks within Pend Oreille County to allow for use of the U.S. Census data. Based on 2012 Census data, there are currently in excess of 2,800 individuals living within Pend Oreille County with an identified disability. This represents approximately 20 percent of the entire county's population, a significantly higher number than most other counties statewide. The highest density of the disabled population falls in the Newport area, which is also true of the highest number of individuals 17 years of age and younger, limited English proficiency, and unemployed. The Cusick and Kalispel Reservation areas appear to have the highest population of elderly 65 years of age and over. Given the age of the building stock within Newport and the high number of elderly, the area would be more susceptible to impact from a disaster event. It should be noted that in an effort to present the most detailed data, different Census datasets were used, which in some cases reflect different values; as such, variations may exist.



Census Tract	Total Number of Households (HH) by Census Tract	Persons (age 25+) w/ No High School Diploma	Single Parent Households w/ Children under 18	Minority Population (all persons except white, non-Hispanic)	Households w/ No Vehicle	Percentage of Persons Below Poverty
53051970100	959	182	43	223	38	16.1%
53051970200	1,063	198	47	488	31	13.6%
53051970300	1,351	282	138	314	137	25.1%
53051970400	1,028	262	150	210	40	20.8%
53051970500	988	107	86	200	51	21.4%

Figure 14-1 Census Tracks and Associated Vulnerability Data

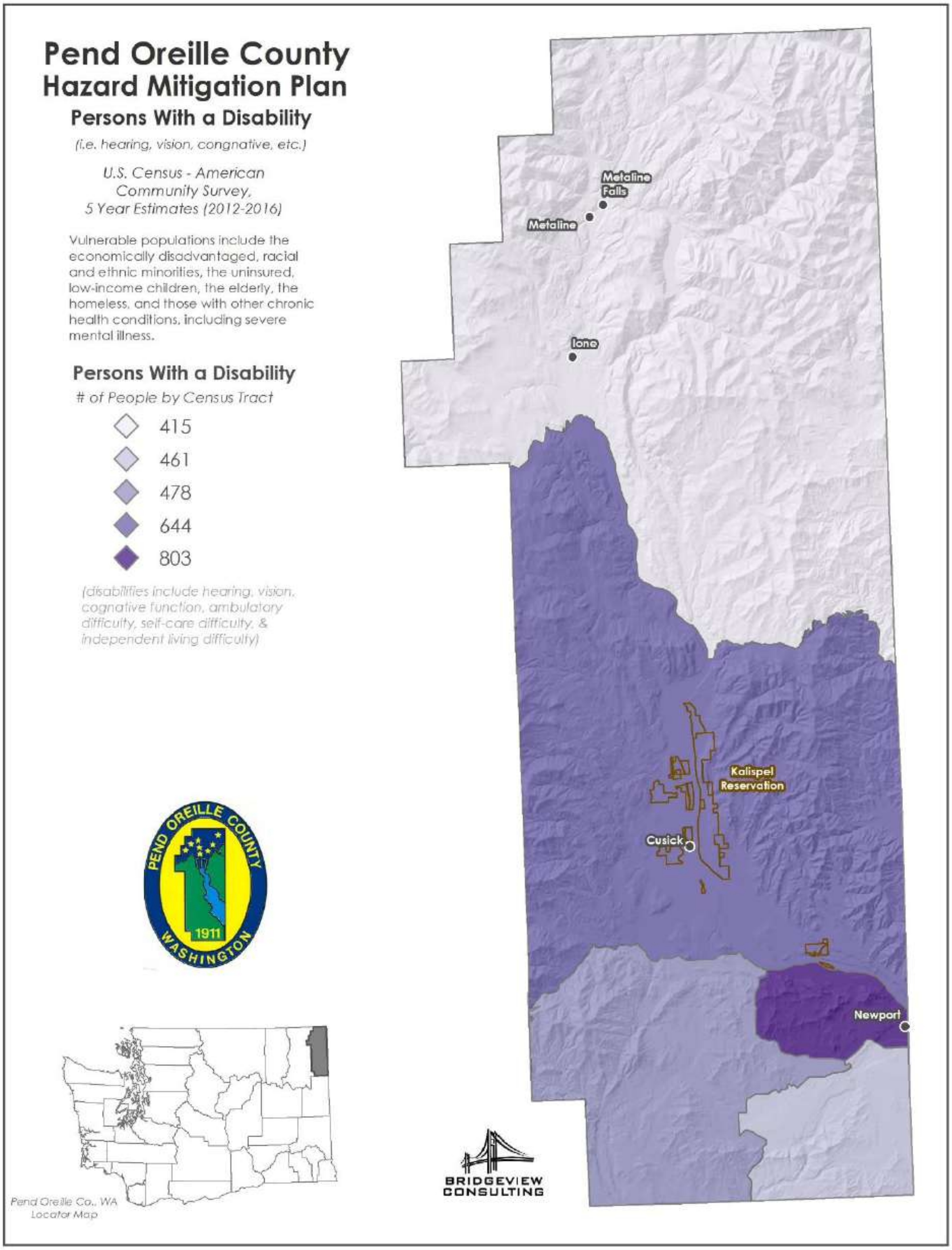


Figure 14-2 Number of Individuals with Reported Disabilities by Census Track

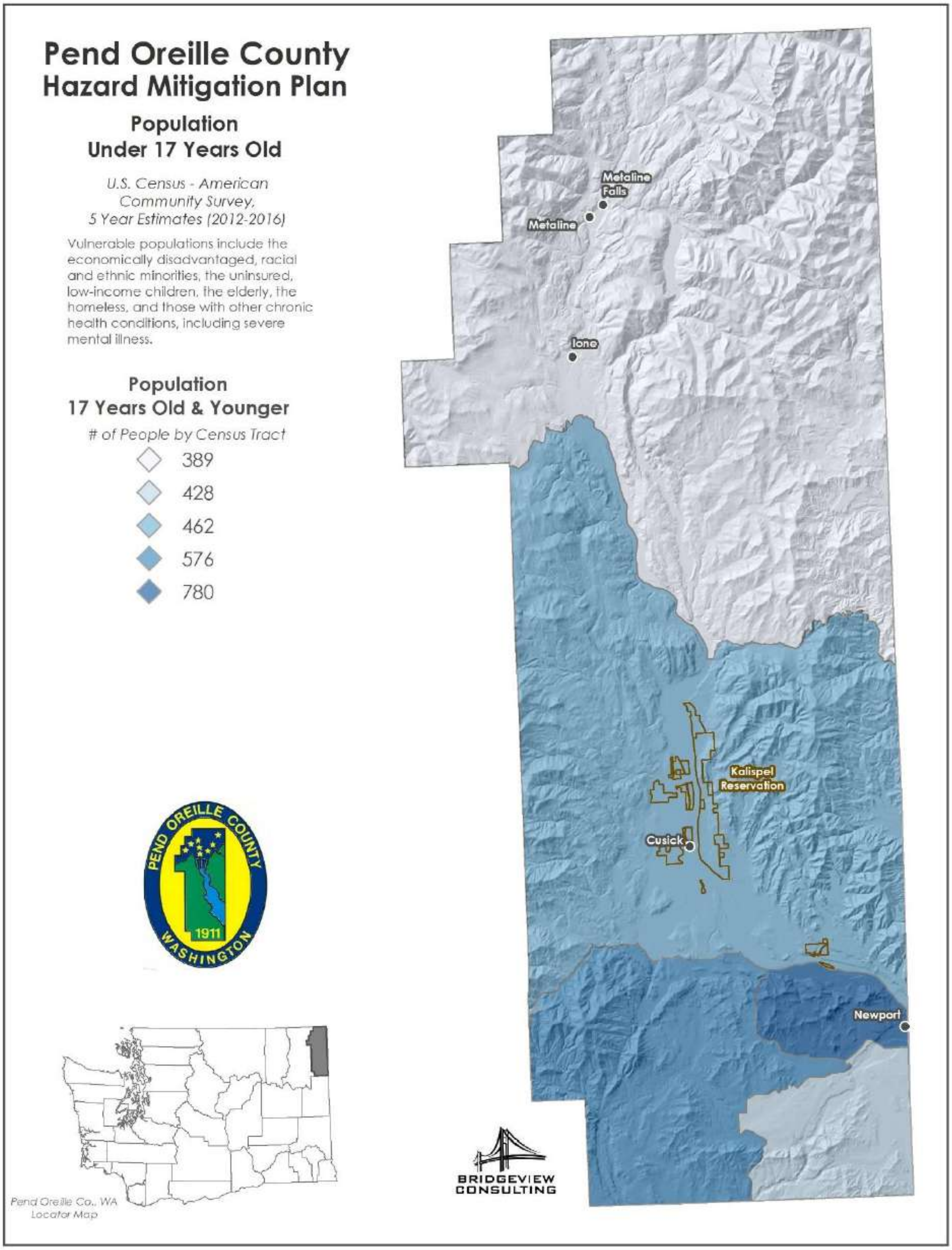


Figure 14-3 Population Distribution by Census Track 17-years and Younger

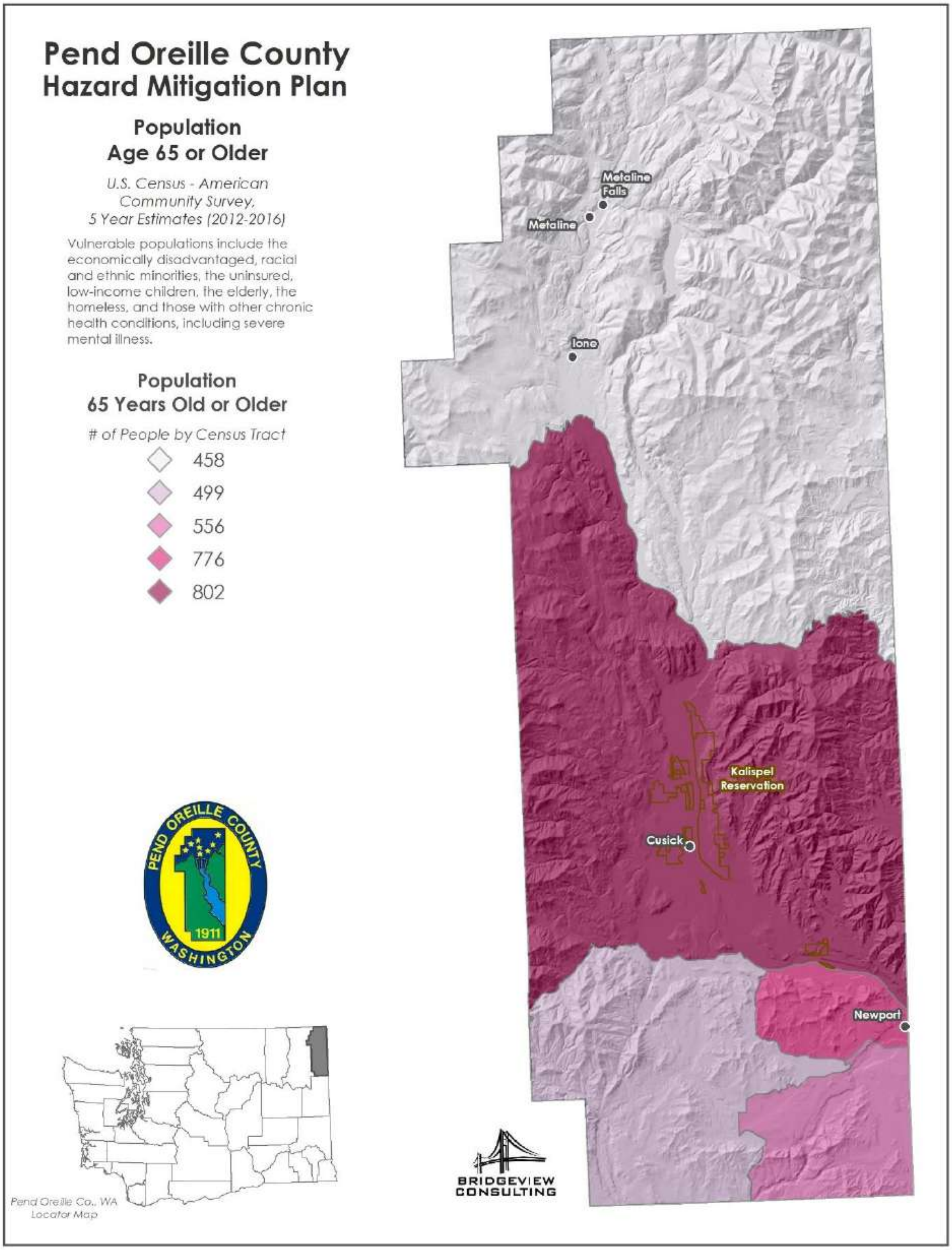


Figure 14-4 Population Distribution by Census Track 65-years and Older

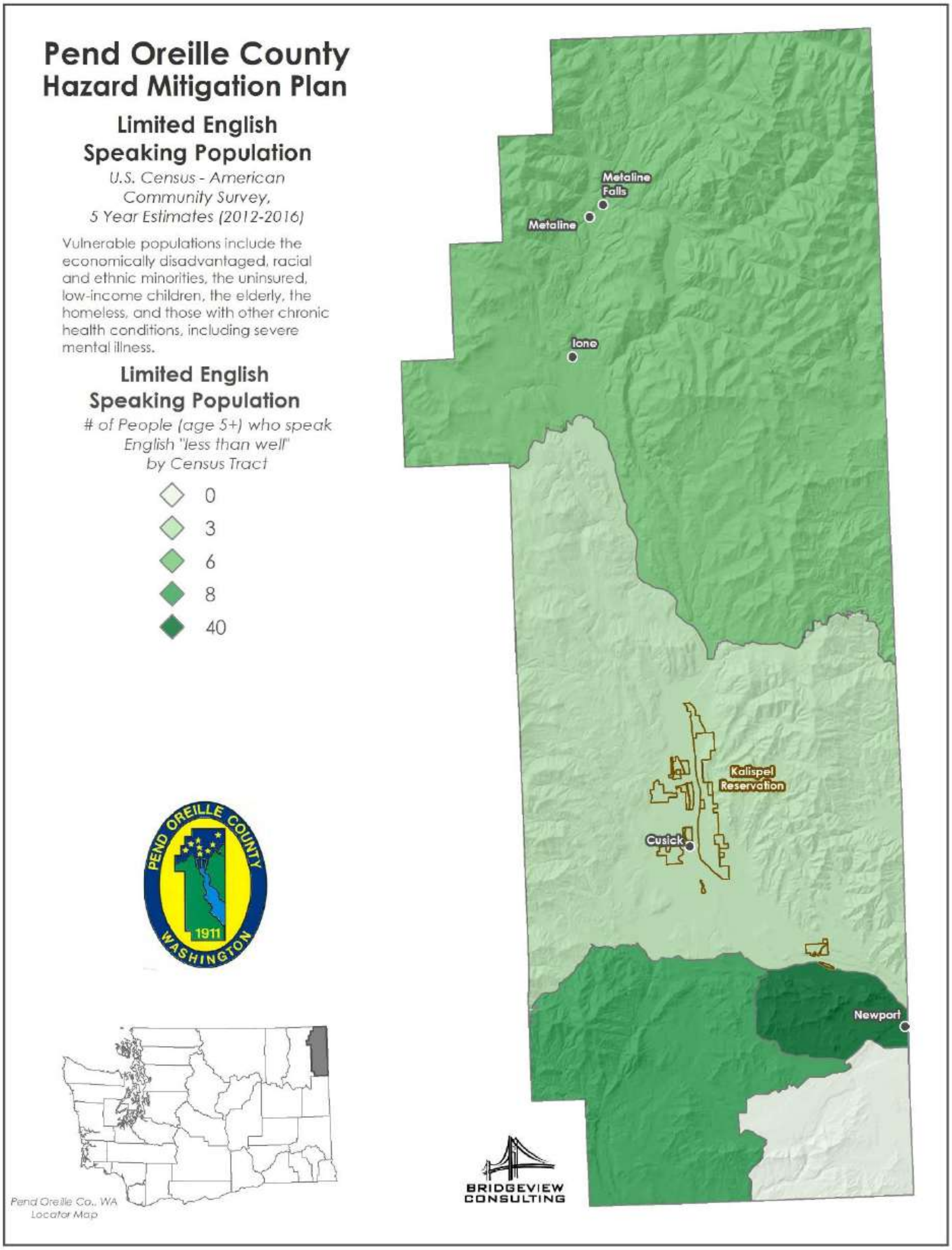


Figure 14-5 Population Distribution by Census Track of Limited English Speaking Households

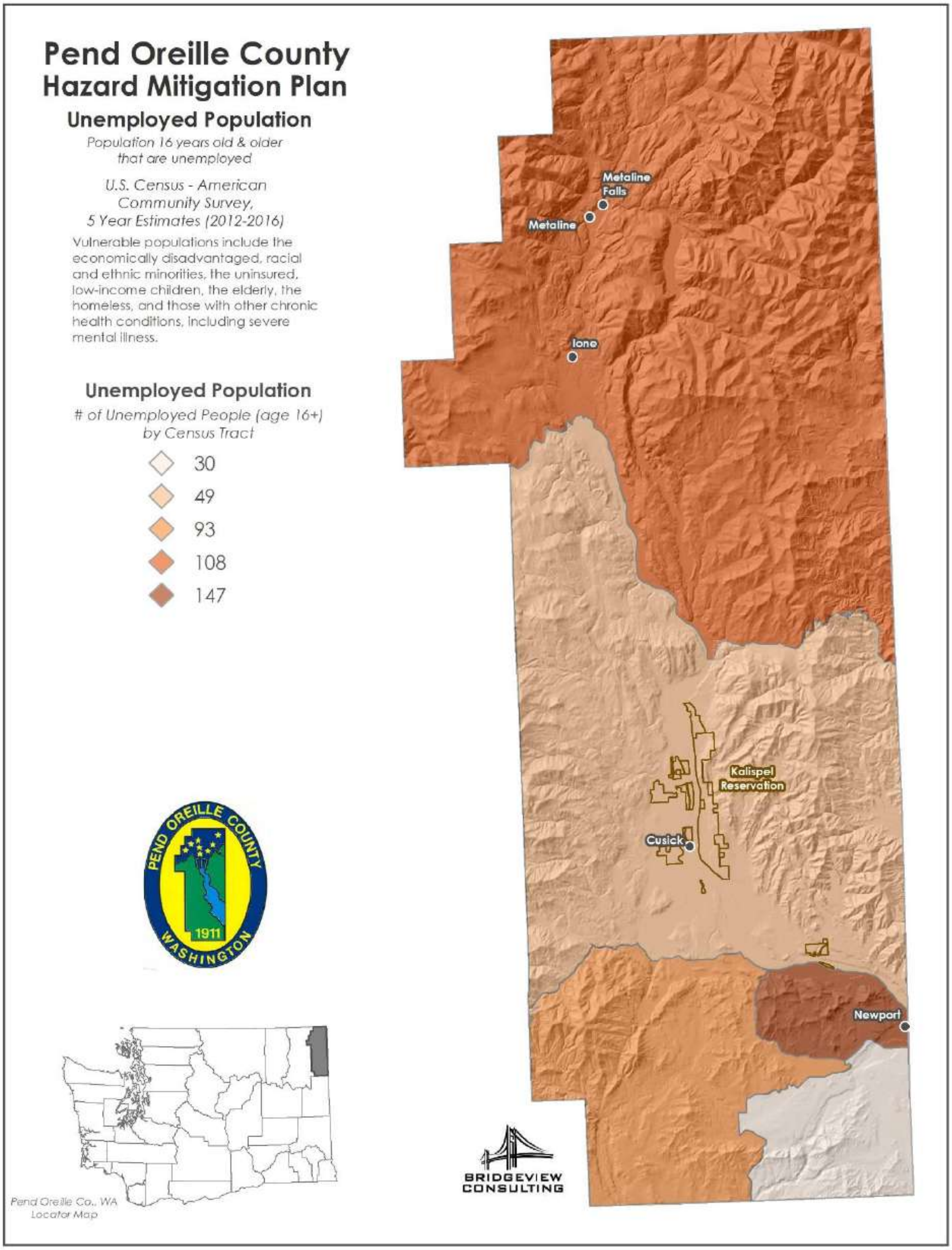


Figure 14-6 Population Distribution by Census Track of Unemployed Population

Once the Social Vulnerability was determined, the Planning Team conducted a qualitative assessment combining the value of the CPRI, and summarizing the potential impact based on past occurrences, spatial extent, and subjective damage and casualty potential. Those items were categorized into the following levels and illustrated in the following tables:

- Extremely Low—The occurrence and potential cost of damage to life and property is very minimal to nonexistent.
- Low—Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal.
- Medium—Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.
- High—Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread. Hazards in this category may have occurred in the past.

Extremely High—Very widespread with catastrophic impact.

Table 14-3
Vulnerability Overview

		Population Groups Impacted (By Group Type)								
Hazard	Synopsis of Potential Impact	Business	Children	Disabled	Elders	Families	Low Income	Language	Level of Impact High, Medium, Low	Summarized Extent and Location
Climate Change	Climate change is often measured in terms of impact on other hazards of concern. Impact varies, but can include drought conditions, water shortage, increased flood incidents, increased wildfire danger, environmental changes which impact habitats and species. Given the economy of the area and its dependence on tourism (skiing and water sports), agriculture, and livestock (Buffalo herd at Kalispel, among others), economic could be significant.	X	X	X	X	X	X	X	Medium	Climate change itself customarily does not impact structures; however, the entire population and natural resources of the area will be impacted by climate change in some form. Wildfire danger will increase. Flood depths will also undoubtedly increase, causing additional damage and impact throughout the area, both in areas previously flooded (more severe flooding), and in areas which previously have not flooded.

Table 14-3
Vulnerability Overview

Hazard	Synopsis of Potential Impact	Population Groups Impacted (By Group Type): Business	Children	Disabled	Elders	Families	Low Income	Language	Level of Impact High, Medium, Low	Summarized Extent and Location
Drought	Drought is typically measured in terms of water availability in a defined geographical area, and is not a sudden-onset hazard, allowing some preparation. Socioeconomic droughts occur when physical water shortage begins to affect people, individually and collectively. Social impacts mainly involve public safety, health, reduced quality of life, and inequities in the distribution of impacts and disaster relief. Many impacts identified as economic and/or environmental also have a social component. During warm seasons, water suppliers are often faced with more demand for water than they are able to distribute. This may lead to rationing and curtailment, with business that rely heavily on water usage (landscapers, farmers, golf courses, car washes, etc.) suffering financially. Most socioeconomic definitions of drought associate it with supply, demand, and economic good.	X	X	X	X	X	X		Medium	Drought customarily does not impact structures, but would adversely impact people, resources, and agricultural businesses (among others) within the area. Therefore, all populations would be susceptible, although the degree would be determined by the severity of the drought in place, and the availability of water. Most of the planning partners do have some type of water-shortage plan in place, and have identified additional water sources should a shortage occur. Land use development trends in the area have been somewhat stagnant, although fewer farms exist now than did during development of the 2011 HMP. Residential development countywide has also been limited. Currently, most of the County receives its water from wells, with strategic planning by water suppliers in the area accounting for expansion for the various special purpose districts that provide water. Likewise, individual well owners also have the ability to expand its services to new construction.

Table 14-3
Vulnerability Overview

Hazard	Synopsis of Potential Impact	Population Groups Impacted (By Group Type): Business	Children	Disabled	Elders	Families	Low Income	Language	Level of Impact High, Medium, Low	Summarized Extent and Location
Earthquake	Older structures (pre ~1970) have high probability of collapse due to building code standards; Non-English speakers may have issues gaining hazard information for preparedness. Low-income individuals may not be able to stockpile supplies or medications. Elderly populations are vulnerable due to health issues, the lack of physical strength to extricate themselves, etc. Businesses many times do not carry insurance which will help them recover from losses. While a Cascadia-type event would not directly impact the County via damages, it would cause an influx of evacuees from the western portion of both the state of Washington and Canada. Such influx would impact commodities, medical services in hospitals, and first responder resources. Resources would also be taxed based on mutual aid agreements in place to support Western Washington jurisdictions.	X	X	X	X	X	X	X	Medium	Many structures in the area were built pre-1970 when lower codes were in place, especially in the case of the City of Newport. This makes the older structures more vulnerable to collapse and increasing the potential for injury. However, there have been limited earthquakes of significant size or number in the area. Only a limited area is susceptible to the impacts from an earthquake based on PGA and liquefiable soils. Of concern would be the impact to the various dams in the area, as several are considered high-hazard dams, although there are limited structures involved in the inundation zones. Also of concern with earthquake are landslides and slope stability. Stability in the area could be undermined, although again, there are limited structures in the landslide susceptibility zone.

Table 14-3
Vulnerability Overview

Hazard	Synopsis of Potential Impact	Population Groups Impacted (By Group Type): Business	Children	Disabled	Elders	Families	Low Income	Language	Level of Impact High, Medium, Low	Summarized Extent and Location
Flood	Year of construction will influence the building code and the height to which the structures were built when compared to the Base Flood Elevation. In most instances, weather patterns which cause flooding are identified in advance, allowing pre-planning for evacuation, thereby potentially reducing the individuals at risk. Individuals without homeowner's insurance which covers flooding may suffer extreme financial risk. Businesses impacted many times do not carry insurance which will help them recover from losses. In many instances, those businesses do not return to the area because they cannot overcome the financial loss.	X	X	X	X	X	X	X	High	Flooding in the area occurs annually at some level, with the areas of Cusick and the Kalispel Reservation impacted more significantly than the other towns and the City of Newport. Currently, there are almost 1,678 structures exposed to FEMA's 100-year floodplain (2002 Updated Study), the majority structures in the unincorporated areas of the county. Flooding in the area has impacted transportation, causing roadways to be blocked, and causing landslides which also block major arterials. There are currently only two major roadways which traverse the entire county, either of which, if impacted, would hamper evacuation in certain areas. All areas within the floodplain would be vulnerable, however, given the higher-than-average population of elderly and young, the level of vulnerability is higher than when compared to other areas. The County also has increased populations from tourists who frequent the area, and travel through the county from Idaho and Canada. This is particularly true during summer months, when tourist activity increases for recreational purposes at the County's lakes.

Table 14-3
Vulnerability Overview

Hazard	Synopsis of Potential Impact	Population Groups Impacted (By Group Type): Business	Children	Disabled	Elders	Families	Low Income	Language	Level of Impact High, Medium, Low	Summarized Extent and Location
Severe Weather – inclusive of heat, cold, wind, snow, ice, hail, Thunder-storm, lightning	Severe weather occurs regularly throughout the planning area. In most instances, weather patterns are forecasted in advance, allowing for preparation. Individuals with lower income may not have the ability to stock supplies, nor afford the cost of increased energy costs for both heating or cooling, depending on the weather event. Snow and ice conditions are commonplace in the area, but the planning region is well-prepared to deal with accumulations. Elderly and young children are especially susceptible to cold, ice, and heat conditions. Lighting strikes also occur throughout the planning area. In densely wooded areas, such as the National and State Forests or any of the timber land areas, fires could go unnoticed for a period of time, allowing the fire to gain strength and severity, especially during drought situations. Lightning risks also increases life-safety due to the large waterbodies in the area, and the time it takes for boaters to get to safety. The area also has extensive hiking trails and other outdoor tourist attractions (including golf courses), which are open and provide little cover from lightning strikes.	X	X	X	X	X	X	X	High	The entire region is susceptible to severe weather incidents, including impact to people, property, economy, and the environment. Incidents of some nature and degree occur annually, although the extent of impact is limited in nature unless urban flooding occurs due to plugged storm drains, etc.. Depending on the type of event, roadways may be impassible. Power outages, while they do occur, do not occur often, and do not customarily last for a long period of time. However, when coupled with cold conditions which would cover the entire planning area, the impact to vulnerable populations increases. With extreme heat events, physical manifestation on the young and elderly rise. In addition, the increased fire danger impacts the entire area.

Table 14-3
Vulnerability Overview

Hazard	Synopsis of Potential Impact	Population Groups Impacted (By Group Type): Business	Children	Disabled	Elders	Families	Low Income	Language	Level of Impact High, Medium, Low	Summarized Extent and Location
Volcano	Volcanic eruption would impact the area primarily through ash accumulations. The area is outside of the lahar zone. Ash accumulations could impact structures due to not only machinery, but also from the weight of the ash itself, and load capacity. Individuals with health concerns, especially breathing or lung issues, would be more susceptible and at risk. Economic impact could be significant, given the planning areas' reliance on agriculture, the timber industry, and outdoor recreational activities – all of which would be impacted by ash and the acidic nature when mixed with precipitation.	X	X	X	X	X	X	X	Low	One incident of volcanic eruption has occurred in the area which rose to the level of a disaster declaration. No dollar loss figures were captured on which to base economic impact; however, due to the areas reliance on agriculture and aquaculture, economic impact could be significant. Environmental impact would also be a major concern throughout the entire area, as ash spread would be carried both through wind and also vehicles traveling through the area, carrying ash. Small amounts of ash can negatively impact water sources and vegetation due to the acidic nature of the ash itself.

Table 14-3
Vulnerability Overview

Hazard	Synopsis of Potential Impact	Population Groups Impacted (By Group Type): Business	Children	Disabled	Elders	Families	Low Income	Language	Level of Impact High, Medium, Low	Summarized Extent and Location
Wildfire	Impact from wildfires has increased over time due to effective suppression tactics. This has now caused fires to burn with greater intensity, with the traditional fire regimes being modified. Embers from wildfires can be carried significant distances (miles). With climate change impacting drought conditions, the potential for wildfire increases as moisture content is depleted. The daily change in wind direction makes firefighting more difficult and hazardous for firefighters. People are one of the major causes to wildfires, which can spread very quickly, leaving little to no time to evacuate. Individuals with access and functional needs, the young and elderly are at greater risk due to their potential dependence on others to assist with evacuation. Individuals with health concerns are impacted significantly by smoke. Increased rates of death due to smoke can occur.	X	X	X	X	X	X	X	Very High	Wildfire danger can impact the entire planning area. The various Fire Regimes do identify areas of higher levels of risk. Due to the wind patterns in the area, including the shift of winds during afternoon hours, embers have the potential to travel great distances (miles) and ignite fires in areas which are densely wooded. In some instances, these fires can burn for periods of time, going un-noticed until ignition consumes a large area, making containment difficult. Elderly, young and individuals with breathing/health issues are more vulnerable due to smoke and particulates. Areas around Cusick and the Kalispel Reservation have a higher population of elderly. Language may also be a barrier for non-English speaking populations due to the inability to understand evacuation orders, which can be very short-notice.

CHAPTER 15.
MITIGATION STRATEGY

The development of a mitigation strategy allows the community to create a vision for preventing future disasters. This is accomplished by establishing a common set of mitigation goals and objectives, a common method to prioritize actions, and evaluation of the success of such actions. Specific mitigation goals, objectives and projects were developed for Pend Oreille County and its planning partners by the Planning Team in their attempt to establish an overall mitigation strategy by which the jurisdictions would enhance resiliency of the planning area.

The CRS program credits NFIP communities points for setting goals which help reduce the impact of flooding and other known natural hazards; identifying mitigation projects that include activities for prevention, property protection, natural resource protection, emergency services, structural control projects, and public information. Establishing goals in such a manner was a primary focus of the Planning Team.

15.1 GOALS AND OBJECTIVES

During the March 20, 2018 meeting, the Planning Team reviewed the 2011 existing goals. For the 2018 update, the Planning Team used the existing goals as a base, making modifications to support a countywide effort of enhanced capabilities which support resilience through protection of life, property, the economy and the environment. The goals as written for the 2018 update more accurately describe the overall direction that Pend Oreille County and its planning partners can take to work toward mitigating risk from natural hazards and avoid long-term vulnerabilities to the hazards of concern. Mitigation goals for this plan are listed below.

15.1.1 Goals

Goals for the 2018 mitigation strategy are as follows:

Goal 1 Reduce or prevent future hazard-related injuries and loss of life, property damage, environmental impact, and economic loss caused by disaster incidents.

Goal 2 Develop and implement long-term, cost-effective, and environmentally sound mitigation opportunities and projects which address all hazards of concern.

Goal 3 Leverage partnering opportunities through enhanced community capabilities by increased public awareness and readiness (i.e., prepare, plan, protect, respond, recover, mitigate).

Goal 4 Promote disaster-resistant and resilient communities.

15.1.2 Objectives

Objectives identified for the 2018 effort are identified below.

Objective Number	Objective Statement	Applicable Goals
O-1	Acquire (purchase), retrofit, relocate, or otherwise mitigate structures in high hazard areas.	1, 2, 3, 4,
O-2	Use best available data, science, and technologies to improve the understanding of location and potential impacts of hazards, and to promote disaster resilient communities that minimize risk.	1, 2, 3, 4
O-3	Consider the impacts of natural hazards in all planning mechanisms that address current and future land use.	1, 2, 4
O-4	Increase resilience of identified critical facilities throughout the County.	1, 2, 3, 4
O-5	Continue to improve coordination and partnerships among all sectors to mitigate hazards, including government, local businesses, and citizens.	1, 2, 3, 4
O-6	Enhance community capabilities to prepare for, protect from, respond to, recover from, and mitigate the impact of hazards.	3, 4
O-7	Develop or improve emergency warning notifications; response and recovery operations; communication systems, and evacuation procedures.	1, 3
O-8	Provide/improve mitigation activities through various means, including things such as: public education and outreach activities; programmatic-level initiatives; and structural and environmental projects.	1, 2, 3, 4
O-9	Encourage hazard mitigation measures that result in the least adverse effect on the natural environment, and that use natural processes, while preserving and maintaining the cultural and environmental elements of the planning area.	2, 4

15.2 HAZARD MITIGATION ALTERNATIVES

After the goals and objectives were established, the Planning Team developed specific action items to further increase resilience. FEMA's 2013 catalog of *Mitigation Ideas* was presented to the Planning Team. This document includes a broad range of alternatives to be considered for use in the planning area, in compliance with 44 CFR (Section 201.6.c.3.ii and Section 201.7.c.3.ii), and can be applied to existing structures and new construction. The catalog provides a baseline of mitigation alternatives that are backed by a planning process, are consistent with the planning partners' goals and objectives, and are within the capabilities of the partners to implement. It presents alternatives that are categorized in two ways:

- By what the alternative would do:

  - Manipulate a hazard
  - Reduce exposure to a hazard
  - Reduce vulnerability to a hazard
  - Increase the ability to respond to or be prepared for a hazard.
- By who would have responsibility for implementation:
  - Individuals
  - Businesses
  - Government

Hazard mitigation initiatives recommended in this plan were selected from among the alternatives presented in the catalogs, as well as projects identified by the planning partners, citizens, and interested stakeholders specific to their jurisdiction. Some were carried over from the previous plans, both the HMP and the CWPP. Some may not be feasible based on the selection criteria identified for this plan, but are included nonetheless as the Planning Team felt they are viable actions to be taken to reduce hazard influence in some manner.

15.3 SELECTED MITIGATION INITIATIVES

For the 2018 update, particular attention was given to new and existing buildings and infrastructure, and developing appropriate mitigation strategies for these facilities. Priority was also given to both wildfire- and flood-prevention strategies. The Planning Team determined that some initiatives from the mitigation catalogs could be implemented to provide hazard mitigation benefits countywide, such as the request to FEMA for updated floodmaps.

Very limited funding on the part of some of the planning partners significantly restricts their abilities to meet any type of match requirements for funding, either in-kind due to limited staffing, or actual dollar match. As such, identification of structural-related projects for mitigation efforts for some of the municipalities are limited in nature as several of the jurisdictions feel that they may qualify as a small and impoverished community, and will seek assistance from the state in the future to assist them in making that determination. Mitigation initiatives in some instances are limited, and are focused on the abilities and capabilities of the jurisdictions, which in some instances revolve around preparedness and response efforts to help ensure life safety of its citizenry. In an effort to support strategy development, the county worked with the Planning Team to develop countywide initiatives which would support the planning partners as a whole, including the development of some structural-related mitigation efforts which include multiple jurisdictions and the Kalispel Tribe. Table 15-1 lists those recommended countywide initiatives. Table 15-2 identifies County-specific initiatives.

15.4 ANALYSIS OF MITIGATION INITIATIVES

In addition to identifying potential funding sources available for each project, the Planning Team also developed strategies/action items that are categorized and assessed in several ways:

- By what the alternative would impact – new or existing structures, to include efforts which:
  - Manipulate/mitigate a hazard
  - Reduce exposure to a hazard
  - Reduce vulnerability to a hazard
- By who would have responsibility for implementation:

  - Individuals
  - Businesses
  - Government (County, Local, State and/or Federal)
- By the timeline associated with completion of the project, based on the following parameters:
  - Short Term = to be completed in 1 to 5 years
  - Long Term = to be completed in greater than 5 years
  - Ongoing = currently being funded and implemented under existing programs.
- By who benefits from the initiative, as follows:
  - A specific structure or facility
  - A local community
  - County-level efforts
  - Regional level benefits

Table 15-1
Countywide Hazard Mitigation Initiatives

New or Existing assets	Hazards Mitigated	Objectives Met	Lead Agency*	Estimated Cost	Funding Sources	Timeline	In Previous Plan?	Initiative Type	Who Benefits?
CW-1 Continue data gathering for facility information to continue to improve the risk assessment and identification of infrastructure countywide.									
New/ Existing	All	2, 3, 4, 6	EM, All planning partners	Low	HLS/EMPG, PDM, HMGP, HUD, General Funds	Ongoing	No	Structural Projects, Property Protection	Regional
CW-2 Work with County, Pend Oreille Port District, and state agencies to establish a protocol and advance permitting for transporting of hazardous materials and for identification during an incident.									
New	Hazardous Materials	5, 6, 7, 8, 9	Port District, PH, Fire, EM, PW, WSDOT, WDOE	Low	General Funds, HLS (EMPG), CDC grants	Long-Term	No	Prevention, Public Information and Education, Natural Resource Protection, Emergency Services/ Response	Regional

Table 15-1
Countywide Hazard Mitigation Initiatives

New or Existing assets	Hazards Mitigated	Objectives Met	Lead Agency*	Estimated Cost	Funding Sources	Timeline	In Previous Plan?	Initiative Type	Who Benefits?
CW-3 Using risk data, identify points of distribution in areas of potential isolation.									
New	All	5, 6, 7	PH, EM, Tribal EM and Health, PW, Local EMs	Low	EMPG, HUD	Short-Term	No	Public Information and Education, Emergency Services / Response, Recovery	Regional
CW-4 Work with Public Health and Human Services to develop an information bank identifying individuals with access and functional needs. This will assist the County in determining shelter locations requiring specific resources to meet the needs of those individuals. NOTE: This is not an attempt to gather medical-related data, but rather to determine access and functional needs of citizens – e.g., citizens in wheel chairs need more space and shower/restroom facilities; hearing impaired need to have an area which allows them to be near to their signer, the use of oxygen tanks increases space requirements, etc.									
New	All	2, 3, 5, 6, 7, 8	PH, EM, HS	Low	Health and Human Service Grants, HUD, HMGP	Long-Term	No	Public Information and Education, Emergency Services / Response, Recovery	Community Level
CW-5 Coordinating with Assessor's Office, Permitting and other County offices, update Assessor's parcel data to include more building-specific information which may be utilized within the GIS and Hazus programs for enhanced risk assessments to provide a detailed loss estimation.									
New and Existing	All	2, 3, 4, 5, 6, 7	Assessor's Office, GIS, PW, EM, CD	Medium	General Fund, HMGP	Short-Term	No	Structural Projects, Property Protection, Recovery	County and Local
CW-6 Coordinate among all jurisdictions and planning partners to seek out and apply for grants for site hardening of facilities.									
New/ Existing	A, EQ, F, LS, SW	1, 2, 3, 4, 5, 6, 7, 8, 9	EM	Medium	Earthquake and Tsunami Program, HMGP, PDM, HUD, DOT, EPA	Long-Term	No	Structural Projects, Property Protection, Natural Resource Protection	Facility Specific

Table 15-1
Countywide Hazard Mitigation Initiatives

New or Existing assets	Hazards Mitigated	Objectives Met	Lead Agency*	Estimated Cost	Funding Sources	Timeline	In Previous Plan?	Initiative Type	Who Benefits?
CW-7 Maintain and regularly update fire hydrant layer countywide, as well as draw-down facilities on lakes to ensure adequate water supplies during firefighting.									
New/ Existing	WF	2, 3, 5, 6, 7, 8	EM, GIS, Fire Districts/ Agencies	Low	HMGP, HUD, SAFER	Long-Term	No	Property Protection, Emergency Services/ Response	Countywide
CW-8 Continue implementation of public information program within Pend Oreille County to inform citizens about the hazards faced and the appropriate preparedness and response measures, including, but not limited to, NFIP, wildfire, and landslide information and insurance.									
New/ Existing	All	All	EM and Local EM, Local and County Land Use Planning, private industry	Low	EMPG, General Fund	Ongoing	Yes	Prevention, Public Information and Education	County and Community
CW-9 Continue training of volunteer firefighters to include wildland fire response.									
New/ Existing	WF	2, 6, 7, 8	Fire Districts, EM, Local EM, Kalispel Tribe, Citizen Groups	Low	EMPG	Ongoing	Yes	Prevention, Public Information and Education, Emergency Services, Response, Recovery	All
CW-10 Develop and prepare a fueling plan, addressing both automotive and heating fuels in case of prolonged interruption of normal distribution to Pend Oreille County locations.									
New and Existing	EQ, F, LS, SW, T	2, 3, 4, 5, 6, 7, 8	EM, Local EM, Sheriff, LE, Fire, PW and Local PW	Low	General Fund, various grants.	Long-Term	No	Response, Recovery	County and Local
CW-11 Evaluate current coverage and equipment and provide a strategic emergency communications plan that provides better coverage to all areas of Pend Oreille County for first responders and emergency amateur radio communications.									
Existing	All	2, 5, 6, 7	EM and Local EM, Communica-tions Group, ARES/ RACES	Low	General Funds	Short-Term	No	Emergency Services/ Response, Prevention, Public Information and Education	County and Local

Table 15-1
Countywide Hazard Mitigation Initiatives

New or Existing assets	Hazards Mitigated	Objectives Met	Lead Agency*	Estimated Cost	Funding Sources	Timeline	In Previous Plan?	Initiative Type	Who Benefits?
CW-12 Work with local communities and Red Cross to identify and designate emergency shelter structural and utility readiness for occupancy after a significant incident in areas throughout the County.									
New/ Existing	All	1, 2, 3, 4 5, 6, 8	EM	Medium	PDM, HMGP, General Funds	Short-Term	No	Prevention, Public Information Emergency Services/ Response	Regional
CW-13 Provide landslide control information and steep slope stability recommendations to citizens and homeowners. Educate owners concerning structures above steep bluffs or below steep bluffs. Increase monitoring of countywide slide issues and bluffs.									
New/ Existing	A, EQ, F, LS, SW	1, 2, 3, 4, 5, 6, 7, 8, 9	EM, County and Local PW, WDNR	Medium	PDM, HMGP, General Funds	Long-Term	No	Structural Projects, Property Protection	County and Local
CW-14 Work with the planning partners to conduct a needs assessment in high-hazard areas to assist in determining logistical requirements for equipment and parts for wells and water distribution sources to ensure a surplus allowing for continued supply of water in case of impact during a major event, including within the areas of Cusick, the Kalispel Tribe, and Metaline, among others.									
New/ Existing	All	2, 3, 4, 5, 6, 9	PH, EM PW, WDOE, Town of Cusick, Kalispel Tribe	Medium	Earthquake and Tsunami Program Grant Funds, EPA, EMPG	Ongoing	No	Response, Recovery	County and Local
CW-15 Work with local communities and fire districts to support a "FireWise" program Countywide to increase fire safety zones around businesses and residences. Encourage owners to reduce woodland fuel loads on their property.									
New/ Existing	CC, D, WF, SW, LS, F	2, 3, 4, 5, 6, 7, 8, 9	EM, Local EM, Fire	Low	Fire Grants, PDM, HMGP	Ongoing	No	Property Protection, Natural Resource Protection, Prevention	Local
CW-16 Work with local jurisdiction and planning partners to develop various emergency planning efforts to help ensure continuity of business and resiliency.									
New/ Existing	All	1, 2, 3, 4, 5, 6, 7, 8	EM, Local EM, ED, Chamber	Medium	EMPG Funds, General Funds	Long-Term	No	Recovery	County, Local

Table 15-1
Countywide Hazard Mitigation Initiatives

New or Existing assets	Hazards Mitigated	Objectives Met	Lead Agency*	Estimated Cost	Funding Sources	Timeline	In Previous Plan?	Initiative Type	Who Benefits?
CW-17 Identify and establish redundant or back-up emergency operations center locations throughout the County in case of road closures which restrict access to areas of the County.									
New	All	4, 5, 6, 7, 8	EM, Public Officials - County and Local	Medium	EMPG and General Funds	Short-Term	No	Emergency Services/ Response, Recovery	County and Local
CW-18 Partner with Washington State Department of Transportation and local jurisdictions to expand avalanche, landslide, and earthquake assessment (soil liquefaction); continue to expand and implement training and exercises throughout the county which support transportation-related issues (including hazmat response) and potential isolation. This includes review and inclusion of data concerning evacuation for a Cascadia-type event from the west side of the state.									
New/ Existing	All	2, 5, 6, 7, 8	EM, Local EM, PW, Shelton Roads, WSDOT	Medium	US DOT and WA DOT Grants, HLS	Long-Term	No	Emergency Services/ Response, Recovery	Regional
CW-19 Continue to promote and establish countywide emergency management actions, projects, and programs, working with all planning team members to enhance resiliency and maintain consistency in mitigation activities, emergency management programs, and capabilities. This includes seeking grant funding to support such initiatives.									
New/ Existing	All	All	EM, Local EM, Municipaliti es, Fire, Hospitals, School Districts, Kalispel Tribe	Medium	General Funds, Grant Opportunities as they arise	Long-Term	No	Prevention, Public Information and Education, Emergency Services/ Response, Recovery	County and Local
CW-20 Strive to capture time-sensitive, perishable data such as high water marks, extent and location of hazard, and loss information following hazard events to support future updates to the risk assessment and in support of future grant applications to demonstrate impact. This will assist the Towns of Ione, Cusick, and Metaline, as will as the City of Newport as they seek out grant funds.									
New/ Existing	All	2, 3, 7	EM and Local EMs	Medium	General Funds	Long-Term	No	Emergency Services/ Response, Recovery	County and Local
CW-21 Continue to enhance local emergency planning committee (LEPC) involvement with private industry and local jurisdictions throughout the County with the goal of quarterly meetings.									
Existing	WF	5, 7, 8	EM, Local EM, Fire, Private Industry	Low	General Funds	Ongoing	No	Prevention, Emergency Services/ Response, Recovery	County and Local

Table 15-1
Countywide Hazard Mitigation Initiatives

New or Existing assets	Hazards Mitigated	Objectives Met	Lead Agency*	Estimated Cost	Funding Sources	Timeline	In Previous Plan?	Initiative Type	Who Benefits?
CW-22 Seek grant funding to develop a countywide school or mass care and evacuation exercise, which includes all fire and police departments, Hospital District, Public Health, County Transit, Emergency Management and search-and-rescue, as well as other planning partners as identified during exercise design.									
New and Existing	All	5, 6, 7, 8	EM, Local EM, Fire, Hospitals, PH, PW, WSDOT, Sheriff, LE	High	EMPG, DOJ Grants, Fire Training Grants, EMPG	Long-Term	No	Emergency Services/ Response, Recovery	County and Local
CW-23 Continue to integrate mitigation planning data into ongoing land-use planning to assist in providing information necessary to enforce existing building codes, floodplain and critical areas ordinances, and shoreline protection. As the land use data for the towns of Ione, Cusick, and Metaline and the City of Newport is updated, continue integrating the risk assessment data to help identify areas of concern, as well as help focus where funding via grants may be applicable. Continue to apply the risk data to future planning updates to also assist the planning partnership as a whole to identify areas of greatest concern to help direct where local funds identified in infrastructure or CIPs would most directly benefit the communities.									
New and Existing	A, F, EQ, LS, SW	1, 2, 3, 4, 5, 6, 7, 8	EM, PW	Low	FEMA	Short-Term	Yes	Prevention, Emergency Services, Planning, Response, Recovery	Local and County
CW-24 Develop countywide mutual aid agreements with both public and private agencies in support of preparedness and response activities.									
New	All	4, 5, 6	EM	Medium	General Funds	Ongoing	No	Emergency Services/ Response, Recovery	County and Local
CW-25 Capture data concerning the number of portable generators at fueling stations and local grocery outlets to determine need to acquire generators to ensure fuel availability and food items during significant events which may impact transportation flows, reducing commodities in the planning area. If necessary, seek grant opportunities to purchase generators for use during such events.									
New/ Existing	All	5, 7, 8	EM	Low	General Funds	Ongoing	No	Emergency Services/ Response, Recovery	County and Local
CW-26 Capture information concerning the surplus supply maintained by local fueling stations and grocery outlets to determine quantities available should commodities be interrupted as a result of a significant incident.									
New/ Existing	All	5, 6, 7, 8	PW	Low	General Funds	Ongoing	No	Emergency Services/ Response, Recovery	County and Local

Table 15-1
Countywide Hazard Mitigation Initiatives

New or Existing assets	Hazards Mitigated	Objectives Met	Lead Agency*	Estimated Cost	Funding Sources	Timeline	In Previous Plan?	Initiative Type	Who Benefits?
CW-27 Utilizing data generated from Hazus outputs, develop countywide debris management plan to support all of the local towns and the city.									
New/ Existing	A, EQ, F, LS, SW, WF	2, 3, 4, 5, 6, 7	PW	High	Grant Sources TBD	Long-Term	No	Recovery	County and Local
CW-28 Work with various communications organizations within the area to identify location of cell towers and capacity to support area during disaster incidents. Work with communications organizations to develop redundant systems in case of damage or destruction of any tower.									
New/ Existing	All	5, 6, 7, 8	PW	Low	General Funds	Ongoing	No	Emergency Services/ Response, Recovery	County and Local
CW-29 Request updated flood study from FEMA for the towns of Ione, Cusick and Metaline, the City of Newport and the County. Once updated, review and modify the HMP's flood hazard profile once completed. This may include the County seeking grant funding to develop a comprehensive update to the flood profile, including public outreach to ensure information is disseminated countywide.									
New/ Existing	All	1, 2, 3, 4, 5, 6, 7, 8, 9	DEM	High	Ecology, HMGP or PDM Grant Funds	Ongoing	No	Emergency Services/ Response, Recovery	County and Local
CW-30 Work with local school districts to study and retrofit school facilities to better withstand damage from flood, severe weather, earthquake, and landslide events.									
New/ Existing	All	All	DEM, Local DEM, School Districts	High	HLS/EMPG, PDM, HMGP, HUD, Dept. of Education, State Earthquake Program	Ongoing	No	Structural Projects, Property Projection, Emergency Services/ Response, Recovery	Facility, County, and Local

* CD=Community Development; ED=Economic Development; EM= Emergency Management; Fire=Districts and Depts.; HS=Human Services; LE=Law Enforcement; PH=Public Health; PW=Public Works; WSDOT=Washington State Dept. of Transportation; WDOH=Washington State Dept. of Health; WDNR=Washington State Dept. of Natural Resources; WDOE=Washington Dept. of Ecology

Table 15-2
County-Specific Hazard Mitigation Initiatives

New or Existing assets	Hazards Mitigated	Objectives Met	Lead Agency	Estimated Cost	Funding Sources	Timeline	In Previous Plan?	Initiative Type	Who Benefits?
C-1 Study and retrofit county owned facilities to better withstand damage from earthquake, flood, and severe weather.									
Existing	All	1, 2, 3, 4 5, 7, 8, 9	EM, Facilities	High	HLS/EMPG, PDM, HMGP, HUD, General Funds	Ongoing	No	Structural Projects, Property Protection	Facility
C-2 Evaluate and enhance the current capital improvements program for county roads, bridges and culverts, including among others: the Spring Valley Road, Ashen Felter Bay, Perkins Slough, LeClerc Road, Sullivan Lake Road, and the Cusick and Usk Bridges, as well as drainage projects to provide better flood control in known flood problem areas, including drainage system maintenance plans and sediment and debris clearance to ensure unobstructed flow of floodwaters.									
New/ Existing	F, SW	1, 2, 3, 4 5, 6, 7, 8, 9	PW	High	General Funds, HLS (EMPG), CDC grants	Long-Term	Partial	Property Protection, Structural Projects, Natural Resource Protection	County and Local
C-3 Seek steep slope stability project funding or relocation funding for county roads with histories of instability .									
Existing	EQ, F, LS, SW, WF	1, 2, 3, 4 5, 6, 7, 8, 9	PW	High	PDM, HMGP, USDOT, WADOT	Long-Term	No	Property Protection, Structural Projects, Natural Resource Protection	County
C-4. Seek grant funding for acquisition of properties in high-hazard areas.									
Existing	All	1, 2, 4	Commis-sioners, EM	High	PDM, HMGP, FMA	Long-Term	Yes	Property Protection, Structural Projects,	Facility and County
C-5. Obtain and install river gauges on those rivers which currently have none, or for which additional gauges are needed.									
New/ Existing	F, SW	1, 2, 3, 4, 5, 6, 7, 8	EM, PW, USGS	High	HMGP, USGS Grant	Ongoing	Yes	Response, Recovery	County

Table 15-2
County-Specific Hazard Mitigation Initiatives

New or Existing assets	Hazards Mitigated	Objectives Met	Lead Agency	Estimated Cost	Funding Sources	Timeline	In Previous Plan?	Initiative Type	Who Benefits?
C-6. Seek grant funding to address areas in high landslide areas, such as along Box Canyon Reservoir.									
New	LS	1, 3, 4, 5, 6, 7, 8, 9	EM, PW/Roads, WSDOT, PUD	Low	General Fund, DOH, WSDOT	Short-Term	Yes	Prevention Public Information and Education, Response, Recovery	County and Local
C-7 Continue participation in the NFIP; consider implementing various steps which will increase CRS scores to help lower insurance premiums.									
New/ Existing	F, SW	1, 2, 3, 4, 5, 6, 7, 8, 9	EM, Planning	Medium	General Fund	Long-Term	Yes	Prevention, Mitigation	County
C-8 Continue to design and build facilities to meet or exceed code standards, including redundant essential equipment. Apply current wind load, flood, and wildfire standards to all renovation or replacement of existing facilities, and/or equipment.									
New/ Existing	EQ, LS, SW	1, 2, 3, 4, 5, 6, 7, 8, 9	Planning, PW	High	PDM, HMGP	Ongoing	No	Structural Projects, Property Protection	County
C-9 Conduct activities that support mitigation efforts to reduce the negative influence of natural hazards impacting Pend Oreille County, such as appropriate hazard identification, warning, dissemination of relevant information and data, and public outreach.									
New	All	All	Planning, PH, EM	Low	General Fund, various grants	Ongoing	No	Structural Projects, Public Information and Education, Natural Resource Protection	County, Facility, Local
C-10 Work with local public and private entities to review infrastructure control systems and ensure appropriate level of security and protection measures are in place. As appropriate, conduct audit of policies and procedures to ensure consistency and accuracy in application of security devices in place.									
Existing	All	2, 4, 5, 6, 7	EM, PUDs, IT	Low	General Funds	Short-Term	No	Prevention, Property Protection, Emergency Services	Regional

Table 15-2
County-Specific Hazard Mitigation Initiatives

New or Existing assets	Hazards Mitigated	Objectives Met	Lead Agency	Estimated Cost	Funding Sources	Timeline	In Previous Plan?	Initiative Type	Who Benefits?
C-11 Implement cost-effective measures to address vulnerability of water facilities and wells at risk to hazards as they relate to potential water contamination or availability to assist with firefighting. This includes working with local private water purveyors to identify capacity and deficiencies.									
New/ Existing	A, CC, EQ, F, LS, SW	1, 2, 3, 4, 5, 6, 7, 8, 9	EM, PH, PW, WDNR, WDOH, WDOE	Medium	PDM, HMGP, General Funds, Ecology, DOH, HLS	Long-Term	No	Structural Projects, Property Protection, Natural Resource Protection	County, Facility Specific, Local
C-12 Utilize data gathered during risk assessment to identify capital projects that, when modified, increase the resilience of the County's structures and conveyances to damage, or that allow a more expedited process for recovery from the impact of disaster incidents.									
New/ Existing	All	All	EM, PW, Planning, FEMA, WDNR	Medium	Earthquake and Tsunami Program Grant Funds, General Funds, PDM, HMGP	Short-Term	No	Structural Projects, Property Protection, Recovery	Facility, County
C-13 Consider projects enhancing resistance of county structures to impact from hazards of concern, such as bracing of equipment, piping and fixtures, removal of high hazard beams, access road reinforcement, or upgrades of underwater interceptors.									
New/ Existing	A, EQ, LS, SW	1, 2, 3, 4, 7, 8, 9	EM, PW	High	Earthquake and Tsunami Grant Program, PDM, HMGP	Ongoing	No	Property Protection, Structural Projects	Facility, County
C-14 Implement a recovery system to ensure maximum FEMA reimbursement for disaster response, repair, mitigation and recovery, which will capture and track emergency activities, associated expenses (mileage, supplies, expendables, outside vendors, etc.), employee time and dedicated resources.									
New/ Existing	All	2, 5, 7, 8	EM, Risk, Finance	Medium	EMPG Funds, General Funds	Long-Term	No	Recovery	County
C-15 Utilize data from the current risk assessment and comprehensive land use planning effort underway to update GIS capacity and capabilities.									
New	All	1, 2, 3, 4, 5, 6, 8	County GIS, Planning, EM	Medium	HMGP, EMPG and General Funds	Short-Term	No	Response, Recovery	County

Table 15-2
County-Specific Hazard Mitigation Initiatives

New or Existing assets	Hazards Mitigated	Objectives Met	Lead Agency	Estimated Cost	Funding Sources	Timeline	In Previous Plan?	Initiative Type	Who Benefits?
C-16 Develop a web-based application to capture damage assessment from citizens, which can be verified by emergency personnel to expedite damage assessment. This may include an interface between the Assessor's office for property values, as well as a mechanism for rapid windshield assessment by first responders.									
New/ Existing	All	2, 5, 6, 8	IT, Assessor's Office, Risk Mgmt. EM	Medium	General Funds, HLS, HMGP	Short-Term	No	Recovery	County
C-17 Assess the County's communications systems to determine its current vulnerability. This will include a review of the number of radios necessary to allow for adequate communications during emergency situations with field units, emergency response personnel, and emergency managers.									
Existing	All	7	EM, IT, PW	Low	General Funds	Ongoing	No	Emergency Services, Response	County and Local
C-18 In accordance with OSHA/WISHA requirements for all employees performing emergency response activities (post-disaster), identify and train County staff and volunteers that will be utilized for these efforts. Training to be considered includes: ATC 20/45, Disaster Site Worker Training, and Emergency Response Training, Damage Assessment.									
New/ Existing	All	2, 4, 5, 6, 7	Commis-sioners, EM, All County Depts.	High	EMPG, DOJ Grants, Fire Training Grants	Ongoing	No	Emergency Services, Response, Recovery	County
C-19 Develop (or update) plans to ensure response and recovery efforts. This includes working with the Board of County Commissioners to develop appropriate committees, such as a continuity of operations team, which will develop a countywide continuity of operations plan, and an emergency communications team which will look at communications and interoperability issues.									
Existing	All	3, 4, 5, 6, 7	EM, Commis-sioners	Low	Various	Long-Term	No	Response and Recovery	County
C-20 Develop public outreach which supports community participation in incentive-based programs, such as FireWise and StormReady.									
New/ Existing	All	2, 3, 5, 6, 7	EM	Low	General Funds	Ongoing	No	Public Information and Education, Emergency Services/ Response	County
C-21 Seek out grant funding to purchase drones, which can be used in damage assessment and identifying potential areas of impact from disasters.									
New/ Existing	All	All	EM, Fire	Low	Grant	Short-Term	No	Emergency Services, Response, Recovery	All

15.5 CRS ANALYSIS OF MITIGATION INITIATIVES

Each Planning Partner further reviewed its recommended initiatives to classify them based on the hazard it addresses and the type of mitigation it involves. This analysis incorporated, among others, the Community Rating System scale, identifying each mitigation action item by type. Mitigation types used for this categorization are as follows.

- Prevention - Government, administrative or regulatory actions that influence the way land and buildings are developed to reduce hazard losses. This includes planning and zoning, floodplain laws, capital improvement programs, open space preservation, and stormwater management regulations.
- Public Information and Education - Public information campaigns or activities which inform citizens and elected officials about hazards and ways to mitigate them – a public education or awareness campaign, including efforts such as: real estate disclosure, hazard information centers, and school-age and adult education, all of which bring awareness of the hazards of concern.
- Structural Projects —Efforts taken to secure against acts of terrorism, manmade, or natural disasters. Types of projects include levees, reservoirs, channel improvements, or barricades which stop vehicles from approaching structures to protect.
- Property Protection – Actions taken that protect the properties. Types of efforts include: structural retrofit, property acquisition, elevation, relocation, insurance, storm shutters, shatter-resistant glass, sediment and erosion control, stream corridor restoration, etc. Protection can be at the individual homeowner level, or a service provided by police, fire, emergency management, or other public safety entities.
- Emergency Services / Response —Actions that protect people and property during and immediately after a hazard event. Includes warning systems, emergency response services, and the protection of essential facilities (e.g., sandbagging).
- Natural Resource Protection – Wetlands and floodplain protection, natural and beneficial uses of the floodplain, and best management practices. These include actions that preserve or restore the functions of natural systems. Includes sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.
- Recovery —Actions that involve the construction or re-construction of structures in such a way as to reduce the impact of a hazard, or that assist in rebuilding or re-establishing a community after a disaster incident. It also includes advance planning to address recovery efforts which will take place after a disaster. Efforts are focused on re-establishing the planning region in such a way as enhance resiliency and reduce impacts to future incidents. Recovery differs from response, which occurs during, or immediately after an incident. Recovery views long-range, sustainable efforts.

15.6 BENEFIT/COST REVIEW

Once the general analysis was completed for each mitigation initiative, 44 CFR requires the prioritization of the initiatives or action items according to a benefit/cost analysis of the proposed projects and their associated costs (Section 201.6 & 7.c.3iii). The benefit/cost analysis conducted during this planning process is not of the detailed variety required by FEMA for project grant eligibility under the Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation (PDM) grant program. Rather, parameters were established for assigning subjective ratings (high, medium, and low) to the costs and benefits of these projects. Cost ratings were defined as follows:

- **High** —Existing funding will not cover the cost of the project; implementation would require new revenue through an alternative source (for example, bonds, grants, and fee increases).
- **Medium**—The project could be implemented with existing funding but would require a re-apportionment of the budget or a budget amendment, or the cost of the project would have to be spread over multiple years.
- **Low**—The project could be funded under the existing budget. The project is part of or can be part of an ongoing existing program.

Benefit ratings were defined as follows:

- **High—**Project will provide an immediate reduction of risk exposure for life and property.
- **Medium—**Project will have a long-term impact on the reduction of risk exposure for life and property, or project will provide an immediate reduction in the risk exposure for property.
- **Low—**Long-term benefits of the project are difficult to quantify in the short term.

Using this approach, projects with positive benefit versus cost ratios (such as high over high, high over medium, medium over low, etc.) are considered cost-beneficial and are prioritized accordingly. Prioritization of the projects in such a manner serves as a guide for choosing and funding projects.

15.7 PRIORITIZATION OF INITIATIVES

The method for prioritizing initiatives for the 2018 update differs from the method used for the previous mitigation initiatives. While the factors involved in the ranking remain similar, there is now a consistent category or level (high/medium/low) assigned with those identified factors to ensure consistency. Table 15-3 lists the priority of each countywide initiative. Table 15-4 lists the priority for each county-specific initiative. A qualitative benefit-cost review as described above was performed for each of these initiatives.

Table 15-3
Prioritization of Countywide Mitigation Initiatives

Initiative #	# of Objectives Met	Benefits	Costs	Do Benefits Equal or Exceed Costs?	Is Project Grant Eligible?	Can Project Be Funded under Existing Programs/ Budgets?	Priority (High, Med., Low)
1	4	H	L	Y	Y	Y	H
2	5	H	L	Y	Y	Y	H
3	3	H	L	Y	Y	Y	H
4	6	H	L	Y	Y	Y	H
5	6	H	M	Y	N	Y	M
6	9	H	M	Y	N	Y	M
7	6	M	L	Y	N	Y	M
8	9	H	L	Y	Y	Y	H
9	4	H	L	Y	Y	Y	H
10	7	H	L	Y	N	Y	H
11	4	H	L	Y	N	Y	H
12	7	H	M	Y	Y	Y	H
13	9	H	M	Y	Y	Y	H
14	6	M	M	Y	Y	N	M
15	8	M	L	Y	Y	N	L
16	8	M	M	Y	Y	Y	M
17	5	H	M	Y	Y	Y	M
18	5	M	M	Y	Y	N	M
19	9	H	M	Y	N	N	M
20	3	H	L	Y	Y	N	H
21	3	M	L	Y	N	Y	M
22	4	H	H	Y	Y	N	M
23	8	L	M	N	Y	N	L
24	3	H	M	Y	N	Y	M
25	3	M	L	Y	N	Y	M
26	4	M	L	Y	N	Y	M
27	6	H	H	Y	Y	N	M
28	4	M	L	Y	N	Y	M
29	9	H	H	Y	Y	N	H
30	9	H	H	Y	Y	N	H

Table 15-4
Prioritization of County-Specific Hazard Mitigation Initiatives

Initiative #	# of Objectives Met	Benefits	Costs	Do Benefits Equal or Exceed Costs?	Is Project Grant Eligible?	Can Project Be Funded under Existing Programs/ Budgets?	Priority (High, Med., Low)
1	8	H	H	Y	Y	N	H
2	9	M	H	N	Y	N	M
3	9	H	H	Y	Y	Y	H
4	3	M	H	Y	Y	Y	M
5	8	H	H	Y	Y	N	H
6	8	H	H	Y	Y	N	H
7	9	H	L	Y	N	Y	H
8	9	H	H	Y	N	N	L
9	9	H	L	Y	Y	N	H
10	5	H	L	Y	Y	Y	H
11	9	M	M	Y	Y	N	M
12	9	M	M	Y	N	N	L
13	7	H	H	Y	Y	N	H
14	4	H	M	Y	N	Y	M
15	7	H	H	Y	Y	Y	H
16	4	H	M	Y	Y	Y	H
17	1	M	L	Y	N	Y	L
18	6	H	H	Y	N	Y	H
19	6	H	L	Y	Y	N	M
20	5	H	L	Y	Y	Y	H
21	9	H	L	Y	Y	N	H

The priorities are defined as follows:

- **High Priority**—A project that meets multiple objectives (i.e., multiple hazards), has benefits that exceed cost, has funding secured or is an ongoing project and meets eligibility requirements for the HMGP or PDM grant program. High priority projects can be completed in the short term (1 to 5 years).
- **Medium Priority**—A project that meets goals and objectives, that has benefits that exceed costs, and for which funding has not been secured but that is grant eligible under HMGP, PDM or other grant programs. Project can be completed in the short term, once funding is secured. Medium priority projects will become high priority projects once funding is secured.
- **Low Priority**—A project that will mitigate the risk of a hazard, that has benefits that do not exceed the costs or are difficult to quantify, for which funding has not been secured, that is not eligible for HMGP or PDM grant funding, and for which the time line for completion is long term (1 to 10 years). Low priority projects may be eligible for other sources of grant funding from other programs.

For many of the strategies identified in this action plan, the partners may seek financial assistance under the HMGP or PDM programs, both of which require detailed benefit/cost analyses. These analyses will be performed on projects at the time of application using the FEMA benefit-cost model. For projects not seeking financial assistance from grant programs that require detailed analysis, the partners reserve the right to define "benefits" according to parameters that meet the goals and objectives of this plan.

Because this is a multi-jurisdictional plan, the prioritization of initiatives specific to the remaining jurisdictions must also be done at the individual level based on the needs and programs of that body, and accomplished as resources can be secured. Funding to complete any initiative will likely be acquired from a variety of sources, with the lack of funding alone preventing an initiative from being implemented. As such, the less formal approach used during this process is more appropriate because some projects may not be implemented for up to 10 years, and associated costs and benefits could change dramatically in that time.

The method of prioritization utilized also allows for the inclusion of new projects throughout the life cycle of this plan without having to numerically re-value each of the projects based on an assigned value of 1, 2, 3, etc. Further, it supports the plan maintenance strategy for review, addition, and reprioritization of initiatives on an annual basis, reducing the level of effort involved in a numeric system of ranking, and enhancing the likelihood that the annual review will occur as a reduced level of effort will be required.

15.8 2011 ACTION PLAN STATUS

A comprehensive review of the 2011 action plan was performed to determine which countywide actions were completed, which should carry over to the updated plan, and which were no longer feasible and should be removed from the plan. Table 15-5 identifies the results of this review. Each Planning Team member's respective annex update contains information concerning their previous strategies.

Table 15-5
2018 Status of 2011 Action Plan

	Associated Hazards									2018 Status			
2011 Mitigation Strategy	Avalanche	Climate Change	Drought	Earthquake	Flood	Landslide	Severe Weather	Wildland Fire	2018 Project Status ✓	Completed	Continual /Ongoing Nature	Removed /No Longer Relevant	Carried Over to 2018 Plan
Seek Community Rating System (CRS) Status for the Community.					✓				Staffing restricts the County's ability to become a CRS member; however, it is something that the county may consider in the future.				✓

Table 15-5
2018 Status of 2011 Action Plan

	Associated Hazards									2018 Status			
2011 Mitigation Strategy	Avalanche	Climate Change	Drought	Earthquake	Flood	Landslide	Severe Weather	Wildland Fire	2018 Project Status ✓	Completed	Continual /Ongoing Nature	Removed /No Longer Relevant	Carried Over to 2018 Plan
Request FIRM updates for known inaccuracies.					✓				This is a strategy in the 2018 plan as flood maps are significantly outdated as a result of development occurring and the increased flood risk associated with increased diversion practices in other states along the Pend Oreille River, which have increased flow. Recent wildfire events have also destroyed vegetation on thousands of acres, which also increases flooding and landslide issues.				✓
Reduce Flooding from runoff at Border Crossing.					✓							✓	
Raise the Spring Valley Road at section 29 township 30N range 45E.					✓		✓		Still a viable project; carried forward.				✓
Replace Sullivan Lake Inlet Bridge over Harvey Creek.				✓	✓		✓		Still a viable project; county has worked on portions of this, but project carried over.				✓
Replace the road crossing culvert on Perkins Slough					✓		✓		Still a viable project; carried over.				✓
Cusick Flats Flood Area Feasibility Study: Determine best cost effective and community acceptable approach to solve the flood problems in the Cusick Flats area including towns of Cusick and Usk.					✓				This is a Town of Cusick project for which the County has no authority. We will continue to work with the Town and those impacted, but it is not a County project for which they serve as the primary responsible party.			✓	

Table 15-5
2018 Status of 2011 Action Plan

	Associated Hazards									2018 Status			
2011 Mitigation Strategy	Avalanche	Climate Change	Drought	Earthquake	Flood	Landslide	Severe Weather	Wildland Fire	2018 Project Status ✓	Completed	Continual /Ongoing Nature	Removed /No Longer Relevant	Carried Over to 2018 Plan
Develop a Wildland Fire Ordinance which establishes road widths, access, water supply, and building regulations suitable to ensure new structures can be protected.								✓	Portions of this initiative have been completed through update of the County's Comprehensive Land Use Plan; however, the plan is still under review and update, and additional factors will be incorporated to new regulations established with the use of the hazard information captured from this effort.				✓
Designate the WUI areas as a special land use category in the County Comprehensive Plan								✓					✓
Require new construction to install underground power lines.	✓			✓			✓	✓	The PUD and the County will continue to work towards this goal as grant funding allows.		✓		✓
Fuels mitigation of the "Emergency Evacuation Routes" in the county to ensure these routes can be maintained in the case of an emergency.	✓			✓	✓	✓	✓	✓			✓		
Road-side fuels management: State Highway 20, State Highway 31, State Highway 211, LeClerc Creek Road, Scotia Valley Road, Spring Valley Road, Fertile Valley Road, Deer Valley Road, Bead Lake Road, Flowery Trail Road, Diamond Lake Road, and Sullivan Lake Road.	✓			✓	✓	✓	✓	✓	The County continues to work with the Kalispel Tribe, Fire Districts, Conservation District and various communities to conduct fuels reduction projects.		✓		✓

Table 15-5
2018 Status of 2011 Action Plan

	Associated Hazards									2018 Status			
2011 Mitigation Strategy	Avalanche	Climate Change	Drought	Earthquake	Flood	Landslide	Severe Weather	Wildland Fire	2018 Project Status ✓	Completed	Continual /Ongoing Nature	Removed /No Longer Relevant	Carried Over to 2018 Plan
Road-side fuels management: Congen, Flowery Trail, Limestone, Hwy 31, Dry Ridge, Dry Canyon, Bear Paw, and East Tiger	✓			✓	✓	✓	✓	✓			✓		✓
Riverbend Water System: To aid in the current water capacity: build a 200,000 gallon reservoir, Increase pump intake, treatment system upgrade, and main line size upgrade. Additionally 1.0 miles of 8" main line (C-900), and 8 fire hydrants placed locally throughout the subdivision.	✓			✓	✓	✓	✓	✓	County is not owner of water system			✓	
Metaline Falls Water: To aid in current water capacity: build additional 1.0 million gallon reservoir placed upon rye field flats to balance fire flow.		✓	✓					✓	This is a Town of Metaline Falls project; the County has no authority. Therefore, it is removed from the County's list.			✓	
Increase the standard for snow loads on Manufactured Home roofs.	✓						✓		The County's Comprehensive Land Use Plan was updated in 2015, with the most recent codes adopted, including snow-load capacity.	✓			
Install system at weather station at the Ione Airport to provide weather data for the northern end of the County.	✓	✓	✓	✓	✓	✓	✓	✓	The National Weather Service has provided this information to the County through weather briefings. In addition, this is a Town of Ione Airport, and the County has no authority.			✓	

Table 15-5
2018 Status of 2011 Action Plan

	Associated Hazards									2018 Status			
2011 Mitigation Strategy	Avalanche	Climate Change	Drought	Earthquake	Flood	Landslide	Severe Weather	Wildland Fire	2018 Project Status ✓	Completed	Continual /Ongoing Nature	Removed /No Longer Relevant	Carried Over to 2018 Plan
Seismically reinforce (tie down) equipment in the Pend Oreille County Dispatch Center				✓	✓	✓	✓		On-going				✓
Stabilize the slide area along Sullivan Road				✓	✓	✓	✓		On-going effort				✓
Stabilize the rock slide area along the Spring Valley Road south of Land of the Woods				✓	✓	✓	✓				✓		✓
Mitigate the sink holes along Sullivan Lake Road					✓	✓	✓				✓		✓
Repair the sink hole on the north end of LeClerc Road near Yochum Lake					✓	✓	✓						✓
Replace the Indian Creek bridge/culvert on south LeClerc Road South				✓	✓	✓	✓						✓
Replace the County Road Shop at Metaline Falls				✓	✓	✓	✓						✓
Develop an alternate communications center for the north end of the County	✓	✓	✓	✓	✓	✓	✓	✓	The county has just received a communications grant for the Homeland Security Region. As funds are received, prioritized projects under the grant will be completed. This will be a county-specific project, but it is unclear which projects regionally will be completed, and the amount of funds available.				✓
Develop a reverse 911 system for the County.	✓	✓	✓	✓	✓	✓	✓	✓	The County has acquired and utilizes Nixel for alert notifications.	✓			
Develop a Continuity of Operations Plan	✓	✓	✓	✓	✓	✓	✓	✓	No action to date, but remains a focus of the County to complete.				✓

Table 15-5
2018 Status of 2011 Action Plan

	Associated Hazards									2018 Status			
2011 Mitigation Strategy	Avalanche	Climate Change	Drought	Earthquake	Flood	Landslide	Severe Weather	Wildland Fire	2018 Project Status ✓	Completed	Continual /Ongoing Nature	Removed /No Longer Relevant	Carried Over to 2018 Plan
Review and Revise Evacuation Plan	✓	✓	✓	✓	✓	✓	✓	✓	This is an on-going process each time new risk data is received, or after an event to ensure maps remain current.		✓		✓

15.9 ADDITIONAL MITIGATION ACTIVATES:

In addition to the projects identified above, additional efforts include:

- Funding by the County PUD for erosion-control projects on privately owned lands where the PUD may contribute funds for qualified applicants as an incentive to landowners (additional information is available at PUD's website: http://popud.org/projects/erosion-control).[75]
- Wake control measures on the county's lakes to assist with erosion and flood control.
- Wetland mitigation for flooding issues by the Kalispel Tribe along the 60-acre site situated on Highway 20 in the floodplain where the Tribe's new Casino and RV park are being constructed.

15.10 FUNDING OPPORTUNITIES

Although a number of the mitigation projects listed may not be eligible for FEMA funding, Pend Oreille County and its planning partners may secure alternate funding sources to implement these projects in the future including federal and state grant programs, and funds made available through the county. In order to be eligible for some of those grant funds, completion of a hazard mitigation plan may be required. Table 15-6 identifies some of those grant requirements. Additional funding sources identified in Table 15-7 are also available which support various types of mitigation efforts on a countywide basis.

Alternate funding sources which may further support mitigation efforts of various types include, but are not limited to, the following:

[75] https://pendoreilleco.org/wp-content/uploads/2016/04/PendOreilleShorelineStabilizationGuide_2016_April-8.5x11.pdf

- **U.S. Department of Housing and Urban Development, Community Development Block Grants (CDBG)**—The CDBG program is a flexible program that provides communities with resources to address a wide range of community development needs. CDBG money can be used to match FEMA grant money. More information: http://www.hud.gov/offices/cpd/communitydevelopment/programs/

- **U.S. Fish & Wildlife Service Rural Fire Assistance Grants**—Each year, the U.S. Fish & Wildlife Service provides Rural Fire Assistance grants to neighboring community fire departments to enhance local wildfire protection, purchase equipment, and train volunteer firefighters. U.S. Fish & Wildlife Service fire staff also assist directly with community projects. These efforts reduce the risk to human life and better permit U.S. Fish & Wildlife Service firefighters to interact and work with community fire organizations when fighting wildfires. The Department of the Interior receives a budget each year for the Rural Fire Assistance grant program. The maximum award per grant is $20,000. The assistance program targets rural and volunteer fire departments that routinely help fight fire on or near Department of Interior lands. More information: http://www.fws.gov/fire/ living_with_fire/rural_fire_assistance.shtml

Table 15-6
Grant Opportunities

Program	Enabling Legislation	Funding Authorization	Hazard Mitigation Plan Requirement	
			Grantee	**Sub-Grantee**
Public Assistance, Categories A-B (e.g., debris removal, emergency protective measures)	Stafford Act	Presidential Disaster Declaration	□	□
Public Assistance, Categories C-G (e.g., repair of damaged infrastructure, publicly owned buildings)	Stafford Act	Presidential Disaster Declaration	☑	□
Individual Assistance (IA)	Stafford Act	Presidential Disaster Declaration	□	□
Fire Management Assistance Grants	Stafford Act	Fire Management Assistance Declaration	☑	□
Hazard Mitigation Grant Program (HMGP) Planning Grant	Stafford Act	Presidential Disaster Declaration	☑	□
HMGP Project Grant	Stafford Act	Presidential Disaster Declaration	☑	☑
Pre-Disaster Mitigation (PDM) Planning Grant	Stafford Act	Annual Appropriation	□	□
PDM Project Grant	Stafford Act	Annual Appropriation	☑	☑
Flood Mitigation Assistance (FMA)	National Flood Insurance Act	Annual Appropriation	☑	☑
Severe Repetitive Loss (SRL)	National Flood Insurance Act	Annual Appropriation	☑	☑
Repetitive Flood Claims (RFC)	National Flood Insurance Act	Annual Appropriation	☑	□
Homeland Security	Dept. of Homeland Security	Annual Appropriation	☑	□

☑ = Hazard Mitigation Plan Required
□ = No Hazard Mitigation Plan Required

Table 15-7
Countywide Fiscal Capabilities which Support Mitigation Efforts

Financial Resources	Accessible or Eligible to Use?
Community Development Block Grants	Y
Capital Improvements Project Funding	Y
Authority to Levy Taxes for Specific Purposes	Y
User Fees for Water, Sewer, Gas or Electric Service	Y
Incur Debt through General Obligation Bonds	Y
Incur Debt through Special Tax Bonds	Y
Incur Debt through Private Activity Bonds	Y
Withhold Public Expenditures in Hazard-Prone Areas	Y
State Sponsored Grant Programs	Y
Development Impact Fees for Homebuyers or Developers	Y

- **U.S. Department of Homeland Security—**Enhances the ability of states, local and tribal jurisdictions, and other regional authorities in the preparation, prevention, and response to terrorist attacks and other disasters, by distributing grant funds. Localities can use grants for planning, equipment, training and exercise needs. These grants include, but are not limited to areas of critical infrastructure protection, equipment and training for first responders, and homeland security. More information: http://www.dhs.gov/
- **FEMA, Hazard Mitigation Grant Program (HMGP)—**The HMGP provides grants to states, Indian tribes, local governments, and private non-profit organizations to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. More information: http://www.fema.gov/ government/grant/hmgp/
- **FEMA, Pre-Disaster Mitigation (PDM) Competitive Grant Program—**The PDM program provides funds to states, territories, Indian tribal governments, communities, and universities for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event. Funding these plans and projects reduces overall risks to the population and structures, while also reducing reliance on funding from actual disaster declarations. PDM grants are to be awarded on a competitive basis and without reference to state allocations, quotas, or other formula-based allocation of funds. More information: http://www.fema.gov/government/grant/pdm/index.shtm
- **U.S. Bureau of Land Management (BLM), Community Assistance Program—**BLM provides funds to communities through assistance agreements to complete mitigation projects, education and planning within the wildland urban interface. More information: http://www.blm.gov/nifc/st/en/prog/fire/community_assistance.html
- **U.S. Department of Agriculture Community Facilities Loans and Grants—**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.
- **General Services Administration Sale of Federal Surplus Personal Property—**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 are no restrictions on the property purchased. More information: http://www.gsa.gov/portal/category/21045

- **FEMA Readiness, Response and Recovery Directorate, Fire Management Assistance Grant Program —** Program provides grants to states, tribal governments and local governments for the mitigation, management and control of any fire burning on publicly (non-federal) 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 information is available at: http://www.fema.gov/government/grant/fmagp/index.shtm
- **Hazardous Materials Emergency Preparedness Grants —** Grant funds are passed through to local emergency management offices and Hazmat teams having functional and active local emergency planning committees. More information is available at: http://www.phmsa.dot.gov/hazmat/grants

CHAPTER 16.
CAPABILITY ASSESSMENT

16.1 LAWS AND ORDINANCES

Existing laws, ordinances and plans at the federal, state and local level can support or impact hazard mitigation initiatives identified in this plan. Hazard mitigation plans are required by 44 CFR to include a review and incorporation, if appropriate, of existing plans, studies, reports, and technical information as part of the planning process (Section 201.6.b(3)). Pertinent federal and state laws are described below. Each planning partner has individually reviewed existing local plans, studies, reports, and technical information as referenced and identified in its specific jurisdictional annexes presented in Volume 2.

16.1.1 Federal

Disaster Mitigation Act

The DMA is the current federal legislation addressing hazard mitigation planning. It emphasizes planning for disasters before they occur. It specifically addresses planning at the local level, requiring plans to be in place before Hazard Mitigation Grant Program funds are available to communities. This plan is designed to meet the requirements of DMA, improving the planning partners' eligibility for future hazard mitigation funds.

Endangered Species Act

The 1973 Endangered Species Act (ESA) was enacted to conserve species facing depletion or extinction and the ecosystems that support them. The act sets forth a process for determining which species are threatened and endangered and requires the conservation of the critical habitat in which those species live. The ESA provides broad protection for species of fish, wildlife and plants that are listed as threatened or endangered. Provisions are made for listing species, as well as for recovery plans and the designation of critical habitat. The ESA outlines procedures for federal agencies to follow when taking actions that may jeopardize listed species. It is the enabling legislation for the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Criminal and civil penalties are provided for violations of the ESA and the Convention. Federal agencies must seek to conserve endangered and threatened species. The ESA defines three fundamental terms:

- **Endangered** means that a species of fish, animal or plant is "in danger of extinction throughout all or a significant portion of its range." (For salmon and other vertebrate species, this may include subspecies and distinct population segments.)
- **Threatened** means that a species "is likely to become endangered within the foreseeable future." Regulations may be less restrictive than for endangered species.
- **Critical habitat** means "specific geographical areas that are…essential for the conservation and management of a listed species, whether occupied by the species or not."

The following are critical sections of the ESA:

- **Section 4: Listing of a Species**—The National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries) is responsible for listing marine species; the U.S. Fish and Wildlife Service is responsible for listing terrestrial and freshwater aquatic species. The agencies may initiate reviews for listings, or citizens may petition for them. A listing must be made "solely on the basis of the best scientific and commercial data available." After a listing has been proposed, agencies receive comment and conduct further scientific reviews, after which they must decide if the listing is warranted. Economic impacts cannot be considered in this decision, but it may include an evaluation of the adequacy of local and state protections.

- **Section 7: Consultation**—Federal agencies must ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed or proposed species or adversely modify its critical habitat. This includes private and public actions that require a federal permit. Once a final listing is made, non-federal actions are subject to the same review, termed a "consultation." If the listing agency finds that an action will "take" a species, it must propose mitigations or "reasonable and prudent" alternatives to the action; if the proponent rejects these, the action cannot proceed.
- **Section 9: Prohibition of Take—**It is unlawful to "take" an endangered species, including killing or injuring it or modifying its habitat in a way that interferes with essential behavioral patterns, including breeding, feeding or sheltering.
- **Section 10: Permitted Take**—Through voluntary agreements with the federal government that provide protections to an endangered species, a non-federal applicant may commit a take that would otherwise be prohibited as long as it is incidental to an otherwise lawful activity (such as developing land or building a road). These agreements often take the form of a "Habitat Conservation Plan."
- **Section 11: Citizen Lawsuits**—Civil actions initiated by any citizen can require the listing agency to enforce the ESA's prohibition of taking or to meet the requirements of the consultation process.

With the listing of salmon and trout species as threatened or endangered, the Pacific Coast states have been impacted by mandates, programs and policies based on the presumed presence of listed species. Most West Coast jurisdictions must now take into account the impact of their programs on habitat.

The Clean Water Act

The federal Clean Water Act (CWA) employs regulatory and non-regulatory tools to reduce direct pollutant discharges into waterways, finance municipal wastewater treatment facilities, and manage polluted runoff. These tools are employed to achieve the broader goal of restoring and maintaining the chemical, physical, and biological integrity of the nation's surface waters so that they can support "the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water."

Evolution of CWA programs over the last decade has included a shift from a program-by-program, source-by-source, and pollutant-by-pollutant approach to more holistic watershed-based strategies. Under the watershed approach, equal emphasis is placed on protecting healthy waters and restoring impaired ones. A full array of issues are addressed, not just those subject to CWA regulatory authority. Involvement of stakeholder groups in the development and implementation of strategies for achieving and maintaining water quality and other environmental goals is a hallmark of this approach.

National Flood Insurance Program

The National Flood Insurance Program (NFIP) provides federally backed flood insurance in exchange for communities enacting floodplain regulations. Participation and good standing under NFIP are prerequisites to grant funding eligibility under the Robert T. Stafford Act. The County, the City of Newport and the various towns participate in the NFIP and have adopted regulations that meet the NFIP requirements. At the time of the preparation of this 2018 edition, all participating jurisdictions in the partnership were in good standing with NFIP requirements. The Kalispel Tribe is not currently registered as an NFIP community. Additional NFIP data can be found within the Flood Hazard Profile, and within each partners' annex document.

Presidential Disaster Declarations

Presidentially declared disasters are disaster events that cause more damage than state and local governments/resources can handle without federal assistance. There is not generally a specific dollar threshold that must be met. A Presidential Major Disaster Declaration puts into motion long-term federal recovery programs, some of which are matched by state programs, and designed to help disaster victims, businesses, and public entities. A Presidential Emergency Declaration can also be declared, but assistance is limited to specific emergency needs.

16.1.2 State-Level Planning Initiatives

Washington State Enhanced Mitigation Plan

The Washington State Enhanced Hazard Mitigation Plan approved by FEMA provides guidance for hazard mitigation throughout Washington. The plan identifies hazard mitigation goals, objectives, actions and initiatives for state government to reduce injury and damage from natural hazards. By meeting federal requirements for an enhanced state plan (44 CFR parts 201.4 and 201.5), the plan allows the state to seek significantly higher funding from the Hazard Mitigation Grant Program following presidential declared disasters (20 percent of federal disaster expenditures versus 15 percent with a standard plan).

Growth Management Act

The 1990 Washington State Growth Management Act (Revised Code of Washington (RCW) Chapter 36.70A) mandates that local jurisdictions adopt land use ordinances to protect the following critical areas:

- Wetlands
- Critical aquifer recharge areas
- Fish and wildlife habitat conservation areas
- Frequently flooded areas
- Geologically hazardous areas

The Growth Management Act (GMA) regulates development in these areas, and therefore has the potential to affect hazard vulnerability and exposure at the local level.

Shoreline Management Act

The 1971 Shoreline Management Act (RCW 90.58) was enacted to manage and protect the shorelines of the state by regulating development in the shoreline area. A major goal of the act is to prevent the "inherent harm in an uncoordinated and piecemeal development of the state's shorelines." Its jurisdiction includes the Pacific Ocean shoreline and the shorelines of Puget Sound, the Strait of Juan de Fuca, and rivers, streams and lakes above a certain size. It also regulates wetlands associated with these shorelines.

Wild and Scenic River

A federal designation that is intended to protect the natural character of rivers and their habitat without adversely affecting surrounding property.

Zero-Rise Floodway

A 'zero-rise' floodway is an area reserved to carry the discharge of a flood without raising the base flood elevation. Some communities have chosen to implement zero-rise floodways because they provide greater flood protection than the floodway described above, which allows a one foot rise in the base flood elevation.

Washington State Building Code

The Washington State Building Code Council adopted the 2015 editions of national model codes, with some amendments. The Council also adopted changes to the Washington State Energy Code and Ventilation and Indoor Air Quality Code. Washington's state-developed codes are mandatory statewide for residential and commercial buildings.

Comprehensive Emergency Management Planning

Washington's Comprehensive Emergency Management Planning law (RCW 38.52) establishes parameters to ensure that preparations of the state will be adequate to deal with disasters, to ensure the administration of state and federal programs providing disaster relief to individuals, to ensure adequate support for search and rescue operations, to protect the public peace, health and safety, and to preserve the lives and property of the people of the state. It achieves the following:

- Provides for emergency management by the state, and authorizes the creation of local organizations for emergency management in political subdivisions of the state.
- Confers emergency powers upon the governor and upon the executive heads of political subdivisions of the state.
- Provides for the rendering of mutual aid among political subdivisions of the state and with other states and for cooperation with the federal government with respect to the carrying out of emergency management functions.
- Provides a means of compensating emergency management workers who may suffer any injury or death, who suffer economic harm including personal property damage or loss, or who incur expenses for transportation, telephone or other methods of communication, and the use of personal supplies as a result of participation in emergency management activities.
- Provides programs, with intergovernmental cooperation, to educate and train the public to be prepared for emergencies.

It is policy under this law that emergency management functions of the state and its political subdivisions be coordinated to the maximum extent with comparable functions of the federal government and agencies of other states and localities, and of private agencies of every type, to the end that the most effective preparation and use may be made of manpower, resources, and facilities for dealing with disasters.

Washington Administrative Code 118-30-060(1)

Washington Administrative Code (WAC) 118-30-060 (1) requires each political subdivision to base its comprehensive emergency management plan on a hazard analysis, and makes the following definitions related to hazards:

- Hazards are conditions that can threaten human life as the result of three main factors:
  - Natural conditions, such as weather and seismic activity;
  - Human interference with natural processes, such as a levee that displaces the natural flow of floodwaters; and

  - Human activity and its products, such as homes on a floodplain.
- The definitions for hazard, hazard event, hazard identification, and flood hazard include related concepts:
  - A hazard may be connected to human activity.
  - Hazards are extreme events.

Hazards generally pose a risk of damage, loss, or harm to people and/or their property.

Washington State Floodplain Management Law

Washington's floodplain management law (RCW 86.16, implemented through WAC 173-158) states that prevention of flood damage is a matter of statewide public concern and places regulatory control with the Department of Ecology. RCW 86.16 is cited in floodplain management literature, including FEMA's national assessment, as one of the first and strongest in the nation. A major challenge to the law in 1978, *Maple Leaf Investors v. Ecology*, is cited in legal references to floodplain management issues. The court upheld the law, declaring that denial of a permit to build residential structures in the floodway is a valid exercise of police power and did not constitute a taking. RCW Chapter 86.12 (Flood Control by Counties) authorizes county governments to levy taxes, condemn properties and undertake flood control activities directed toward a public purpose.

Flood Control Assistance Account Program

Washington's first flood control maintenance program was passed in 1951, and was called the Flood Control Maintenance Program (FCMP). In 1984, RCW 86.26 (State Participation in Flood Control Maintenance) established the Flood Control Assistance Account Program (FCAAP), which provides funding for local flood hazard management. FCAAP rules are found in WAC 173-145. Washington State Department of Ecology (WDOE) distributes FCAAP matching grants to cities, counties and other special districts responsible for flood control. This is one of the few state programs in the U.S. that provides grant funding to local governments for floodplain management. The program has historically been funded for $4 million per Biennium unless modified by the state legislature, with additional amounts provided after severe flooding events.

To be eligible for FCAAP assistance, flood hazard management activities must be approved by WDOE in consultation with the Washington Department of Fish and Wildlife (WDFW). A comprehensive flood hazard management plan must have been completed and adopted by the appropriate local authority or be in the process of being prepared in order to receive FCAAP flood damage reduction project funds. This policy evolved through years of the FCMP and early years of FCAAP in response to the observation that poor management in one part of a watershed may cause flooding problems in another part.

Local jurisdictions must participate in the NFIP and be a member in good standing to qualify for an FCAAP grant. Grants up to 75 percent of total project cost are available for comprehensive flood hazard management planning. Flood damage reduction projects can receive grants up to 50 percent of total project cost, and must be consistent with the comprehensive flood hazard management plan. Emergency grants are available to respond to unusual flood conditions. FCAAP can also be used for the purchase of flood prone properties, for limited flood mapping and for flood warning systems.

16.1.3 Local Programs

Each planning partner has prepared a jurisdiction-specific annex to this plan contained in Volume 2, which identifies its regulatory, technical and financial capability to carry out proactive mitigation efforts. Additional jurisdiction-specific information is available for review within each of those annexes. It should be noted that many of the local jurisdictions within this planning effort are very small in nature, with populations below 200, and very small staffing levels. As such, planning in general is limited, with many of the jurisdictions relying on the County to provide many of the services normally delivered by the communities themselves, including planning. This includes land use planning, inspections, and permitting, etc. Most expressed comments that had the County not obtained the grant to develop this HMP, and provided the guidance and assistance to each of the planning partners, they would not have been in a position to complete such an endeavor independently. The following sections present additional regulatory information that applies to the planning partnership as a whole.

Comprehensive Land Use Plans

Comprehensive plans are long-range in nature and serve as policy guides for how a jurisdiction plans to manage growth and development with respect to the natural environment and available resources. Washington State law (36.70A.040 RCW) requires that jurisdictions operating under the Growth Management Act develop comprehensive plans and development regulations that are consistent with the comprehensive plans and implement them (36.70A RCW).

The GMA requires that comprehensive plans consist of the following elements: land use, housing, capital facilities, utilities, rural (for counties), transportation, economic development, and park and recreation (RCW 36.70A.070). A comprehensive plan may also include additional optional elements that relate to physical development, such as conservation, historic preservation, and subarea plans (RCW 36.70A.080).

Pend Oreille County's last completed major update to its Comprehensive Land Use Plan as required under the GMA was adopted in June 2016. Since the original plan was written, amendments to various elements of the comprehensive plan have been made on an almost-annual basis as allowed by law (RCW 36.70A.130(2)(a)). The GMA requires that jurisdictions periodically review their comprehensive plans and implementing development regulations in their entirety and revise them if needed. Pend Oreille County is required to have this review and revision completed every eight years thereafter (RCW 36.70A.130(5)(b)). Opportunities for public participation in this process will be provided (see RCW 36.70A.035).

Critical Areas Ordinance

Washington's Growth Management Act requires local governments to protect five types of critical areas: important fish and wildlife habitat areas, wetlands, critical aquifer recharge areas, frequently flooded areas, and geologically hazardous areas, such as bluffs. Pend Oreille County's critical areas regulations are a response to that law; they regulate how development and redevelopment can safely occur on lands that contain critical areas. The last update to the CAO was 2016.

Although Washington's Watershed Management Act does not require planning, Pend Oreille County and local governments have undertaken related planning activities. The Washington Department of Ecology is providing technical and financial support for the effort. Pend Oreille County has participated in watershed planning for its WRIAs, as follows:

- Pend Oreille (WRIA 62)
- Pend Oreille Lake
- Priest
- Little Spokane (WRIA 55)
- Franklin D. Roosevelt Lake (WRIA 58, and others)
- Colville (WRIA 59)

16.2 MITIGATION-RELATED REGULATORY AUTHORITY

Hazard mitigation builds on a community's existing capabilities in place, including financial, regulatory, programmatic and planning capabilities. the County's capabilities to implement mitigation projects include community planners, engineers, floodplain managers, GIS personnel, emergency managers, and financial, legal and regulatory requirements (zoning, building codes, subdivision regulations, and floodplain management ordinances). These resources have the responsibility to provide overview of past, current, and ongoing pre- and post-disaster mitigation planning projects, including capital improvement programs, wildfire mitigation programs, stormwater management programs, and NFIP compliance projects. The following information and tables identify the County's capabilities with respect to (mitigation) efforts of varying types. Each planning partner also completed the same tables within their respective Annex documents.

Building Codes

The Pend Oreille County Building Department has adopted and enforces, as mandated by the State of Washington, the current editions of the International Code Council's Building, Residential, Fire, Mechanical, Fuel Gas and Existing Building codes the Washington State Energy Code and the Uniform Plumbing Code with State and local amendments.

Pend Oreille County adopted the 2012 Building Codes in 2015. The County's Code includes the 2012 editions of the International Building, Residential, Mechanical, Fire, Existing Building and Fuel Gas codes and the 2012 editions of the Uniform Plumbing Code and Washington State Energy Code will become effective in December 2015, as well as the 2009 ICC A117.1-2009 Edition of the Accessibility Code, as adopted by the Washington State Building Code Council, and as published by the International Code Council.

Local Load Requirements.

1. Snow Load. Fifty pounds per square foot on the roof live load minimum. Structures that do not meet the snow load requirement but were legally constructed in Pend Oreille County can be relocated as long as a building permit is issued and a finding can be made that structure meets all life safety requirements.
2. Wind Load. 110 MPH.
3. Seismic Zone design Category C.

Washington State Farmland Preservation

Washington State, through the Department of Revenue, provides tax incentives for open space enrollment of designated farmlands. The program is one tool for making farmland more affordable, thus keeping it out of development. Current use classification lowers the taxable value of farm and agricultural lands and other resource lands relative to other land uses. Land that would be assessed at $10,000 an acre for its "highest and best use" might be valued at perhaps $3,000 an acre as farmland. The effect of this lower valuation is to lower the tax assessed on lands classified as "current use," thereby making the land more affordable to keep in farm production.[76]

[76] WA Department of Revenue Property Tax Statistics. http://dor.wa.gov/content/aboutus/statisticsandreports/stats_proptaxstats_report.aspx

Regulatory, Technical, Community Organizations, Programs and Social Systems

Regulatory capabilities currently available are summarized in Table 16-1. In addition to the financial and regulatory capabilities summarized in Table 16-2, there are other programs available, some of which provide incentives for citizens. Such programs further enhance resiliency throughout the County. Two such programs include the National Flood Insurance Program, and the Community Rating System, both of which are discussed in detail in Chapter 9 – Flood.

Social systems can be defined as community organizations and programs that provide social and community-based services, such as health care or housing assistance, to the public. In planning for natural hazard mitigation, it is important to know what social systems exist within the community because of their existing connections to the public.

Table 16-1
Pend Oreille County Legal and Regulatory Capability

	Local Authority	Other Jurisdictional Authority	State Mandated	Comments
Codes, Ordinances & Requirements				
Building Code	Yes	Yes	Yes	2015 International Building Code
Zoning Ordinance	Yes		Yes	
Subdivision Ordinance	Yes		Yes	
Floodplain Ordinance	Yes	Yes	Yes	FEMA Requirements
Stormwater Management	Yes			
Post Disaster Recovery	No			
Real Estate Disclosure	No	No	Yes	
Growth Management	Yes		Yes	Approved 10-17-2005; Last update adopted June 2015.
Critical Areas Ordinance	Yes		Yes	Critical Areas Ordinance #92-04 identified and regulatory authority established. Last update occurred in 2015.
Site Plan Review	Yes			
Public Health and Safety	Yes	Yes	Yes	
Climate Change Adaptation	No			
Shoreline Master Program	Yes			Adopted 2012
Natural Hazard Specific Ordinance (stormwater, steep slope, wildfire, etc.)	Yes		Yes	
Environmental Protection	Yes	Yes	Yes	
Planning Documents				
General or Comprehensive Plan	Yes		Yes	Plan was updated in 2016.
Is the plan equipped to provide linkage to this mitigation plan? Yes				
Floodplain or Basin Plan	Yes			Through the Critical Areas Ordinance and Shoreline Master Plan

Table 16-1
Pend Oreille County Legal and Regulatory Capability

	Local Authority	Other Jurisdictional Authority	State Mandated	Comments
Stormwater Plan	Yes			Various plans are in place
Capital Improvement Plan	Yes		Yes	(2015 available on-line)
Habitat Conservation Plan	Yes			Through the Critical Areas Ordinance and Shoreline Master Plan
Economic Development Plan	Yes		Yes	
Shoreline Management Plan	Yes		Yes	
Community Wildfire Protection Plan	Yes		No	
Transportation Plan	Yes		Yes	
Response/Recovery Planning				
Comprehensive Emergency Management Plan	Yes		Yes	Completed and approved by state 2018
Threat and Hazard Identification and Risk Assessment	Yes		Yes	Homeland Security Region 9 Plan
Terrorism Plan	Yes			
Post-Disaster Recovery Plan	No			
Continuity of Operations Plan	No			
Public Health Plans	Yes			Various public health plans are in place both through the Northeast Tri-County Health District and through the hospital district.
Administration, Boards and Commission				
Planning Commission	Yes		Yes	
Mitigation Planning Committee	Yes			
Local Emergency Planning Committees (LEPC)	Yes			Utilized during development of the 2018 HMP process.
Maintenance programs to reduce risk (e.g., tree trimming, clearing drainage systems, chipping, etc.)	Yes			Various programs in place, including tree trimming, drainage systems, etc.
Mutual Aid Agreements / Memorandums of Understanding	Yes			
Other				

Table 16-2 Administrative and Technical Capability		
Staff/Personnel Resources	Available?	Department/Agency/Position
Planners or engineers with knowledge of land development and land management practices	Y	
Professionals trained in building or infrastructure construction practices (building officials, fire inspectors, etc.)	Y	
Engineers specializing in construction practices?	Y	
Planners or engineers with an understanding of natural hazards	Y	
Staff with training in benefit/cost analysis	Y	
Surveyors	Y	
Personnel skilled or trained in GIS applications	Y	
Personnel skilled or trained in Hazus use	Y	
Scientist familiar with natural hazards in local area	Y	The county has hazard-specific subject matter experts on staff in various departments, available via contracting mechanisms, and available through state resources.
Emergency Manager	Y	Emergency Management Department with trained personnel and volunteers.
Grant writers	Y	Various County departments have internal personnel who write grants; county staff monitors grants.
Warning Systems/Services	Y	E-911; Nixle, Public Works signage available as needed.
Hazard data and information available to public	Y	Planning Department
Maintain Elevation Certificates	Y	Through Planning Department.

Often, actions identified by the plan involve communicating with the public or specific subgroups within the population (e.g. elderly, children, low income). The County and its planning partners can use existing social systems as resources for implementing such communication-related activities because these service providers already work directly with the public on a number of issues, one of which could be natural hazard preparedness and mitigation.

The following highlights organizations and programs that are active within Pend Oreille County, which may be potential partners for implementing mitigation actions. The various tables include information on each organization or program's service area, types of services offered, populations served, and how the organization or program could be involved in natural hazard mitigation. The three involvement methods are defined below.

- Education and outreach – organizations could partner with the community to educate the public or provide outreach assistance on natural hazard preparedness and mitigation.
- Information dissemination – organizations could partner with the community to provide hazard-related information to target audiences.

- Plan/project implementation – organizations may have plans and/or policies that may be used to implement mitigation activities or the organization could serve as the coordinating or partner organization to implement mitigation actions. Table 16-3 identifies several of the ongoing efforts which assist in notification and social service programs, further enhancing the resilience of the County.

Table 16-3
Education and Outreach

Program/Organization	Available ?	Department/Agency/Position and Brief Description
Local citizen groups or non-profit organizations focused on emergency preparedness?	Y	Volunteer Firefighters, CERT members (limited number) and SAR trained personnel
Local citizen groups or non-profit organizations focused on environmental protection?	Y	Pend Oreille County Conservation District
Organization focused on individuals with access and functional needs populations?	N	
Ongoing public education or information program (e.g., responsible water use, fire safety, household preparedness, environmental education)	Y	Various agencies at the county and state levels which promote educational efforts such as Firewise, Forestland-Urban Interface Fire Protection Act, and Fire Adapted Communities from the National Cohesive Wildfire Strategy.
Natural disaster or safety related school programs?	Y	Pursuant to the RCW, schools are required to develop and exercise hazard-specific response plans.
Public-private partnership initiatives addressing disaster-related issues?	Y	Various public education outreach; provide information and presentations; NFIP insurance; outreach for Continuity Planning.
Multi-seasonal public awareness program?	Y	The County maintains information on its website to address specific hazards at issue; also, as situations arise, the website, email lists and local area broadcasting provides public service announcements and information.

16.3 WASHINGTON STATE RATING BUREAU LEVELS OF SERVICE

In Washington, the Washington State Rating Bureau (WSRB) helps determine standards on which insurance rates are set. WSRB, like most other states, utilizes the Insurance Service Office, Inc. (ISO) to determine levels of protection based on a prescribed level of service. Two such levels of services assessed are the Public Protection Classification Program and the Building Code Effectiveness Grading Schedule.

16.3.1 Public Protection Classification Program

The Public Protection Classification (PPC) program recognizes the efforts of communities to provide fire protection services for citizens and property owners. A community's investment in fire mitigation is a proven and reliable predicator of future fire losses. Insurance companies use PPC information to help establish fair premiums for fire insurance — generally offering lower premiums in communities with better protection. By offering economic benefits for communities that invest in their firefighting services, the program provides an additional incentive for improving and maintaining public fire protection.

In order to establish appropriate fire insurance premiums for residential and commercial properties, insurance companies utilize up-to-date information about the Community's fire-protection services. Through analysis of relevant data, communities are able to evaluate their public fire-protection services, and secure lower fire insurance premiums for communities with better protection. This program provides incentives and rewards in those areas with improved firefighting services. This program has gathered extensive information on more than 46,000 fire-response jurisdictions. Once all of the data is reviewed and analyzed, communities are assigned a PPC from 1 to 10. Class 1 generally represents superior property fire protection, while Class 10 indicates that the area's fire-suppression program is not as robust.

The most significant benefit of the PPC program is its effect on losses. Statistical data on insurance losses bears out the relationship between excellent fire protection — as measured by the PPC program — and low fire losses. PPC helps communities prepare to fight fires effectively. The program also provides help for fire departments and other public officials as they plan, budget for, and justify improvements.

Table 16-4 identifies the Public Protection Classification for Pend Oreille County Fire Districts and the various city fire departments.

Table 16-4
Countywide Public Protection Classification

Community	Protection Class Grade
Pend Oreille FPD 1	8
Pend Oreille FPD 2	8
Pend Oreille FPD 3	7
Pend Oreille FPD 4	8
Pend Oreille FPD 5	8
Pend Oreille FPD 6	8
Pend Oreille FPD 7	7
Pend Oreille FPD 8	8
Cusick	8
Ione	8
Kalispel Indian Reservation	8
Metaline	7
Metaline Falls	7
Newport	7

Data effective as of April 2018

16.3.2 Building Code Effectiveness Grading Schedule

The Building Code Effectiveness Grading Schedule (BCEGS) assesses building codes and amendments adopted in a community and evaluates that community's commitment to enforce them. The concept is simple: Municipalities with well-enforced, up-to-date codes should demonstrate better loss experience, and insurance rates can reflect that. The prospect of reducing damage and ultimately lowering insurance costs provides an incentive for communities to enforce their building codes rigorously. Table 16-5 identifies the BCEGS for the planning partnership.

Table 16-5
Countywide Building Code Effectiveness Grading

Community	BCEG
Pend Oreille FPD 1	4
Pend Oreille FPD 2	4
Pend Oreille FPD 3	4
Pend Oreille FPD 4	4
Pend Oreille FPD 5	4
Pend Oreille FPD 6	4
Pend Oreille FPD 7	4
Pend Oreille FPD 8	4
Cusick	4
Ione	4
Kalispel Indian Reservation	NA
Metaline	4
Metaline Falls	4
Newport	4

Data effective as of April 2018

16.3.3 Public Safety Programs

Communications / E911

Pend Oreille County Sheriff's Office Communication/E911 provides dispatch services to Pend Oreille County. Overseen by the E9-1-1 Coordinator, the Center is located in Newport and has a staff of ten full-time communication officers. The Center is a vital part of the Sheriff's Department as the County's Communication Center. It not only provides service for the Sheriff's Department but also serves the towns and cities of Cusick, Ione, Metaline, and Metaline Falls, as well as the Kalispel Reservation, Kalispel Tribal Police, Newport Police, and County Fire Districts. The County's Communication Center serves over 12,000 residents by answering fire, emergency medical, and law enforcement calls. They dispatch for two of the ambulance services in the County; Pend Oreille EMS and Fire District #2. The County's Communications Center also works closely with the following agencies:

- Washington State Patrol
- Washington State Department of Fish and Wildlife (WSDFW)
- US Border Patrol
- US Forest Service
- US Department of Fish and Wildlife

- Washington State Department of Natural Resources (WSDNR).

Pend Oreille County Emergency Management is under the Direction of JoAnn Boggs, who serves as the Deputy Director.

Law Enforcement

Law Enforcement is provided to the County by the Pend Oreille County Sheriff's Office, and the Washington State Patrol. The Sheriff's Office is located in Newport. Law Enforcement for the Kalispel Reservation is provided by the Kalispel Tribal Police, while the Newport Police Department provides law enforcement for the City of Newport.

The U.S. Border Patrol also assists in law enforcement near the Canadian Border.

Access and Functional Needs

One of the most important roles of local government is to protect their citizens from harm, including helping people prepare for and respond to emergencies. Making local government emergency preparedness and response programs accessible to people with special needs is a critical part of this responsibility. Pend Oreille County Department of Emergency Management (DEM) has the mission to assess and plan for all hazards and emergencies, and works with other public safety and local government agencies to ensure public welfare for all of its citizens.

Pend Oreille County Fire Districts

The various Pend Oreille County Fire Districts and Departments are illustrated in Figure 16-1. Pend Oreille County Fire Protection District is a private company divided into eight districts under the County Government to protect the residents of the County in various sections/parcels. Fire Protection District #8 and District #1 cover the southern end of the County. Fire District #1 was merged with Fire District #3 in February 2008; these two districts then merged with Fire District #7 and became the South Pend Oreille Fire and Rescue. Fire Protection District #2 is located in Metaline Falls and covers the Northeastern portion of the County. Fire Protection District #5 is just below District #2 and follows State Route 20. Fire Protection District #4 covers the western portion with District #6 covering the eastern portion. Overall, Fire Protection Districts #2 and #6, as well as South Pend Oreille Fire and Rescue cover the largest areas.

South Pend Oreille Fire and Rescue is an organization made up of volunteers who operate under the leadership of a professional fire chief. The area is served by five fire stations and nearly 70 volunteers. There are 36 certified EMS personnel that provide primarily Basic Life Support response. All volunteer firefighters are trained in CPR and first aid.

The City of Newport has its own Fire Department with one staff member and fifteen volunteers. The towns of Ione, Metaline and Metaline Falls have their own volunteer fire departments as well. The US Forest Service and Washington State Department of Natural Resources also provide wildland protection in Pend Oreille County. The Kalispel Reservation is served by the newly developed Kalispel Fire Department.

Advanced Life Support (ALS) Ambulance services are provided by Pend Oreille EMS to the City of Newport and the southern end of the County. BLS Ambulance service is provided by South Pend Oreille Fire & Rescue, Kalispell Tribe, and Pend Oreille Fire District #4 in their respective response areas. Lifeflight is available with 3 medical transport helicopters within the region to provide Air transport to the necessary medical center. Pend Oreille County Fire District #2 provides ambulance service in the northern half of the County and to the communities of Ione, Metaline, and Metaline Falls with three ambulances, one career firefighter/paramedic, and 20 volunteer personnel.

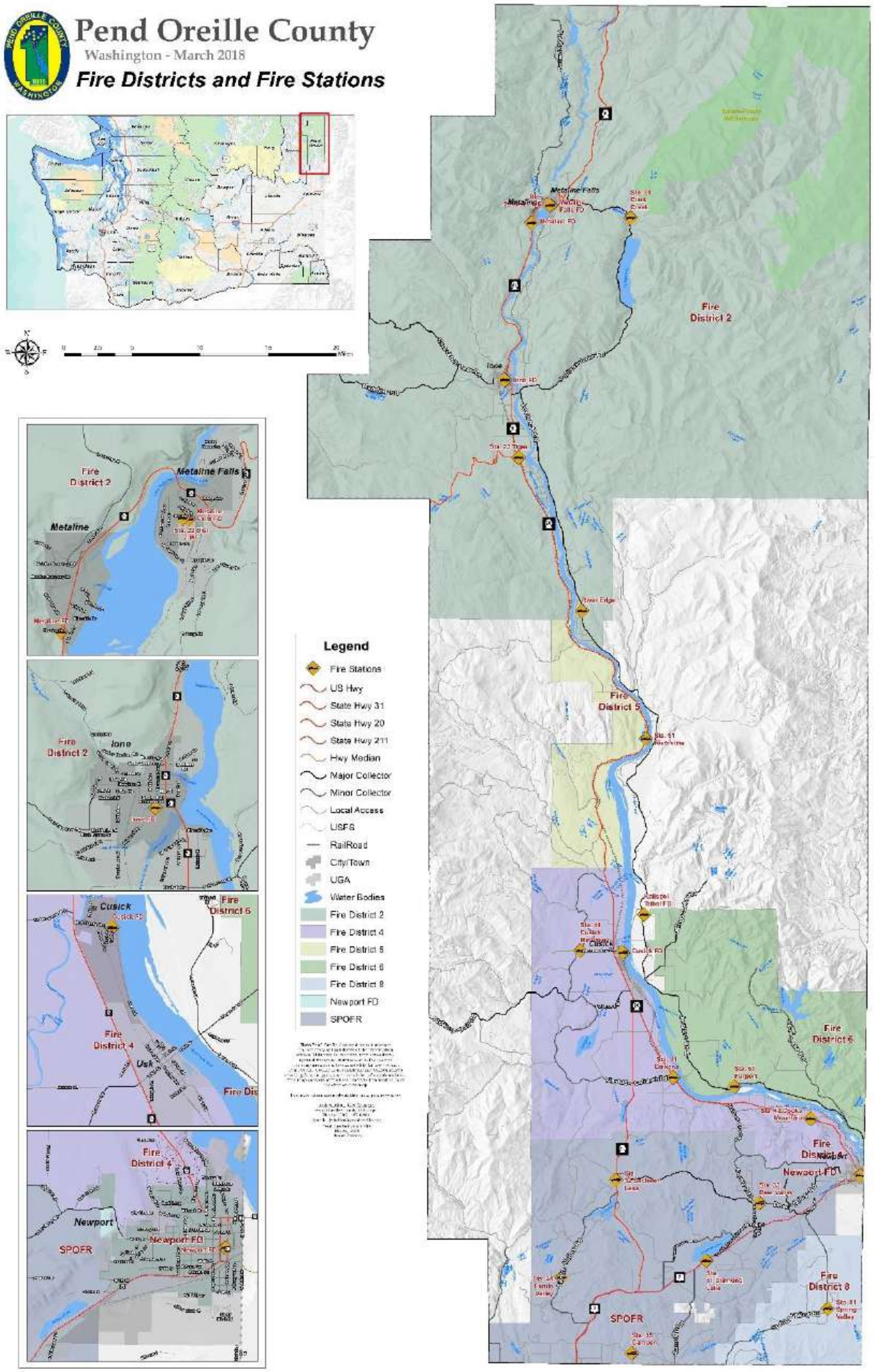


Figure 16-1 Pend Oreille County Fire Districts

Local Emergency Planning Committee

Washington State has 43 Local Emergency Planning Committees (LEPC), including Pend Oreille County's LEPC. These LEPCs, in concert with their respective local emergency management offices, conduct hazard identification, vulnerability analysis, and risk assessment activities for their jurisdictions. Federal and state statutes require LEPCs to develop and maintain emergency response plans based on the volumes and types of substances found in, or transported through, their districts.

Response Plans

Pend Oreille County and its jurisdictions have developed various response plans to be utilized during incident-specific events. Such plans provide guidance to first responders and community members in what actions need to be taken during such event. These plans, once completed, go through a training and exercise phase to help ensure quick response when the plans are activated.

CHAPTER 17.
PLAN MAINTENANCE STRATEGY

In accordance with 44 CFR 201.6(c)(4) and 201.7(c)(4), a hazard mitigation plan must present a plan maintenance process that includes the following:

- A section describing the method and schedule of monitoring, evaluating and updating the mitigation plan over its five year life-cycle;
- A process by which local governments incorporate the requirements of mitigation plans into other planning mechanisms, such as comprehensive land use plans (as appropriate);
- A discussion on how the community will continue to engage public participation in mitigation planning `efforts;

The CRS program credits NFIP communities points for adopting the Plan; establishing a procedure for implementation, review, and updating the Plan; and submitting an annual evaluation report.

This section of the plan is focused on the plan maintenance strategy, and details the formal process that will ensure that the Pend Oreille County Hazard Mitigation Plan remains an active and relevant document and that the planning partners maintain their eligibility for applicable funding sources. The maintenance process identified for Pend Oreille County and its planning partners includes a schedule for monitoring and evaluating the plan and producing a plan revision every five years. This chapter also describes how public participation will be integrated throughout the plan maintenance and implementation process. It also explains how the mitigation strategies outlined in this plan will be incorporated into existing planning mechanisms and programs, such as comprehensive land-use planning processes, capital improvement planning, and building code enforcement and implementation. The plan's format allows sections to be reviewed and updated when new data becomes available, resulting in a plan that will remain current and relevant.

The Pend Oreille County Emergency Management Deputy Director will maintain primary responsibility for overseeing the plan implementation and maintenance strategy. Plan implementation and evaluation will be a shared responsibility among all planning partnership members and agencies identified as lead agencies in the mitigation action plans (see planning partner annexes in Volume 2 of this plan).

17.1 MONITORING, EVALUATION AND UPDATING THE PLAN

17.1.1 Progress Report - 2011 Plan Status

The 2011 Hazard Mitigation Plan identified a maintenance strategy which included regular reviews during the life cycle of the plan. To a large extent, those reviews did occur; however, the County and its current planning partners were heavily engaged in wildfire response over multiple years during the life cycle of the 2011 plan, as well as update to its Comprehensive Emergency Management Plan. Those efforts required a very large level of involvement by the Emergency Management Department, as well as other departments within the County, its jurisdictional planning partner, and, its firefighting special purpose districts. In addition, the County upgraded, and continues to upgrade, its 9-1-1 system, which has required personnel to focus on that project, reducing the level of participation in others due to limited staffing. All of these efforts impeded the County's ability to do a comprehensive annual review and update. While the plan review did not occur as intended, the County nonetheless was effective in completing several of the strategies and action items identified in the plan. The status of the County's previous mitigation projects is shown in Table 15-5.

17.1.2 Plan Implementation and Maintenance

The effectiveness of the hazard mitigation plan depends on its implementation and incorporation of its action items into partner jurisdictions' existing plans, policies and programs. Together, the action items in the plan provide a framework for activities that the partnership can implement over the next 5 years. The planning partners have established goals and objectives and have prioritized mitigation actions that will be implemented through existing plans, policies, and programs.

44 CFR requires that local hazard mitigation plans be reviewed, revised if appropriate, and resubmitted for approval in order to remain eligible for benefits under the DMA (Section 201.6.d.3 and 201.7.d.3). The Pend Oreille County partnership intends to update the hazard mitigation plan on a 5-year cycle from the date of initial plan adoption. This cycle may be accelerated to less than 5 years based on the following triggers:

- A presidential disaster declaration that impacts the planning area.
- A hazard event that causes loss of life.
- A comprehensive update of the County or participating Tribal, city/town's comprehensive plan.

It will not be the intent of future updates to develop a complete new hazard mitigation plan for the planning area. The update will, at a minimum, include the following elements:

- The update process will be convened through a Planning Team.
- The hazard risk assessment will be reviewed and, if necessary, updated using best available information and technologies.
- The action plans will be reviewed and revised to account for any initiatives completed, dropped, or changed and to account for changes in the risk assessment or new partnership policies identified under other planning mechanisms (such as the comprehensive plan).
- The draft update will be sent to appropriate agencies and organizations for comment.
- The public will be given an opportunity to comment on the update prior to adoption.
- The partnership governing bodies will adopt their portions of the updated plan.

NFIP/CRS

The hazard mitigation plan will be reviewed annually and a progress report prepared. These reviews may be more or less frequent, as deemed necessary by the Emergency Management Deputy Director, but there will be a minimum of one review per year. The minimum task of each planning partner will be the evaluation of the progress of its individual action plan during a 12-month performance period. This review will include the following:

- Summary of any hazard events that occurred during the performance period and the impact these events had on the planning area.
- Review of mitigation success stories.
- Review of continuing public involvement.
- Brief discussion about why targeted strategies were not completed.
- Re-evaluation of the action plan to determine if the timeline for identified projects needs to be amended (such as changing a long-term project to a short-term one because of new funding).

- Recommendations for new projects.
- Changes in or potential for new funding options (grant opportunities).
- Impact of any other planning programs or initiatives that involve hazard mitigation.

A template to guide the planning partners in preparing a progress report has been created as part of this planning process (see Appendix D). The Deputy Director of Emergency Management will then prepare a formal annual report on the progress of the plan. This report should be used as follows:

- Posted on the Pend Oreille County website page dedicated to the hazard mitigation plan.
- Provided to the local media through a press release.
- Presented to planning partner governing bodies to inform them of the progress of actions implemented during the reporting period.

Use of the progress report will be at the discretion of each planning partner. Annual progress reporting is not a requirement specified under 44 CFR. However, it may enhance the planning partnership's opportunities for funding. While failure to implement this component of the plan maintenance strategy will not jeopardize a planning partner's compliance under the DMA, completion of the annual review will reduce the level of effort involved in future plan updates, and is highly encouraged by FEMA.

In addition to the annual review, three years after adoption of the hazard mitigation plan, the Deputy Director may decide to apply for a planning grant through FEMA to start the 2023 update. Upon receipt of funding, the County will solicit bids under applicable contracting procedures and hire a contractor to assist with the project. The proposed schedule for completion of the plan update is one year from award of a contract, to coincide with the five-year adoption date of the 2018 hazard mitigation plan update.

The Deputy Director will be responsible for the plan update. Before the end of the five-year period, the updated plan will be submitted to FEMA for approval. When concurrence is received that the updated plan complies with FEMA requirements, it will be submitted to the Board of County Commissioners, the local jurisdiction councils, and the Special Purpose District Commissioners for adoption. The County will send an e-mail to individuals and organizations on the stakeholder list to inform them that the updated plan is available on the County website.

17.2 IMPLEMENTATION THROUGH EXISTING PROGRAMS

Pend Oreille County will have the opportunity to implement hazard mitigation projects through existing programs and procedures through plan revisions or amendments. The hazard mitigation plan will be incorporated into the plans, regulations and ordinances as they are updated in the future or when new plans are developed.

The County's Comprehensive Plan and the comprehensive plans of the planning partners are considered to be integral parts of this plan. The County and its jurisdictional partners, through adoption of comprehensive plans and zoning ordinances, have planned for the impact of natural hazards. The plan development process provided the County and its cities with the opportunity to review and expand on policies contained within these planning mechanisms. The planning partners used their comprehensive plans and the hazard mitigation plan as complementary documents that work together to achieve the goal of reducing risk exposure to the citizens of the Pend Oreille County. An update to a comprehensive plan may trigger an update to the hazard mitigation plan.

All planning partners are committed to creating a linkage between the hazard mitigation plan and their individual comprehensive and other plans by identifying a mitigation initiative to do so and giving that initiative a high priority. Other planning processes and programs to be coordinated with the recommendations of the hazard mitigation plan include the following:

- Partners' emergency response plans;
- Capital improvement programs;
- Municipal codes;
- Building codes;
- Critical areas regulation;
- Growth management;
- Water resource inventory area planning;
- Basin planning;
- Community design guidelines;
- Water-efficient landscape design guidelines;
- Stormwater management programs;
- Water system vulnerability assessments;
- Master fire protection plans;
- Landslide reports and planning;
- Evacuation planning; and
- Transportation planning.

Some action items do not need to be implemented through regulation. Instead, these items can be implemented through the creation of new educational programs, continued interagency coordination, or improved public participation. As information becomes available from other planning mechanisms that can enhance this plan, that information will be incorporated via the update process.

17.3 CONTINUED PUBLIC INVOLVEMENT

Pend Oreille County, the Kalispel Tribe, and the planning partnership are dedicated to involving the public directly in review and updates of the hazard mitigation plan. The public will continue to be apprised of the plan's progress through the county's website and the annual progress reports that will be provided to the media. All planning partners have agreed to provide links to the Hazard Mitigation Plan website on their websites to increase avenues of public access to the plan. The Pend Oreille County Department of Emergency Management has agreed to maintain the hazard mitigation plan website. This site will not only house the final plan, it will become the one-stop shop for information regarding the plan, the partnership and plan implementation. Upon initiation of future update processes, a new public involvement strategy will be initiated. This strategy will be based on the needs and capabilities of the planning partnership at the time of the update. At a minimum, this strategy will include the use of social media and local media outlets within the planning area.

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Pend Oreille County
Multi-Jurisdiction Hazard Mitigation Plan 2018 Update

APPENDIX A
ACRONYMS AND DEFINITIONS

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ACRONYMS

ASHRAE—American Society of Heating, Refrigerating, and Air-Conditioning Engineers
BOR—U.S. Bureau of Reclamation
CFR—Code of Federal Regulations
cfs—cubic feet per second
CIP—Capital Improvement Plan
CRS—Community Rating System
DFIRM—Digital Flood Insurance Rate Maps
DHS—Department of Homeland Security
DMA —Disaster Mitigation Act
DSO—Dam Safety Office
EAP—Emergency Action Plan
EPA—U.S. Environmental Protection Agency
ESA—Endangered Species Act
FCAAP—Flood Control Assistance Account Program
FCMP—Flood Control Maintenance Program
FEMA—Federal Emergency Management Agency
FERC—Federal Energy Regulatory Commission
FIRM—Flood Insurance Rate Map
FIS—Flood Insurance Study
GIS—Geographic Information System
GMA—Growth Management Act
Hazus-MH—Hazards, United States-Multi Hazard
HMGP—Hazard Mitigation Grant Program
IBC—International Building Code
IRC—International Residential Code
MM—Modified Mercalli Scale
NEHRP—National Earthquake Hazards Reduction Program
NFIP—National Flood Insurance Program
NFPA—National Fire Protection Association
NFR—Natural fire rotation
NOAA—National Oceanic and Atmospheric Administration
NWS—National Weather Service
PDM—Pre-Disaster Mitigation Grant Program
PDI—Palmer Drought Index
PGA—Peak Ground Acceleration
PHDI—Palmer Hydrological Drought Index
RCW—Revised Code of Washington
SCS—U.S. Department of Agriculture Soil Conservation Service
SFHA—Special Flood Hazard Area
SHELDUS—Special Hazard Events and Losses Database for the US
SPI—Standardized Precipitation Index
USGS—U.S. Geological Survey
WAC—Washington Administrative Code
WDFW—Washington Department of Fish and Wildlife
WUI— Wildland Urban Interface

DEFINITIONS

100-Year Flood: The term “100-year flood” can be misleading. The 100-year flood does not necessarily occur once every 100 years. Rather, it is the flood that has a 1 percent chance of being equaled or exceeded in any given year. Thus, the 100-year flood could occur more than once in a relatively short period of time. The Federal Emergency Management Agency (FEMA) defines it as the 1 percent annual chance flood, which is now the standard definition used by most federal and state agencies and by the National Flood Insurance Program (NFIP).

Acre-Foot: An acre-foot is the amount of water it takes to cover 1 acre to a depth of 1 foot. This measure is used to describe the quantity of storage in a water reservoir. An acre-foot is a unit of volume. One acre foot equals 7,758 barrels; 325,829 gallons; or 43,560 cubic feet. An average household of four will use approximately 1 acre-foot of water per year.

Asset: An asset is any constructed or natural feature that has value, including, but not limited to, people; buildings; infrastructure, such as bridges, roads, sewers, and water systems; lifelines, such as electricity and communication resources; and environmental, cultural, or recreational features such as parks, wetlands, and landmarks.

Base Flood: The flood having a 1% chance of being equaled or exceeded in any given year, also known as the “100-year” or “1% chance” flood. The base flood is a statistical concept used to ensure that all properties subject to the National Flood Insurance Program (NFIP) are protected to the same degree against flooding.

Basin: A basin is the area within which all surface water—whether from rainfall, snowmelt, springs, or other sources—flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains, and ridges. Basins are also referred to as **watersheds** and **drainage basins**.

Benefit: A benefit is a net project outcome and is usually defined in monetary terms. Benefits may include direct and indirect effects. For the purposes of benefit-cost analysis of proposed mitigation measures, benefits are limited to specific, measurable, risk reduction factors, including reduction in expected property losses (buildings, contents, and functions) and protection of human life.

Benefit/Cost Analysis: A benefit/cost analysis is a systematic, quantitative method of comparing projected benefits to projected costs of a project or policy. It is used as a measure of cost effectiveness.

Building: A building is defined as a structure that is walled and roofed, principally aboveground, and permanently fixed to a site. The term includes manufactured homes on permanent foundations on which the wheels and axles carry no weight.

Capability Assessment: A capability assessment provides a description and analysis of a community’s current capacity to address threats associated with hazards. The assessment includes two components: an inventory of an agency’s mission, programs, and policies, and an analysis of its capacity to carry them out. A capability assessment is an integral part of the planning process in which a community’s actions to reduce losses are identified, reviewed, and analyzed, and the framework for implementation is identified. The following capabilities were reviewed under this assessment:

- Legal and regulatory capability
- Administrative and technical capability
- Fiscal capability

Community Rating System (CRS): The CRS is a voluntary program under the NFIP that rewards participating communities (provides incentives) for exceeding the minimum requirements of the NFIP and completing activities that reduce flood hazard risk by providing flood insurance premium discounts.

Critical Area: An area defined by state or local regulations as deserving special protection because of unique natural features or its value as habitat for a wide range of species of flora and fauna. A sensitive/critical area is usually subject to more restrictive development regulations.

Critical Facility: Facilities and infrastructure that are critical to the health and welfare of the population. These become especially important after any hazard event occurs. For the purposes of this plan, critical facilities include:

- Structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic and/or water reactive materials;
- Hospitals, nursing homes, and housing likely to contain occupants who may not be sufficiently mobile to avoid death or injury during a hazard event;
- Police stations, fire stations, vehicle and equipment storage facilities, and emergency operations centers that are needed for disaster response before, during, and after hazard events;
- Public and private utilities, facilities and infrastructure that are vital to maintaining or restoring normal services to areas damaged by hazard events; and
- Government facilities.

Cubic Feet per Second (cfs): Discharge or river flow is commonly measured in cfs. One cubic foot is about 7.5 gallons of liquid.

Dam: Any artificial barrier or controlling mechanism that can or does impound 10 acre-feet or more of water.

Dam Failure: Dam failure refers to a partial or complete breach in a dam (or levee) that impacts its integrity. Dam failures occur for a number of reasons, such as flash flooding, inadequate spillway size, mechanical failure of valves or other equipment, freezing and thawing cycles, earthquakes, and intentional destruction.

Debris Avalanche: Volcanoes are prone to debris and mountain rock avalanches that can approach speeds of 100 mph.

Debris Flow: Dense mixtures of water-saturated debris that move down-valley; looking and behaving much like flowing concrete. They form when loose masses of unconsolidated material are saturated, become unstable, and move down slope. The source of water varies but includes rainfall, melting snow or ice, and glacial outburst floods.

Debris Slide: Debris slides consist of unconsolidated rock or soil that has moved rapidly down slope. They occur on slopes greater than 65 percent.

Disaster Mitigation Act of 2000 (DMA); The DMA is Public Law 106-390 and is the latest federal legislation enacted to encourage and promote proactive, pre-disaster planning as a condition of receiving financial assistance under the Robert T. Stafford Act. The DMA emphasizes planning for disasters before they occur. Under the DMA, a pre-disaster hazard mitigation program and new requirements for the national post-disaster hazard mitigation grant program (HMGP) were established.

Drainage Basin: A basin is the area within which all surface water- whether from rainfall, snowmelt, springs or other sources- flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains and ridges. Drainage basins are also referred to as **watersheds** or **basins**.

Drought: Drought is a period of time without substantial rainfall or snowfall from one year to the next. Drought can also be defined as the cumulative impacts of several dry years or a deficiency of precipitation over an extended period of time, which in turn results in water shortages for some activity, group, or environmental function. A hydrological drought is caused by deficiencies in surface and subsurface water supplies. A socioeconomic drought impacts the health, well-being, and quality of life or starts to have an adverse impact on a region. Drought is a normal, recurrent feature of climate and occurs almost everywhere.

Earthquake: An earthquake is defined as a sudden slip on a fault, volcanic or magmatic activity, and sudden stress changes in the earth that result in ground shaking and radiated seismic energy. Earthquakes can last from a few seconds to over 5 minutes, and have been known to occur as a series of tremors over a period of several days. The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Casualties may result from falling objects and debris as shocks shake, damage, or demolish buildings and other structures.

Exposure: Exposure is defined as the number and dollar value of assets considered to be at risk during the occurrence of a specific hazard.

Extent: The extent is the size of an area affected by a hazard.

Fire Behavior: Fire behavior refers to the physical characteristics of a fire and is a function of the interaction between the fuel characteristics (such as type of vegetation and structures that could burn), topography, and weather. Variables that affect fire behavior include the rate of spread, intensity, fuel consumption, and fire type (such as underbrush versus crown fire).

Fire Frequency: Fire frequency is the broad measure of the rate of fire occurrence in a particular area. An estimate of the areas most likely to burn is based on past fire history or fire rotation in the area, fuel conditions, weather, ignition sources (such as human or lightning), fire suppression response, and other factors.

Flash Flood: A flash flood occurs with little or no warning when water levels rise at an extremely fast rate.

Flood Insurance Rate Map (FIRM): FIRMs are the official maps on which the Federal Emergency Management Agency (FEMA) has delineated the Special Flood Hazard Area (SFHA).

Flood Insurance Study: A report published by the Federal Insurance and Mitigation Administration for a community in conjunction with the community's Flood Insurance rate Map. The study contains such background data as the base flood discharges and water surface elevations that were used to prepare the FIRM. In most cases, a community FIRM with detailed mapping will have a corresponding flood insurance study.

Floodplain: Any land area susceptible to being inundated by flood waters from any source. A flood insurance rate map identifies most, but not necessarily all, of a community's floodplain as the Special Flood Hazard Area (SFHA).

Floodway: Floodways are areas within a floodplain that are reserved for the purpose of conveying flood discharge without increasing the base flood elevation more than 1 foot. Generally speaking, no development is allowed in floodways, as any structures located there would block the flow of floodwaters.

Floodway Fringe: Floodway fringe areas are located in the floodplain but outside of the floodway. Some development is generally allowed in these areas, with a variety of restrictions. On maps that have identified and delineated a floodway, this would be the area beyond the floodway boundary that can be subject to different regulations.

Fog: Fog refers to a cloud (or condensed water droplets) near the ground. Fog forms when air close to the ground can no longer hold all the moisture it contains. Fog occurs either when air is cooled to its dew point or the amount of moisture in the air increases. Heavy fog is particularly hazardous because it can restrict surface visibility. Severe fog incidents can close roads, cause vehicle accidents, cause airport delays, and impair the effectiveness of emergency response. Financial losses associated with transportation delays caused by fog have not been calculated in the United States but are known to be substantial.

Freeboard: Freeboard is the margin of safety added to the base flood elevation.

Frequency: For the purposes of this plan, frequency refers to how often a hazard of specific magnitude, duration, and/or extent is expected to occur on average. Statistically, a hazard with a 100-year frequency is expected to occur about once every 100 years on average and has a 1 percent chance of occurring any given year. Frequency reliability varies depending on the type of hazard considered.

Fujita Scale of Tornado Intensity: Tornado wind speeds are sometimes estimated on the basis of wind speed and damage sustained using the Fujita Scale. The scale rates the intensity or severity of tornado events using numeric values from F0 to F5 based on tornado wind speed and damage. An F0 tornado (wind speed less than 73 miles per hour (mph)) indicates minimal damage (such as broken tree limbs), and an F5 tornado (wind speeds of 261 to 318 mph) indicates severe damage.

Goal: A goal is a general guideline that explains what is to be achieved. Goals are usually broad-based, long-term, policy-type statements and represent global visions. Goals help define the benefits that a plan is trying to achieve. The success of a hazard mitigation plan is measured by the degree to which its goals have been met (that is, by the actual benefits in terms of actual hazard mitigation).

Geographic Information System (GIS): GIS is a computer software application that relates data regarding physical and other features on the earth to a database for mapping and analysis.

Hazard: A hazard is a source of potential danger or adverse condition that could harm people and/or cause property damage.

Hazard Mitigation Grant Program (HMGP): Authorized under Section 202 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, the HMGP is administered by FEMA and provides grants to states, tribes, and local governments to implement hazard mitigation actions after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to disasters and to enable mitigation activities to be implemented as a community recovers from a disaster

Hazards U.S. Multi-Hazard (Hazus-MH) Loss Estimation Program: Hazus-MH is a GIS-based program used to support the development of risk assessments as required under the DMA. The Hazus-MH software program assesses risk in a quantitative manner to estimate damages and losses associated with natural hazards. Hazus-MH is FEMA’s nationally applicable, standardized methodology and software program and contains modules for estimating potential losses from earthquakes, floods, and wind hazards. Hazus-MH has also been used to assess vulnerability (exposure) for other hazards.

Hydraulics: Hydraulics is the branch of science or engineering that addresses fluids (especially water) in motion in rivers or canals, works and machinery for conducting or raising water, the use of water as a prime mover, and other fluid-related areas.

Hydrology: Hydrology is the analysis of waters of the earth. For example, a flood discharge estimate is developed by conducting a hydrologic study.

Intensity: For the purposes of this plan, intensity refers to the measure of the effects of a hazard.

Inventory: The assets identified in a study region comprise an inventory. Inventories include assets that could be lost when a disaster occurs and community resources are at risk. Assets include people, buildings, transportation, and other valued community resources.

Landslide: Landslides can be described as the sliding movement of masses of loosened rock and soil down a hillside or slope. Fundamentally, slope failures occur when the strength of the soils forming the slope exceeds the pressure, such as weight or saturation, acting upon them.

Lightning: Lightning is an electrical discharge resulting from the buildup of positive and negative charges within a thunderstorm. When the buildup becomes strong enough, lightning appears as a "bolt," usually within or between clouds and the ground. A bolt of lightning instantaneously reaches temperatures approaching 50,000ºF. The rapid heating and cooling of air near lightning causes thunder. Lightning is a major threat during thunderstorms. In the United States, 75 to 100 Americans are struck and killed by lightning each year (see http://www.fema.gov/hazard/thunderstorms/thunder.shtm).

Liquefaction: Liquefaction is the complete failure of soils, occurring when soils lose shear strength and flow horizontally. It is most likely to occur in fine grain sands and silts, which behave like viscous fluids when liquefaction occurs. This situation is extremely hazardous to development on the soils that liquefy, and generally results in extreme property damage and threats to life and safety.

Local Government: Any county, municipality, city, town, township, public authority, school district, special district, intrastate district, council of governments (regardless of whether the council of governments is incorporated as a nonprofit corporation under State law), regional or interstate government entity, or agency or instrumentality of a local government; any Indian tribe or authorized tribal organization, or Alaska Native village or organization; and any rural community, unincorporated town or village, or other public entity.

Magnitude: Magnitude is the measure of the strength of an earthquake, and is typically measured by the Richter scale. As an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value.

Mass movement: A collective term for landslides, mudflows, debris flows, sinkholes and lahars.

Mitigation: A preventive action that can be taken in advance of an event that will reduce or eliminate the risk to life or property.

Mitigation Actions: Mitigation actions are specific actions to achieve goals and objectives that minimize the effects from a disaster and reduce the loss of life and property.

Objective: For the purposes of this plan, an objective is defined as a short-term aim that, when combined with other objectives, forms a strategy or course of action to meet a goal. Unlike goals, objectives are specific and measurable.

Peak Ground Acceleration: Peak Ground Acceleration (PGA) is a measure of the highest amplitude of ground shaking that accompanies an earthquake, based on a percentage of the force of gravity.

Preparedness: Preparedness refers to actions that strengthen the capability of government, citizens, and communities to respond to disasters.

Presidential Disaster Declaration: These declarations are typically made for events that cause more damage than state and local governments and resources can handle without federal government assistance. Generally, no specific dollar loss threshold has been established for such declarations. A Presidential Disaster Declaration puts into motion long-term federal recovery programs, some of which are matched by state programs, designed to help disaster victims, businesses, and public entities.

Probability of Occurrence: The probability of occurrence is a statistical measure or estimate of the likelihood that a hazard will occur. This probability is generally based on past hazard events in the area and a forecast of events that could occur in the future. A probability factor based on yearly values of occurrence is used to estimate probability of occurrence.

Repetitive Loss Property: Any NFIP-insured property that, since 1978 and regardless of any changes of ownership during that period, has experienced:

- Four or more paid flood losses in excess of $1000.00; or
- Two paid flood losses in excess of $1000.00 within any 10-year period since 1978 or
- Three or more paid losses that equal or exceed the current value of the insured property.

Return Period (or Mean Return Period): This term refers to the average period of time in years between occurrences of a particular hazard (equal to the inverse of the annual frequency of occurrence).

Riverine: Of or produced by a river. Riverine floodplains have readily identifiable channels. Floodway maps can only be prepared for riverine floodplains.

Risk: Risk is the estimated impact that a hazard would have on people, services, facilities, and structures in a community. Risk measures the likelihood of a hazard occurring and resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate, or low likelihood of sustaining damage above a particular threshold due to occurrence of a specific type of hazard. Risk also can be expressed in terms of potential monetary losses associated with the intensity of the hazard.

Risk Assessment: Risk assessment is the process of measuring potential loss of life, personal injury, economic injury, and property damage resulting from hazards. This process assesses the vulnerability of people, buildings, and infrastructure to hazards and focuses on (1) hazard identification; (2) impacts of hazards on physical, social, and economic assets; (3) vulnerability identification; and (4) estimates of the cost of damage or costs that could be avoided through mitigation.

Risk Ranking: This ranking serves two purposes: first to describe the probability that a hazard will occur, and, second to describe the impact a hazard will have on people, property, and the economy. Risk estimates are based on the methodology used to prepare the risk assessment for this plan. The following equation shows the risk ranking calculation:

Risk Ranking = Probability + Impact (people + property + economy)

Robert T. Stafford Act: The Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 100-107, was signed into law on November 23, 1988. This law amended the Disaster Relief Act of 1974, Public Law 93-288. The Stafford Act is the statutory authority for most federal disaster response activities, especially as they pertain to FEMA and its programs.

Sinkhole: A collapse depression in the ground with no visible outlet. Its drainage is subterranean. It is commonly vertical-sided or funnel-shaped.

Special Flood Hazard Area: The base floodplain delineated on a Flood Insurance Rate Map. The SFHA is mapped as a Zone A in riverine situations and zone V in coastal situations. The SFHA may or may not encompass all of a community's flood problems

Stakeholder: Business leaders, civic groups, academia, non-profit organizations, major employers, managers of critical facilities, farmers, developers, special purpose districts, and others whose actions could impact hazard mitigation.

Stream Bank Erosion: Stream bank erosion is common along rivers, streams and drains where banks have been eroded, sloughed or undercut. However, it is important to remember that a stream is a dynamic and constantly changing system. It is natural for a stream to want to meander, so not all eroding banks are "bad" and in need of repair. Generally, stream bank erosion becomes a problem where development has limited the meandering nature of streams, where streams have been channelized, or where stream bank structures (like bridges, culverts, etc.) are located in places where they can actually cause damage to downstream areas. Stabilizing these areas can help protect watercourses from continued sedimentation, damage to adjacent land uses, control unwanted meander, and improvement of habitat for fish and wildlife.

Steep Slope: Different communities and agencies define it differently, depending on what it is being applied to, but generally a steep slope is a slope in which the percent slope equals or exceeds 25%. For this study, steep slope is defined as slopes greater than 33%.

Sustainable Hazard Mitigation: This concept includes the sound management of natural resources, local economic and social resiliency, and the recognition that hazards and mitigation must be understood in the largest possible social and economic context.

Thunderstorm: A thunderstorm is a storm with lightning and thunder produced by cumulonimbus clouds. Thunderstorms usually produce gusty winds, heavy rains, and sometimes hail. Thunderstorms are usually short in duration (seldom more than 2 hours). Heavy rains associated with thunderstorms can lead to flash flooding during the wet or dry seasons.

Tornado: A tornado is a violently rotating column of air extending between and in contact with a cloud and the surface of the earth. Tornadoes are often (but not always) visible as funnel clouds. On a local scale, tornadoes are the most intense of all atmospheric circulations, and winds can reach destructive speeds of more than 300 mph. A tornado's vortex is typically a few hundred meters in diameter, and damage paths can be up to 1 mile wide and 50 miles long.

Vulnerability: Vulnerability describes how exposed or susceptible an asset is to damage. Vulnerability depends on an asset's construction, contents, and the economic value of its functions. Like indirect damages, the vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power. Flooding of an electric substation would affect not only the substation itself but businesses as well. Often, indirect effects can be much more widespread and damaging than direct effects.

Watershed: A watershed is an area that drains down gradient from areas of higher land to areas of lower land to the lowest point, a common drainage basin.

Wildfire: These terms refer to any uncontrolled fire occurring on undeveloped land that requires fire suppression. The potential for wildfire is influenced by three factors: the presence of fuel, topography, and air mass. Fuel can include living and dead vegetation on the ground, along the surface as brush and small trees, and in the air such as tree canopies. Topography includes both slope and elevation. Air mass includes temperature, relative humidity, wind speed and direction, cloud cover, precipitation amount, duration, and the stability of the atmosphere at the time of the fire. Wildfires can be ignited by lightning and, most frequently, by human activity including smoking, campfires, equipment use, and arson.

Windstorm: Windstorms are generally short-duration events involving straight-line winds or gusts exceeding 50 mph. These gusts can produce winds of sufficient strength to cause property damage. Windstorms are especially dangerous in areas with significant tree stands, exposed property, poorly constructed buildings, mobile homes (manufactured housing units), major infrastructure, and aboveground utility lines. A windstorm can topple trees and power lines; cause damage to residential, commercial, critical facilities; and leave tons of debris in its wake.

Zoning Ordinance: The zoning ordinance designates allowable land use and intensities for a local jurisdiction. Zoning ordinances consist of two components: a zoning text and a zoning map.

Pend Oreille County
Multi-Jurisdiction Hazard Mitigation Plan 2018 Update

APPENDIX B
PUBLIC OUTREACH MATERIALS AND RESULTS

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PUBLIC OUTREACH MATERIALS AND RESULTS

Public Outreach Materials saved as a separate PDF document due to size and is identified separately on County’s webpage.

Pend Oreille County
Multi-Jurisdiction Hazard Mitigation Plan 2018 Update

APPENDIX C
PLAN ADOPTION RESOLUTIONS FROM PLANNING PARTNERS

APPENDIX C
PLAN ADOPTION RESOLUTIONS FROM PLANNING PARTNERS

Saved separately in folder for ease in updating and maintenance.

Pend Oreille County
Multi-Jurisdiction Hazard Mitigation Plan 2018 Update

APPENDIX D
EXAMPLE TEMPLATE FOR FUTURE PROGRESS REPORTS

APPENDIX D
EXAMPLE TEMPLATE FOR FUTURE PROGRESS REPORTS

Pend Oreille County
Hazard Mitigation Plan
Annual Progress Report

Reporting Period: (Insert reporting period)

Background: Pend Oreille County and participating towns, city, and special purpose districts in the county developed a hazard mitigation plan to reduce risk from all hazards by identifying resources, information, and strategies for risk reduction. The federal Disaster Mitigation Act requires state and local governments to develop hazard mitigation plans as a condition for federal disaster grant assistance. To prepare the plan, the participating partners organized resources, assessed risks from natural hazards within the county, developed planning goals and objectives, reviewed mitigation alternatives, and developed an action plan to address probable impacts from natural hazards. By completing this process, these jurisdictions maintained compliance with the Disaster Mitigation Act, achieving eligibility for mitigation grant funding opportunities afforded under the Robert T. Stafford Act. The plan can be viewed on-line at:

Insert web address

Summary Overview of the Plan's Progress: The performance period for the hazard mitigation plan became effective on ____, 2018, with the final approval of the plan by FEMA. The initial performance period for this plan will be 5 years, with an anticipated update to the plan to occur before ______, 2022. As of this reporting period, the performance period for this plan is considered to be __ percent complete. The hazard mitigation plan has targeted __ hazard mitigation initiatives to be pursued during the 5-year performance period. As of the reporting period, the following overall progress can be reported:

- __ out of __ initiatives (__%) reported ongoing action toward completion.
- __ out of __ initiatives (__%) were reported as being complete.
- __ out of __ initiatives (___%) reported no action taken.

Purpose: The purpose of this report is to provide an annual update on the implementation of the action plan identified in the Pend Oreille County Hazard Mitigation Plan. The objective is to ensure that there is a continuing and responsive planning process that will keep the hazard mitigation plan dynamic and responsive to the needs and capabilities of the partner jurisdictions. This report discusses the following:

- Natural hazard events that have occurred within the last year
- Changes in risk exposure within the planning area (all of Pend Oreille County)
- Mitigation success stories
- Review of the action plan
- Changes in capabilities that could impact plan implementation
- Recommendations for changes/enhancement.

The Hazard Mitigation Plan Planning Team: The Hazard Mitigation Plan Planning Team, made up of planning partners and stakeholders within the planning area, reviewed and approved this progress report at its annual meeting held on _____, 201_. It was determined through the plan's development process that a Planning Team would remain in service to oversee maintenance of the plan. At a minimum, the Planning Team will provide technical review and oversight on the development of the annual progress report. It is anticipated that there will be turnover in the membership annually, which will be documented in the progress reports. For this reporting period, the Planning Team membership is as indicated in Table 1.

TABLE 1
PLANNING TEAM MEMBERS

Name	Title	Jurisdiction/Agency

Natural Hazard Events within the Planning Area: During the reporting period, there were __ natural hazard events in the planning area that had a measurable impact on people or property. A summary of these events is as follows:

- ____________________________
- ____________________________

Changes in Risk Exposure in the Planning Area: *(Insert brief overview of any natural hazard event in the planning area that changed the probability of occurrence or ranking of risk for the hazards addressed in the hazard mitigation plan)*
Mitigation Success Stories: *(Insert brief overview of mitigation accomplishments during the reporting period)*

Review of the Action Plan: Table 2 reviews the action plan, reporting the status of each initiative. Reviewers of this report should refer to the hazard mitigation plan for more detailed descriptions of each initiative and the prioritization process.

Address the following in the "status" column of the following table:

- *Was any element of the initiative carried out during the reporting period?*
- *If no action was completed, why?*
- *Is the timeline for implementation for the initiative still appropriate?*
- *If the initiative was completed, does it need to be changed or removed from the action plan?*

TABLE 2
ACTION PLAN MATRIX

Action Taken? (Yes or No)	Time Line	Priority	Status	Status (X, O,✓)
Initiative #__—_______________________[description]				
Initiative #__—_______________________[description]				
Initiative #__—_______________________[description]				
Initiative #__—_______________________[description]				
Initiative #__—_______________________[description]				
Initiative #__—_______________________[description]				
Initiative #__—_______________________[description]				
Initiative #__—_______________________[description]				
Initiative #__—_______________________[description]				
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Initiative #__—_______________________[description]				
Initiative #__—_______________________[description]				
Initiative #__—_______________________[description]				
Initiative #__—_______________________[description]				

TABLE 2 ACTION PLAN MATRIX				
Action Taken? (Yes or No)	Time Line	Priority	Status	Status (X, O,✓)
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				

Completion status legend:
✓= Project Completed
O = Action ongoing toward completion
X = No progress at this time

Changes That May Impact Implementation of the Plan: *(Insert brief overview of any significant changes in the planning area that would have a profound impact on the implementation of the plan. Specify any changes in technical, regulatory and financial capabilities identified during the plan's development)*

Recommendations for Changes or Enhancements: Based on the review of this report by the Hazard Mitigation Plan Planning Team, the following recommendations will be noted for future updates or revisions to the plan:

- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________

Public review notice: The contents of this report are considered to be public knowledge and have been prepared for total public disclosure. Copies of the report have been provided to the governing boards of all planning partners and to local media outlets and the report is posted on the Pend Oreille County hazard mitigation plan website. Any questions or comments regarding the contents of this report should be directed to:

INSERT NAME AND ADDRESS