Cowlitz County
Hazard Mitigation Plan Update

July, 2013

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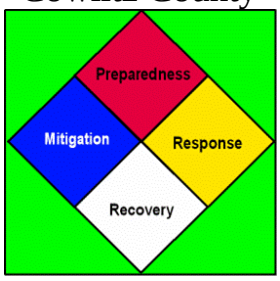
Cowlitz County



Department of
Emergency Management

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Table of Contents

Chapter 1: Introduction

Natural Hazards Will Persist, but Disasters Can Be avoided

The Hazard Mitigation Plan for Cowlitz County is a multi-jurisdictional plan that addresses the most destructive natural hazards that threaten Cowlitz County and its communities.

The primary function of this plan is to explain the risks posed by natural hazards and to identify actions that can create more disaster resilient communities in Cowlitz County.

Cowlitz County frequently endures natural hazard events such as earthquakes, landslides, winter storms, and floods, and also sometimes experiences severe volcanic eruptions. When natural hazard events take place in undeveloped and unpopulated areas, no disaster occurs. Natural disasters occur when people, property and infrastructure are vulnerable or directly exposed to the destructive effects of natural hazards. Natural disasters can grow larger over time as more people and property locate in areas that are predisposed to the effects of natural hazards.

Since 1962, Cowlitz County has received 23 Federal Disaster Declarations; every one of them attributed to natural hazards that are inherent to the Pacific Northwest.

Hazards in the Pacific Northwest

Cowlitz County is located in the southwest portion of Washington State. It is in a region known as the Lower Columbia, meaning that the Columbia River forms the western border in the south of the county and the southern border in the middle of the county. The county is mountainous with the Cascades on the eastern flank of the county and coastal mountains throughout the county. This terrain provides vast recreational opportunities, but comes with a price. Cowlitz County is located in a region that is disposed to recurrent natural hazards.

Washington State is one of the most geologically active regions of North America. The state sits directly above the Cascadia Subduction Zone, a major boundary of colliding tectonic plates and source of earthquake activity. There are multiple major fault lines throughout the state. The region has experienced major earthquakes in 1949, 1965, and 2001. The 1949 earthquake killed the Castle Rock senior class president as a brick fell from the school building.

There are five active volcanoes in Washington State. The May 18, 1980 eruption of Mount St. Helens killed 57 people, destroyed hundreds of miles of roadway, blanketed several eastern Washington communities with ash, and destroyed tens of thousands of acres of prime forest. Today, it is still necessary to dredge deposits in the Cowlitz River that are a result of the eruption.

The state's pronounced mountainous terrain and its immediacy to the vast Pacific Ocean strongly influences the dynamics of the region's weather and hydraulic cycle. The Pacific Northwest frequently experiences intense seasonal precipitation events that result in major lowland flooding, mudslides and landslides in heavily developed and populated areas. In addition, high speed windstorms frequently hit Washington resulting in region- wide power outages, structural damage and tons of debris.

Table 1
Federal Declarations for Cowlitz County 1956-2009

Maj/DR	Presidential Major Disaster Declaration (all eligible assistance programs)
Emerg/EM	Presidential Emergency Declaration (assistance limited to specific emergency need)
FS	Federal Fire Suppression (assistance limited to state agency fire suppression costs)
FM	Federal Fire Management (replaced Fire Suppression - for state & local governments)

DATE	INCIDENT	OTHER COUNTIES/RECIPIENTS
October 1962	Maj. #137 - Columbus Day Wind Storm	Clark, Grays Harbor, Jefferson, Kitsap, Lewis, Mason, Pacific, Pierce, Skagit, Snohomish, Thurston, Wahkiakum, Whatcom
December 1964	Maj. #185 - Heavy rains/flooding	Asotin, Benton, Clark, Columbia, Garfield, Grays Harbor, King, Kittitas, Klickitat, Lewis, Mason, Pacific, Pierce, Skamania, Snohomish, Wahkiakum, Walla Walla, Whitman, Yakima
January 1972	Maj. #322 - Severe storms/flooding	Asotin, Grays Harbor, Lewis, Pacific, Skamania, Thurston, Wahkiakum, Whitman
December 1975	Maj. #492 - Severe storms/flooding	Benton, Grays Harbor, King, Kittitas, Lewis, Mason, Pierce, Skagit, Snohomish, Thurston, Whatcom, Yakima
December 1977	Maj. #545 - Severe storms/ mudslides/flooding	Benton, Clark, Garfield, Grays Harbor, King, Kittitas, Klickitat, Lewis, Pacific, Pierce, Snohomish, Thurston, Wahkiakum, Whitman, Yakima
May 1980	Maj. #623 - Mount St. Helen's eruption	All 39 counties
August 1982	Emerg. #3086 - Threat of Spirit Lake flooding	Skamania, US Army Corp of Engineers, National Weather Service, USGS
February 1986	Maj. #762 - Heavy rain/slides/ flooding	
November 1986	Maj. #784 - Severe storms/flooding	King, Lewis, Pacific, Snohomish, Wahkiakum
November 1995	Major #1079 - Flooding and Wind (Nov – Dec 95) Declared January 3, 1996	Chelan, Clallam, Clark, Grays Harbor, Island, Jefferson, King, Kittitas, Lewis, Mason, Pacific, Pierce, Skagit, Snohomish, Thurston, Wahkiakum, Whatcom, Yakima
February 1996	Major #1100 – Flooding Declared February 9, 1996	Adams, Asotin, Benton, Clark, Columbia, Garfield, Grays Harbor, King, Kitsap, Kittitas, Klickitat, Lewis, Lincoln, Pierce, Skagit, Skamania, Snohomish, Spokane, Thurston, Wahkiakum, Walla Walla, Whitman, Yakima, and Yakima Indian Reservation
December 1996	Major #1159 Winter Storm (Ice, snow, flooding) Declared January 17, 1997	Adams, Asotin, Benton, Chelan, Clallam, Clark, Columbia, Douglas, Ferry, Franklin, Garfield, Grant, Grays Harbor, Island, Jefferson, King, Kitsap, Kittitas, Klickitat, Lewis, Lincoln, Mason, Okanogan, Pacific, Pend Oreille, Pierce, San Juan, Skagit, Skamania, Snohomish, Spokane, Stevens, Thurston, Walla Walla, Whatcom, Yakima
August 1998	FS 2237 - Ballpark Fire	
October 1998	Major 1255 - Landslide Slide occurred Mar-Nov,1998	
February 2001	Major DR-1361 – Nisqually Earthquake Declared March 1, 2001	Benton, Chelan, Clallam, Clark, Douglas, Grays Harbor, Island, Jefferson, King, Kitsap, Kittitas, Lewis, Mason, Pacific, Pierce, Skagit, Skamania, Snohomish, Thurston, Wahkiakum, Walla Walla, Whatcom, Yakima
September 2005	EM-3227 Hurricane Katrina evacuees	All counties

Table 1 (continued) Federal Declarations for Cowlitz County 1956-2009		
Dec 2006	Major DR-1671 Severe storms /floods/ landslides/mudslides Nov 2-11, 2006	Chelan, Clark, Grays Harbor, Jefferson, King, Lewis, Pacific, Pierce, Skagit, Skamania, Snohomish, Thurston, Wahkiakum
Jan 2009	Major DR-1817 Severe winter storm, landslides, mudslides, and flooding Jan 6-16, 2009	IA: Benton, Clallam, Grays Harbor King, Kittitas, Lewis, Mason, Pacific, Pierce, Skagit Snohomish, Thurston, Wahkiakum, Whatcom PA: Chelan, Clallam, Columbia, Cowlitz, Garfield, Grays Harbor, Jefferson, King, Kittitas, Klickitat, Lewis, Lincoln, Mason, Pacific, Pierce, Skagit, Skamania, Snohomish, Thurston, Wahkiakum, Whatcom, Yakima
Mar 2009	Major DR-1825 Severe winter storm, record and near-record snow Dec 12, 2008 – Jan 5, 2009	33 Counties – PA Only Severe Winter Storm/Snow Clallam, Columbia, Grays Harbor, Jefferson, King, Klickitat, Lewis, Mason, Pacific, Skagit, Skamania, Snohomish, Spokane, Thurston, Wahkiakum, Walla Walla, Whatcom

Table 2 Summary of Federal Declarations for Cowlitz County 1956-2009 by Type		
Major Disaster Declarations:	16	11 Floods, 1 Windstorm, 1 Earthquake, 1 Volcano, 1 Wildfire, 5 Landslides, 8 Severe Storms
Emergency Declarations:	2	1 Threat of Spirit Lake Flooding, 1 Hurricane Evacuees
Fire Suppression Declarations:	1	Ballpark Fire

Information about the hazards that threaten Cowlitz County is located in Chapter 4: Risk Assessment.

The Challenge of Building Safe Communities

Population Growth

As the region's communities grow, local governments are challenged with managing growth and providing public services in a safe and efficient fashion. Local government's response to, and recovery from, natural disasters pulls valuable resources and personnel away from the normal business of governance. Population growth can have a negative effect on government resources if growth takes place in areas vulnerable to hazards like liquefaction, flooding or landslides. Natural hazards mitigation planning provides a process for local governments to consider future populations and consider actions to reduce peoples' exposure to the effects of natural hazards.

Aging and Vulnerable Infrastructure

How can local governments mitigate vulnerable properties in high risk hazards zones?

Acquisition and demolition: Under this approach, the community purchases the flood-damaged property and demolishes the structure. The property owner uses the proceeds of the sale to purchase replacement housing on the open market. The local government assumes title to the acquired property and maintains the land as open space in perpetuity.

Relocation: In some cases, it may be viable to physically move a structure to a new location. Relocated structures must be placed on a site located outside the 100-year floodplain, outside any regulatory erosion zone and in conformance with any other applicable state or local land use regulations.

Information Gaps

Cowlitz County communities continue to invest in studies that increase their understanding of natural hazards. More research, data, and forecasting tools are needed at the local level to more accurately map local hazard zones, further protect the public's health and protect the environment. Modern computer models, aerial photos and satellite imaging technology have enabled significant advances in mapping geologic and hydrologic hazard zones. But the availability of local data, though improving, remains limited and expensive.

Mitigation through Regulation

Municipalities can ensure that new construction will be able to withstand the destructive forces of earthquakes, wind storms and other hazards by maintaining and enforcing the most current building codes. An effective approach to mitigating natural disasters is preventing new development from occurring in hazard prone areas. Local land use authority, the Shoreline Management Act, and critical areas ordinances provide local communities essential regulatory mechanisms to restrict new development in areas that have a high risk associated with a natural hazard.

More information about Washington State's and local governments' hazard mitigation capabilities is in Appendix C.

The Disaster Declaration Process

Local and State governments share the responsibility for protecting their citizens from disasters, and for helping them to

recover when disasters strikes. Local government's capacity to respond to natural disasters is often overwhelmed when a significant portion of the population or infrastructure is impacted by a natural disaster. When a state's capacity to respond to disasters is exceeded, the Governor can request federal assistance. The Stafford Disaster Relief and Emergency Assistance Act (401) requires that "All requests for a declaration by the President that a major disaster exists shall be made by the Governor of the affected State." The Governor's request is made through the regional Federal Emergency Management Agency (FEMA) office. If the President declares that a major disaster or emergency exists, an array of federal programs to assist in the response and recovery effort is activated. There are three categories of assistance:

- Individual Assistance – aid to individuals and households;
- Public Assistance – aid to public (and certain private non-profit) entities for certain emergency services and the repair or replacement of disaster damaged public facilities; and
- Hazard Mitigation Assistance – funding for measures designed to reduce future losses to public and private property.

Hazard Mitigation

Of the four stages of disaster response – mitigation, preparedness, response, and recovery – mitigation is the only action that serves to directly eliminate losses from the effects of natural hazards. The other stages all occur in reaction to or anticipation of impacts from disaster events. Hazard mitigation planning identifies and prioritizes sustained measures that if enacted, will reduce or eliminate long-term risk to people and property from natural hazards and their effects. In the long term, mitigation measures will likely reduce personal loss, save lives, and reduce the cost to local, state, and federal governments for responding to, and recovering from, recurrent or unusual natural hazard events.

FEMA identifies six broad categories of action that constitute natural hazards mitigation:

1. **Prevention** – Government administrative or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses. Examples include planning and zoning, building codes, capital improvement programs, open space preservation and storm water management regulations.
2. **Property Protection** – Actions that involve the modification of existing buildings or structures to protect them from a hazard or removal from the hazard area. Examples include acquisition, elevation, relocation, structural retrofits, storm shutters and shatter-resistant glass.
3. **Public Education and Awareness** – Actions to inform and educate citizens, elected officials and property owners about the hazards and potential ways to mitigate them. Such actions include outreach projects, real estate disclosure, hazard information centers, and school-age and adult education programs.
4. **Natural Resource Protection** – Actions that, in addition to minimizing hazard losses, preserve

or restore the functions of natural systems. These actions include sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.

5. **Emergency Services** – Actions that protect people and property during and immediately after a disaster or hazard event. Services include warning systems, emergency response services and protection of critical facilities.
6. **Structural Projects** – Actions that involve the construction of structures to reduce the impact of a hazard. Such activities include dams, levees, floodwalls, seawalls, retaining walls and safe rooms.

The Disaster Mitigation Act of 2000

In an effort to manage risk, contain costs, and promote sustainable communities, the federal government outlined new hazard mitigation planning requirements for states, tribes, and local governments in the Disaster Mitigation Act of 2000. Local governments must adopt a federally approved hazard mitigation plan to apply for or to receive federal mitigation assistance program grants.

Hazard mitigation plans must demonstrate that a community's proposed mitigation measures are based on a sound planning process that accounts for the risks to and capabilities of the individual jurisdiction. The Code of Federal Regulations (CFR), Title 44, Part 201.6 addresses local government mitigation plans. Part 201.7 addresses tribal mitigation plans.

FEMA published "Local Multi-Hazard Mitigation Planning Guidance" on July 1, 2008. This guidance provides interpretation and explanations for the local mitigation plan regulations. The individual regulatory requirements are located throughout this plan. For example, Chapter 4: Risk Assessment lists the federal local mitigation planning requirements found in Section 201.6(c)(2) that pertain to the identification of hazards and the development of a risk assessment.

Federal Hazard Mitigation Assistance

Local governments simply lack sufficient personnel and the funds necessary to respond to, and to recover from, recurrent natural disasters, mitigate hazard prone private properties and reinforce or replace all aging public infrastructure. The Stafford Act can provide local governments some disaster proofing assistance through hazard mitigation funds. Pre-Disaster Mitigation grants are offered on an annual basis and Hazard Mitigation Grant Program funds are available to states only after a federal disaster has been declared.

Local governments with an adopted and federally approved hazard mitigation plan are eligible to apply for mitigation funds through the state. In Washington State, the Emergency Management Division is responsible for fulfilling the state's role as grantee. It is responsible for notifying potential applicants of the availability of funding, defining the project selection process, ranking and prioritizing projects, and forwarding the projects to FEMA for funding. The applicant or sub-grantee carries out approved projects. The federal government will provide up to 75 percent of the cost of a mitigation project with both programs, with some restrictions. The remaining 25 percent must be matched by the local government or in some instances,

the state. Other federal revenue sources cannot be used as match.

More information about federal mitigation assistance programs can be found in Appendix D and on the Washington State Emergency Management Division's website:

http://www.emd.wa.gov/grants/grants_hazard_mitigation.shtml

Hazard Mitigation Planning in Cowlitz County

In 2004, 27 communities and local governments in Cowlitz County convened to collaborate on the development of the region's first Hazard Mitigation Plan for Cowlitz County. All 27 entities adopted the plan by February 2005. Two of the political subdivisions in the County began the process, but were unable to meet the deadlines for completing the plan. One entity opted to withdraw their participation in the plan development.

Since the plan's approval, two additional jurisdictions adopted local plans under the framework of the region's multi-jurisdictional plan. Title 44 Code of Federal Regulations (CFR) §201.6(d)(3) requires that local mitigation plans be updated and reapproved every five years in order for local governments to maintain eligibility for federal mitigation assistance program funds. For local plans that were adopted after the regional plan was approved, their plans also expire at the same time the multi-jurisdictional plan expires.

Each local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts and changes in priorities.

This plan is the culmination of the update process for planning partners that have an adopted hazard mitigation plan. It also serves as a first local hazard mitigation plan for several new planning partners within the region.

The planning period for the development of the previous Cowlitz County Hazard Mitigation Plan began in 2004. The end date of the initial plan development process corresponds to the end date for the Hazard Mitigation Planning grant which provided funding to support this project. Implementation of the plan will occur after the Washington State Emergency Management Division (EMD) and the Federal Emergency Management Agency (FEMA) review the plan and provide Cowlitz County with a "pre-adoption approval".

Plan Structure

The plan in its entirety meets Federal Disaster Mitigation Act hazard mitigation planning requirements for both the multi-jurisdictional planning element requirements and each individual participating jurisdiction's planning element requirements. The core plan is divided into six chapters plus appendices. A plan annex was also prepared by each participating jurisdiction. The contents of the plan are structured as follows:

Table 3 Hazard Mitigation Plan Contents		
	Chapters	**Contents**
Multi-Jurisdiction Core Plan	1. Introduction	An overview of the Disaster Mitigation Act, the role of hazard mitigation planning, and federal mitigation assistance grant programs.
	2. Plan Process and Development	A description of the planning process and documentation of the plan's development.
	3. Cowlitz County	A narrative and tabular summary of Cowlitz County's environment, demographics, development trends, and community services.
	4. Risk Assessment	A comprehensive risk assessment of the natural hazards that threaten Cowlitz County and its communities. It is divided into six hazard profiles. This chapter also includes a discussion on climate change projections.
	5. Mitigation Goals and Initiatives	Mitigation goals and objectives, and county-wide descriptions of planned actions and projects to reduce or prevent impacts from natural disasters.
	6. Adoption, Implementation, Monitoring, and Maintenance	A description of how the plan will be monitored, implemented, and maintained.
	7. Appendices	Supporting documentation and reference material.
Local Plan	Annex	The annex is an addition to the plan that contains information that is specific to the local entity.

Chapter 2: Plan Process and Development

Introduction

This chapter describes how the plan was prepared, who was involved in the process, and how the public was involved. The first *Cowlitz County Hazard Mitigation Plan* established multi-jurisdictional hazards mitigation planning for the region's communities. The previous planning process and the people who participated in the development of the first plan were successful with their endeavor. This plan's update followed the path of the first edition, but made substantial changes to document current hazard knowledge to comply with current federal planning requirements. Therefore, this chapter documents and explains any differences between the original plan and this plan update. In order to maintain continuity between the past and present planning processes, the documentation for the first plan's development process (Chapter II) is included in Appendix A. Each participating jurisdiction also documented their jurisdiction's planning process. The jurisdiction-specific planning process documentation is located in each jurisdiction's annex to this plan.

Federal Requirements

Requirements §201.6(b) and §201.6(c)(1):

An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process **shall** include:

(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;
(2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and
(3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

[The plan **shall** document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

Note: In general, the federal planning requirements with the words "**shall**" and "**must**" indicate that the item is mandatory and must be included in the plan, otherwise it will not be approved by FEMA. Regulations with the word "**should**" indicate that the item is strongly recommended to be included in the plan, but its absence will not cause FEMA to disapprove the plan.

All jurisdictions with adopted plans are required by 44 CFR Section 201.6(d)(3) to review and revise their plans and resubmit them for approval within five years in order to continue to be eligible for federal mitigation assistance grant funding. Therefore, the updated plan shall also describe the process used to review and analyze each section of the plan (plan process, risk assessment, mitigation strategy and plan maintenance).

Guiding Principles

When the *Cowlitz County Hazard Mitigation Plan* was created in 2004, the planning partners identified six guiding principles that served to influence the first plan's development process. These guiding principles also described the purpose of the

plan and how it was to serve the region's communities. These principles remain relevant today and demonstrate the communities' commitment to natural hazard mitigation planning. These guiding principles have been slightly modified from their original form.

1. Provide a Methodical Approach to Mitigation Planning

The process used by the planning partners identifies vulnerabilities to future disasters and proposes the mitigation initiatives necessary to avoid or minimize those vulnerabilities. Each step in the planning process builds upon the previous, providing a high level of assurance that the mitigation initiatives proposed by the participants have a valid basis for both their justification and priority for implementation.

2. Enhance Public Awareness and Understanding of Natural Hazards

This plan contains data and information that can be used in a variety of ways to enhance public awareness about the most destructive natural hazards that threaten the region. This information gives members of the community a better understanding of what the most prevalent hazards have been historically, and how hazards are likely to impact or threaten the public health, safety, economic vitality of businesses, and the operational capability of important institutions in the future. The planning partners have provided opportunities for public involvement and information. This multi-jurisdictional effort has reached out to stakeholders from municipalities, academia, and special purpose districts as well as county and tribal government. The planning partners have also solicited ideas and input during open house meetings before and after the plan was drafted.

3. Create a Decision-Making Tool for Policy and Decision Makers

This document provides basic information needed by managers and leaders of local government, business and industry, community associations, and other key institutions and organizations to take actions to address vulnerabilities to future natural disasters. It also provides proposals for specific projects and programs that are needed to eliminate or minimize those vulnerabilities. The mitigation actions in this plan have been reviewed to assess their benefits and costs, and have been prioritized for implementation. This approach is intended to provide a decision making tool for the management of participating organizations and agencies regarding why the proposed mitigation initiatives should be implemented, which should be implemented first, and the social, technical, administrative, political, economic, and environmental benefits of doing so.

4. Promote Compliance with State and Federal Program Requirements

At a minimum, local hazard mitigation plans must satisfactorily comply with the federal requirements in 44 CFR Section 201.6 in order to receive federal mitigation assistance program grants. This plan exceeds them. It is crucial for local government decision-makers to take an active role in preparing their communities for future disasters - because the effects of natural hazards are unique to each local community, understood best by the local community, and felt by the local community. Developing flexible plans to factor for the unknown is a good practice in risk management.

5. Ensure Inter-Jurisdictional Coordination of Mitigation-Related Programming

A key purpose of the planning process is to ensure that proposals for mitigation initiatives are reviewed and coordinated among the participating jurisdictions within the county. In this way, there is a high level of confidence that mitigation initiatives proposed by one jurisdiction or participating organization, when implemented, will be compatible with the interests of adjacent jurisdictions and unlikely to duplicate or interfere with mitigation initiatives proposed by others.

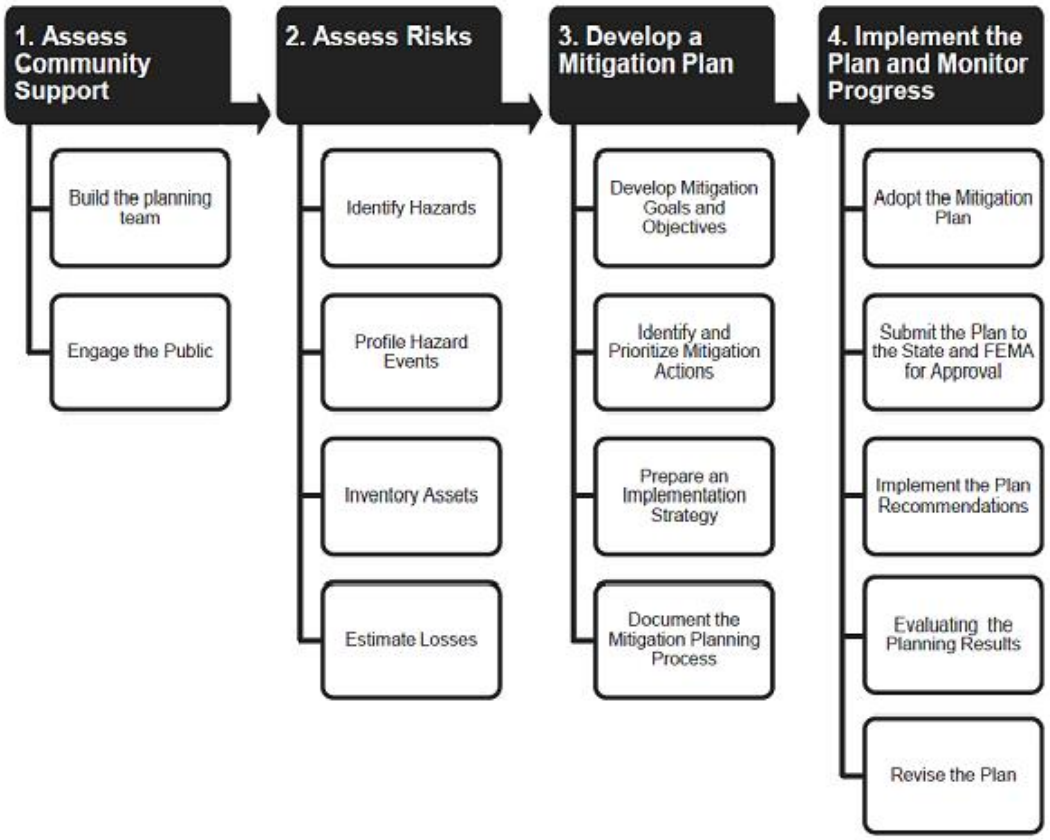
6. Create Jurisdiction-Specific Hazard Mitigation Plans for Implementation

A key purpose of the plan is to provide each participating local jurisdiction with a specific plan of action that can be adopted and implemented pursuant to its own authorities and responsibilities. Each participating jurisdiction developed an annex that is adopted as part of this plan with jurisdiction-specific information, including their mitigation initiatives. The jurisdictions and organizations can then adopt and implement the plan and the corresponding mitigation initiatives for their organization according to their individual needs and schedule. In this way, the plan format and the operational concept of the planning process ensures that proposed mitigation initiatives are coordinated and prioritized effectively among jurisdictions and organizations, while allowing each jurisdiction to adopt only the proposed mitigation initiatives that it actually has the authority or responsibility to implement when resources are available.

The Hazard Mitigation Planning Process

Cowlitz County, through its Department of Emergency Management, contracted with Cowlitz Wahkiakum Council of Governments (CWCOG) in October 2009 to facilitate the plan's update. CWCOG staff facilitated the multi-jurisdictional planning process, assisted local governments in developing their portions of the plan, as well as compiled and authored all sections of the core plan. The plan partners contributed in kind support through their participation in the planning process and in the development of their local plan components. The plan update followed a basic four step hazard mitigation planning process as shown in Figure 1.

Figure 1
Process Development



The plan update followed a basic four step hazard mitigation planning process as outlined by FEMA in its *State and Local Mitigation Planning: How to Guides* (386 Series publications). With the exception of the development of a risk assessment, the planning tasks were not completed in the exact linear fashion as shown in Figure 1.

Plan Update Participants

In July 2009, the Department of Emergency Management of Cowlitz County invited local government entities in Cowlitz County to participate in the update to the Hazard Mitigation Plan. A total of 27 jurisdictions actively participated in the plan update process. Table 4 lists the communities and organizations that participated in the plan update process.

Planning Team

The Hazard Mitigation Planning Workgroup

A multi-jurisdictional plan requires the participation of a variety of stakeholders. The Hazard Mitigation Planning Workgroup (here on referred to as the Workgroup) served as the primary working committee throughout the plan's development process. The Workgroup consisted of Cowlitz Wahkiakum Council of Governments staff and staff or elected representatives from 22 jurisdictions (see Table 4). Some jurisdictions that participated in the 2005 plan chose not to participate in the 2010 update due to budget shortfalls and lack of available staff.

Table 4 Update Planning Participants		
Beacon Hill Water and Sewer District	Kim Adamson	District Manager
	Brian Wilson	Field Lead
Castle Rock School District	Henry Karnofski	Middle School Principal
	Susan Barker	Superintendent
CDID #1	Judi Strayer	District Manager
City of Castle Rock	David Vorse	Public Works Director
City of Kalama	Carl McCrary	Public Works Director
	Kelly Rasmussen	Public Works Superintendent
City of Kelso	David Sypher	Public Works Director
City of Longview	Jeff Cameron	Public Works Director
	Craig Bozarth	City Engineer
Cowlitz 2 Fire & Rescue	Dave LaFave	Fire Chief
	James Graham	Captain
	Mike Murphy	Fire Inspector
Cowlitz PUD	Monte Roden	Director of Operations
	Heather Allen	Risk Manager
Cowlitz-Skamania Fire District #7	Gary Stuart	Fire Chief
Cowlitz Transit Authority	Corey Aldridge	Transit Manager
DID1, DID15, LFCZD, CDID2, CDID3	Dell Hillger	Public Works Utilities Manager
Fire District #1	Eric Dehning	Fire Chief
Fire District #5	Vic Leatzow	Fire Chief
Fire District #6	Eric Koreis	Fire Chief
Longview School District	Larry Mayfield	Executive Director
	Debra Ward	Operations/Security/Grounds Manager
Lower Columbia College	Richard Hamilton	Director of Campus Services
Port of Longview	Norman Krehbiel	Director of Facilities
	Lisa Hendrickson	Director of Planning and Environmental Services
Silver Lake Flood Control District	Ken Stone	Sustainability Director
Toutle Lake School District	Scott Grabenhorst	Superintendent
Unincorporated Cowlitz County	Grover Laseke	Past Director Emergency Mgmt
	Ernie Schnabler	Current Director Emergency Mgmt
	Kent Cash	Public Works Director
Woodland School District	Michael Green	Superintendent
	Tegan Steen	Executive Secretary

The role of individual Workgroup representative was to:

1. Participate in all aspects of the plan update's process.

2. Serve as a liaison to represent their jurisdiction's hazard mitigation issues and needs, and serve as a central resource to coordinate data requests and planning support activities.
3. Meet as needed at the workgroup or at their jurisdiction to review, update, and amend sections of the plan, and coordinate follow-up planning activities with their appropriate inter- and intradepartmental co-workers, managers, and officials.
4. Review, edit, or comment on all elements of the draft and final plan.
5. Facilitate their jurisdiction's public review process and adoption of the plan through their governing body.

The collective role of the Workgroup was to facilitate the development of the plan through a consensus decision making process. Specifically, the workgroup served to:

1. Support inter-jurisdictional cooperation and increase awareness of hazard mitigation planning activities around the region.
2. Provide technical input and information to support the development of the regional risk assessment.
3. Review the plan's goals and objectives.
4. Review all multi-jurisdictional plan elements in draft and final form (Chapters 1- 6 and appendices).
5. Identify, analyze, and prioritize the county-wide mitigation initiatives.
6. Conduct a benefit/cost review of the county-wide initiatives where needed.
7. Participate in an after action review to evaluate effectiveness of the original plan's monitoring, implementation and maintenance process, and recommend a new process if necessary.
8. Identify and participate in appropriate public involvement opportunities at the regional level.

The Workgroup met on a periodic basis to accomplish the business of the plan update process. All Workgroup meetings were open to the public. In addition to scheduled meetings, a significant amount of correspondence and tasks were fulfilled via telephone conversations and email exchanges. File transfers were performed mostly by email, with some data exchanged via compact disc.

The Hazard Mitigation Planning Workgroup Subcommittee

An ad hoc Workgroup Subcommittee was consulted to brainstorm ideas, validate the planning material and its compliance with federal requirements, and advise the project manager in order to foster effective facilitation of the hazard mitigation planning process. The Subcommittee was consulted on an as needed basis. The Subcommittee met in person on occasion, but most business was conducted via the telephone and email correspondence. The Subcommittee served to provide the following support functions:

1. Brainstorm ideas for the updated plan's format and content
2. Identify effective Workgroup facilitation techniques
3. Assist with scheduling hazard mitigation planning timelines
4. Identify opportunities and formats for public process
5. Conduct reviews of early draft plan chapters prior to release to the Workgroup
6. Test document forms and data templates produced by CWCOG

prior to their release to the Workgroup.

During the development of the first plan, the DEM served as an advisory committee and a decision making body for the entire plan development process. During the plan update, the DEM retained their role as a key advisory committee and assisted in the identification of County Wide Mitigation Initiatives. The DEM provided input on the Mitigation Goals and Initiatives (Chapter 5) and the long term plan implementation, monitoring, and maintenance procedures (Chapter 6). The DEM also agreed to retain its role as the overall plan steward through the next five year plan update cycle.

Public Participation

Citizens and members of the community are responsible for their personal safety, the safety of their families, and the protection of their assets from natural disaster events. People can learn about local hazard conditions through the natural hazards mitigation planning process and identify measures that they can take, such as the purchase of flood insurance or the procurement of essential supplies in advance, to reduce the impacts from the effects of natural hazards. A variety of community members desire to be key stakeholders in the vision of building disaster resilient communities. The near- and long-term economic vitality and environmental sustainability of Cowlitz County is important to residents, employees, and business owners, so their involvement in the planning process is essential.

Outreach and Public Review Process

A variety of outreach methods and information sharing was utilized to increase peoples' awareness of the process and attempt to solicit their input for this plan's development. Staff issued press releases to local area newspapers, maintained information on agency websites, distributed brochures, hosted open house meetings, and attended community events.

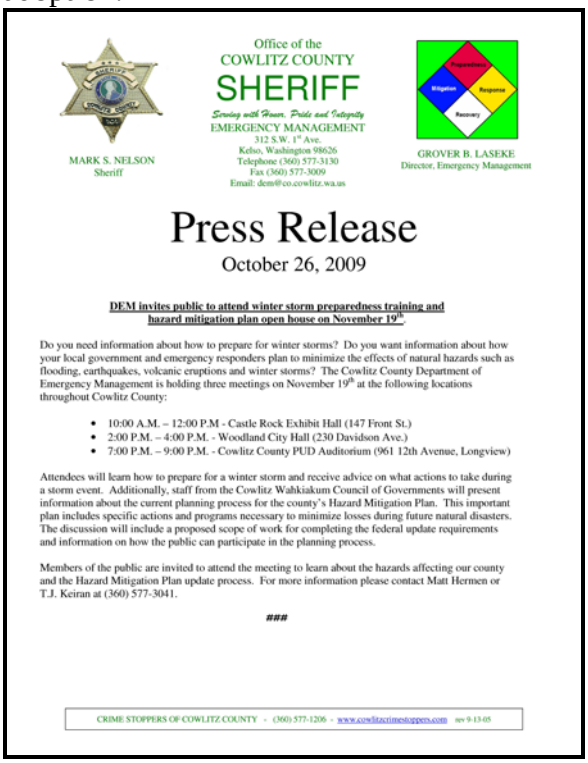
Brochures, Flyers, and Community Events

A combined informational brochure and comment form was produced and distributed county wide early on in the planning process to inform the public about the natural hazards mitigation planning process and to solicit community input. Copies were distributed to town and city halls and community activity centers throughout the region. In addition, copies of the brochure were made available at some community events.

Event flyers and posters for open house meetings were also posted throughout the community prior to the two series of open house meetings during the plan kick off and the draft plan public review period.

News Releases

To kick off the planning process, a news release was distributed to the local area newspaper announcing the update of the plan and the dates and locations of three community open house meetings to introduce the planning process. Newspaper articles announcing the meetings were published in *The Daily News* on October 28, 2009. A second announcement (legal notice) was published in *The Daily News* on Monday, May 16, 2011 to notify the public of open house meetings to review and comment on the draft plan prior to its local adoption.



Office of the
COWLITZ COUNTY
SHERIFF
Serving with Honor, Pride and Integrity
EMERGENCY MANAGEMENT
312 S.W. 1st Ave.
Kelso, Washington 98626
Telephone (360) 577-3130
Fax (360) 577-3009
Email: dem@co.cowlitz.wa.us

MARK S. NELSON
Sheriff

GROVER B. LASEKE
Director, Emergency Management

Press Release

October 26, 2009

DEM invites public to attend winter storm preparedness training and hazard mitigation plan open house on November 19th.

Do you need information about how to prepare for winter storms? Do you want information about how your local government and emergency responders plan to minimize the effects of natural hazards such as flooding, earthquakes, volcanic eruptions and winter storms? The Cowlitz County Department of Emergency Management is holding three meetings on November 19th at the following locations throughout Cowlitz County:

- 10:00 A.M. – 12:00 P.M - Castle Rock Exhibit Hall (147 Front St.)
- 2:00 P.M. – 4:00 P.M. - Woodland City Hall (230 Davidson Ave.)
- 7:00 P.M. – 9:00 P.M. - Cowlitz County PUD Auditorium (961 12th Avenue, Longview)

Attendees will learn how to prepare for a winter storm and receive advice on what actions to take during a storm event. Additionally, staff from the Cowlitz Wahkiakum Council of Governments will present information about the current planning process for the county's Hazard Mitigation Plan. This important plan includes specific actions and programs necessary to minimize losses during future natural disasters. The discussion will include a proposed scope of work for completing the federal update requirements and information on how the public can participate in the planning process.

Members of the public are invited to attend the meeting to learn about the hazards affecting our county and the Hazard Mitigation Plan update process. For more information please contact Matt Hermen or T.J. Keiran at (360) 577-3041.

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CRIME STOPPERS OF COWLITZ COUNTY - (360) 577-1206 - www.cowlitzcrimestoppers.com rev 9-13-05

Community Open House Meetings

Prior to the drafting of the plan update, a series of three public meetings were held at three different locations around the county to provide public stakeholders an opportunity to learn about the planning process and provide input on the plan. The meetings were hosted in an open house format. The format allowed people to attend any time during the meeting. CWCOG staff and Workgroup members hosted the events and were on hand to answer questions. Printed copies of the 2005 plan were available for review, and copies of the plan on compact disc were available for people to take home. Presentations describing the hazard mitigation planning process and Cowlitz Region's most destructive natural hazards were prominently displayed. In addition, the brochure and comment forms were available for people to complete or take home and return at a later time. The public was encouraged to comment on the plan throughout its entire development. Twenty people attended the open house meetings.

Community members were provided an opportunity to review and comment on the draft plan before it was adopted by the local jurisdictions. In addition CWCOG staff and Workgroup members hosted two open house meetings. Copies of the draft plan were on hand for review. Staff was present to answer questions and receive comments. In addition, draft copies of the plan were distributed to all library branch locations in Cowlitz County.

Hazard Mitigation Plan Update

What are the potential local hazards?

There have been three major disaster declarations in the five years since the Hazard Mitigation Plan was adopted. Following is a list of all hazards identified in the Cowlitz County Hazard Identification and Vulnerability Analysis:

HIGH RISK
- Flooding
- Severe Winter Storm
- High Winds
- Earthquakes

MEDIUM
- Landslide
- Volcano Activity
- Subsidence / Expansive Soils
- Wild Fire

LOW RISK
- Fire in the urbanized area
- Lightning
- Tsunami
- Infestation
- Drought
- Hail

?

Do you want to suggest another hazard to be considered? If so, please contact Matt Hermen or TJ Keiran and find out about the plan update process.

Questions about specific hazards

GROVER B. LASEKE
Director, Emergency Management
laseke@co.cowlitz.wa.us

LORI HENDRICKSON
DEM Coordinator
hendricksonl@co.cowlitz.wa.us
577-3130

Questions about the Plan Update

MATT HERMEN
South Cowlitz County

T.J. KEIRAN
North Cowlitz County
577-3041

CWCOG

Website: www.co.cowlitz.wa.us/dem
To Provide Comments: www.cowlitzcountydem.blogspot.com

Local Government Meetings

As part of the initial outreach process, CWCOG staff presented an overview of natural hazards mitigation plan update process to the CWCOG Board of Directors, which represents a majority of the planning participants. The Cowlitz-Wahkiakum Council of Governments is an intergovernmental board made up of local government jurisdictions within Cowlitz and Wahkiakum Counties. The role of the Council is to develop regional plans and policies for transportation, growth management, environmental quality, and other topics. Many of the hazard mitigation planning partners that participated in the plan update process are members of the Regional Council. The Workgroup members were responsible for informing their governing bodies and facilitating local review of the plan. More information about each jurisdiction's local public meetings can be found in their respective annex.

Plan Revisions

Plan Update, 2009 to 2011

The entire plan was reviewed by CWCOG staff and the Workgroup during the plan update process. Substantial changes were made throughout the document to improve its usefulness and fulfill the plan's compliance with current federal planning requirements. Changes were made to both content and format, but the plan outline remains much the same.

Many federal, state and local plans and studies were reviewed and incorporated into this planning effort, including:

- FEMA's Mitigation Planning "How-To" Guides, Fact Sheets and advisory planning documents;
- Washington State's Hazard Identification and Vulnerability Assessment (HIVA);
- Washington State's Washington State Hazard Mitigation Plan;
- Washington HAZUS User Group (WAHUG) for GIS data;
- Cowlitz County Comprehensive Plan, Capital Facilities Plan and Development Regulations;
- Cowlitz County Facilities Needs Analysis;
- Comprehensive Emergency Management Plan;
- Cowlitz County Fire Chiefs association Resource Mobilization Plan
- City of Castle Rock Comprehensive Plan, Capital Facilities Plan and Development Regulations;
- City of Kalama Comprehensive Plan, Capital Facilities Plan and Development Regulations;
- City of Kelso Comprehensive Plan, Capital Facilities Plan and Development Regulations;
- City of Longview Comprehensive Plan, Capital Facilities Plan and Development Regulations;
- City of Longview Fire Department Capital Facilities Planning Report
- City of Woodland Comprehensive Plan, Capital Facilities Plan and Development Regulations;
- Cowlitz 2 Fire and Rescue Operations and Facilities Plan
- Cowlitz County Fire District 5 Strategic Planning Report
- Cowlitz County Fire District 6 Strategic Plan
- Kalama School District Strategic Plan
- Kelso School District Strategic Plan
- Longview School District Strategic Plan
- Lower Columbia College Strategic Plan

- Port of Longview Strategic Plan
- Port of Woodland Strategic Plan
- Woodland School District Capital Projects Plan
- Various scientific studies as referenced in each chapters' endnotes

The following table shows jurisdictional accomplishments since the 2005 plan adoption. These accomplishments reflect progress in local mitigation efforts..

Table 4.1 ACCOMPLISHMENTS SINCE 2005			
Initiative #	**Accomplished?**	**Mitigation Initiative**	**Status Explanation**
Unincorporated Cowlitz County			
1	No	Administrative Building Earthquake Retrofit	Structural assessment completed in 2010. Pursuing grant funding opportunities.
2	No	Elevate generators	Insufficient funding
3	No	Kalama River Gage	Began system design in 2009; placed on hold as other priorities demanded attention
4	No	Generator for LCARA	Insufficient funding
5	No	Admin/ Annex Building Generator	Insufficient funding
6	No	Hall of Justice - Glass Panels	Insufficient funding
7	No	Toutle Valley Warning System	Initialized discussion with USGS
8	No	Health Department/Human Services Install Generator	Insufficient funding
Cowlitz 2 Fire and Rescue			
1	Yes	Secure large interior contents from movement or falling.	
2	Yes	Secure interior utility features from movement.	
3	Yes	Secure exterior utility features from movement.	
4	No	Conduct an engineering study of structural vulnerabilities and retrofits needed.	Insufficient funds
5	Yes	Develop an earthquake response plan for facility personnel.	
6	Yes	Prevent flotation and/ or movement of the structure or component.	
7	Yes	Address flood damage to exterior features.	
8	Yes	Determine/ confirm the elevation of the structure, component, and/ or flood height.	
9	No	Conduct an engineering study of structure or component vulnerability to flooding.	Insufficient funds
10	No	Develop a plan/procedure for flood damage control.	The engineering study is needed first
11	No	Train employees in flood plans/ procedures for facility component protection.	The plan is needed first
12	No	Develop a post-flood clean-up, decontamination, and recovery plan/procedures.	Part of the forthcoming plan
Beacon Hill Water and Sewer District			
1	Yes	Nevada Drive Pump Station Generator	
2	Yes	Lexington Pump Station Generator	
3	Yes	Yelton Drive Pump Station Retaining Wall	
4	Yes	Niblett Way Pump Station Retaining Wall	
Consolidated Diking Improvement District #1			
1	No	Oregon Way Pump Station- Seismic Retrofit	Insufficient funds
2	No	Industrial Way Pump Station - Seismic Retrofit	Insufficient funds
3	No	Reynolds Pump Station – Seismic Retrofit	Insufficient funds

Table 4.1 ACCOMPLISHMENTS SINCE 2005			
Initiative #	**Accomplished?**	**Mitigation Initiative**	**Status Explanation**
4	No	Main Pump Station - Seismic Retrofit	Insufficient funds
5	No	48th Avenue Booster Pump Station - Seismic Retrofit	Insufficient funds
6	No	Various Pump Stations -- Generator	Insufficient funds
7	No	Main Pump Station -- Generator	Insufficient funds
City of Castle Rock			
1	Yes	Earthquake - Wastewater Treatment Plant	
2	No	Community Services - City Hall	Insufficient funds
3	No	Community Services - City Shops	Insufficient funds
4	No	Community Services – Water Treatment Plant	Insufficient funds
5	Ongoing	Communications Failure - City Hall	Completed assessment calls for total system replacement – seeking funding
6	Ongoing	Communications Failure - City Shops	Completed assessment calls for total system replacement – seeking funding
7	Ongoing	Communications Failure - Fire Hall	Completed assessment calls for total system replacement – seeking funding
8	Yes	Power Outage - Water Treatment Plant	
9	Yes	Power Outage – Wastewater Treatment Plant	
City of Kalama			
1	Yes	Wastewater Treatment Plant Generator	
2	Yes	Clapper Valves	
3	No	Repair or replace Kingwood Reservoir	Insufficient funds
4	No	Repair or replace Upper Gore Reservoir	Insufficient funds
5	No	Repair or replace Lower Green Mountain Reservoir	Insufficient funds
Castle Rock School District			
1	No	Temporary Shelter Plan	Insufficient Funding
2	Yes	Greenacres Stormwater Pump	
3	Yes	Cell Phone System	
4	No	Post-Impact Counseling Plan	Insufficient Funding
Cowlitz County Diking Improvement District #1			
1	No	Install permanent generator at North Kelso facility	Insufficient funds
Cowlitz County Fire District #5			
1	Yes	Install permanent generator at main station	
City of Kelso			
1	No	Floodwalls – Haussler Pump station	Insufficient funds
2	Yes	Floodwalls – Catlin Sewer Pump	
3	No	Generator – Water Treatment Plant	Insufficient funds
4	No	Generator – Ranney Well Pump	Insufficient funds
5	Yes	Video Surveillance System – Police Engineering Building	
6	No	Sewer Lines – North Kelso	Insufficient funds

Table 4.1 ACCOMPLISHMENTS SINCE 2005			
Initiative #	**Accomplished?**	**Mitigation Initiative**	**Status Explanation**
Lexington Flood Control Zone District			
1	No	Install and wire McCorkle Pump Station #2 with permanent generator	Insufficient funds
Longview School District			
1	Yes	Secure cabinets and bookcases	
2	No	Earthquake Response Plan	Insufficient funds
3	No	Engineering Study	Insufficient funds
4	No	Earthquake Education	Insufficient funds
5	No	Earthquake Damage Assessment	Insufficient funds
6	Yes	Relocation Procedures	Included in drills and school district employee's handbook
7	No	Replacement of roofs	Insufficient funds
8	Ongoing	Tree Removal	Some have been removed, but funds are needed to remove significant trees

Chapter 1: Introduction

The plan introduction was expanded to provide more background information to explain and support the function of natural hazards mitigation planning in the Cowlitz Region. Additional information was added to describe the region's disposition to natural hazards, various federal mitigation grant programs, the federal disaster declaration process, and various mitigation measures, and to document the history of hazards mitigation planning in the region.

Chapter 2: Plan, Process and Development

This chapter reflects the plan update process. It introduces the structure of the plan and guiding principals which lead the plan development. Within this chapter, the efforts to conduct public outreach are explained as well as the revisions from the initial 2005 plan. CWCOG and DEM staff worked directly with the participating agencies' staff in a formed workgroup to satisfy FEMA requirements. Evaluations of the existing plans were completed prior to conducting the risk assessments. The evaluations asked the participating jurisdiction to report on the initiatives completed from the 2005 update, while providing the opportunity to add new initiatives for mitigating hazards (See Appendix A). CWCOG staff used GIS analysis to display where critical facilities were located in relation to hazards and supplemented the maps with tables that detailed the critical facilities. Because of the sensitive nature of these maps, they are not shown for each jurisdiction, but samples are provided in the appendix. This streamlined the update process, with fewer burdens on the participating agencies' staff.

Chapter 3: Cowlitz County Community Profile

The nature of the content and the data included in this document is very similar to the original content in Chapter 3. Data tables

and narratives were revised to reflect current conditions. Additional data was added to describe certain aspects of the region's services and capabilities in more detail.

Chapter 4: Risk Assessment

The original plan consolidated the risk assessment and the hazard profiles into a single continuous section. It consisted of four hazard profiles including earthquake, flood, storm, and landslide. The plan update divided the risk assessment into six sections. The four original hazard profiles were updated and new sections were added, including a wildland fire hazard profile, a volcanic events hazard profile, and a new section on climate change projections. The risk rating for the original profiled hazards did not change. Section 4.0: Risk Assessment Introduction, describes the methods and data sources that were used to prepare the vulnerability assessments in the hazard profiles.

Chapter 5: Mitigation Goals and Initiatives

Slight modifications were made to goals and initiatives (described in the chapter itself). The Workgroup selected the benefit cost analysis tool method over the STAPLEE benefit cost review. The county-wide mitigation initiatives remain in this chapter, but each jurisdiction's mitigation initiatives were relocated to their respective annex.

Chapter 6: Adoption, Implementation, Monitoring, and Maintenance

The chapter title was slightly revised to reflect the chapter content. The Workgroup and the DEM each reviewed the original version of Chapter 6. The general concepts for the roles, responsibilities, and procedures for monitoring and maintaining the plan remain the same, but were refined to reflect current federal planning requirements, and provide clarity. Specific revisions are noted at the end of each section in Chapter 6.

Annexes

The plan update added a new section for each participating jurisdiction, called an annex. It is a small section of the overall plan that is devoted specifically to a single jurisdiction. This section includes a copy of the adoption resolution, a community profile, documentation of the local planning process, a local risk assessment, mitigation initiatives, and documentation of the community's compliance with the National Flood Insurance Program, if relevant. The planning partners utilized universal templates and forms to maintain format consistency. The inclusion of multiple annexes simplifies the plan format. They are intended to improve the process for local jurisdictions to update their information as well as to enable new partners to develop their own mitigation plans under the framework of the multi-jurisdictional plan. Plan participants intending to forward and adopt their natural hazard mitigation plans developed an annex to the plan during the update process. Budget constraints and staff shortages prevented some plan partners from completing their annex in accordance with the plan update schedule. Several jurisdictions will submit their annex at a later date. Chapter 6 describes a process for adding new communities and their annexes to this plan.

Appendices

The appendices were revised to serve the needs of the plan update.

Plan Update, 2013

In December, 2012, the Cowlitz County Department of Emergency Management received comments from the Federal Emergency Management Agency regarding necessary revisions to fulfill the federal regulations. A planning process was

developed to document participation, reconsider a range of initiative for nine jurisdictions, demonstrate the initiatives integration into other planning mechanisms, and demonstrate progress from the 2005 plan. Staff coordinated with each jurisdiction regarding the necessary revisions through questionnaire, telephone calls and meetings to ensure the plan represented their unique entity, while fulfilling the federal standards. The results of the coordination efforts with each jurisdiction have been incorporated into the Hazard Mitigation Plan. Sample outreach materials can be seen in Appendix A.

Technical Assistance and Regulatory Review

The *Cowlitz County Hazards Mitigation Plan* must be submitted to the Washington State Emergency Management Division and the Federal Emergency Management Agency for their review in order to certify that the plan satisfactorily meets all federal hazard mitigation planning requirements. This section explains this review process. The mitigation planning regulations under 44 CFR Part 201 require that local jurisdictions submit mitigation plans to the State Hazard Mitigation Strategist (SHMS) for initial review and coordination, with the state then forwarding the plans to FEMA for formal review and approval. This approach assures local governing officials that their plans will be approved without delay subsequent to their local adoption process.

Technical Assistance

CWCOG staff consulted state and federal planning partners throughout the development of this plan to ensure that the planning process and the plan's contents would satisfactorily meet FEMA's hazard mitigation planning requirements. CWCOG submitted a draft copy of Chapter 4: Risk Assessment, to the SHMS and FEMA in May 2008. Because of the importance of the risk assessment in influencing the plan's overall quality, early feedback was requested to determine if the section was on track to comply with federal planning requirements.

Regulatory Review

Following a two week public review period, the plan was submitted to Washington State Emergency Management Division to begin the regulatory review process. The remainder of this section describes the state and federal review process.

Washington State Emergency Management Division

Washington State, as the grantee of FEMA mitigation assistance program grant funds, is responsible for reviewing local government hazard mitigation plans. Plans are submitted to the SHMS to ensure that they comply with federal planning requirements and to ensure that local plans are consistent with the Washington State Hazard Mitigation Plan. The SHMS requires 30 days to review the plan. SHMS uses a FEMA plan review checklist to score all required planning elements. Should the reviewer identify a deficiency that requires improvement, the SHMS will notify the appropriate local agency. The SHMS may provide support to the submitting jurisdiction, if necessary, to fulfill the relevant planning requirements. If the plan meets the minimum requirements, the state forwards the plan to FEMA.

Federal Emergency Management Agency

FEMA Region X is responsible for reviewing plans for Washington communities. FEMA requires a minimum of 45 days to review a plan. FEMA and the State utilize the same plan checklist to ensure that all of the federal hazard mitigation planning requirements are satisfactorily met by every local agency

participating in the multi-jurisdictional plan. FEMA will notify the submitting jurisdiction if their portion of a plan requires improvements and subsequently review any required modifications. Once the plan meets all of the local mitigation plan requirements, the plan is then returned to the jurisdiction with an *approvable pending adoption* status. FEMA typically will notify the jurisdiction of the plan status within one week after completing the plan review process. Once a jurisdiction receives notification that their plan is ready for adoption, they may begin the adoption process.

See Chapter 6: Adoption, Implementation, Monitoring, and Maintenance for more information on the local adoption process.

Chapter 3: Cowlitz County Community Profile

Introduction

It is important that local governments, Washington State, and the Federal Government understand the unique characteristics of Cowlitz County. The composition of the region's population, employment, land uses, infrastructure, and government services provide a context for natural hazards mitigation planning. This chapter includes general information about the region's natural setting, its demographics, growth trends, and public and private resources. A variety of natural hazards endangers the health and safety of the population of the county. Each major disaster threatens local and regional economic vitality, and imperils the quality of the affected community's environment. Hazard events such as flooding, landslides, storms and earthquakes are relatively common and present major financial and emotional challenges during the recovery phases following these disasters.

As Cowlitz County continues to grow and become more urban, the risk associated with natural hazards could increase as more people move to areas affected by natural hazards. The importance of developing strategies, coordinating resources, and increasing public awareness to reduce risk and prevent loss from future natural hazard events is becoming increasingly urgent.

Geography and Topography

Geographically, Cowlitz County is situated in southwest Washington. To the north is Lewis County and to the east, Skamania County. Southeast of Cowlitz County, the Lewis River forms a boundary with Clark County. On the south and southwest border of Cowlitz County, respectively, is the Columbia River with Oregon on the other side. Cowlitz County constitutes a geographic area of 1,166 square miles. As such, it ranks 28th in size among Washington counties.

The county is part of the Puget Sound-Willamette Depression. The depression is a geologic formation extending south from Puget Sound to the Willamette Valley in Oregon. It was created eons ago by the same forces.

Despite nestling up against the Cascade Range, the region is not exceptionally elevated. Those parts of Cowlitz County that abut the Cascades rise to around 4,000 feet above sea level; the highest is Elk Mountain (4,538 feet). Mount St. Helens (8,365 feet) is just to the east of the Cowlitz-Skamania County border. Most of Cowlitz County, though, is rather hilly, reaching elevations of around 1,000 feet above sea level. As might be expected, a number of tributaries flow through the county from sources originating in the Cascades. In Cowlitz County, the major rivers include the Columbia, Cowlitz, Toutle, Coweeman, Kalama and Lewis which has been dammed at three points (refered to as "Projects" by PacifiCorp, within Cowlitz County at Yale Project, Merwin Project, and Swift Project), resulting in Yale Lake and Merwin Lake.

Population Trends

Cowlitz County is the 12th most populous county in Washington State. The population of Cowlitz County has increased over sixty percent in the fifty years between 1960 and 2010 (Table 5). The 2010 United States Decennial Census data has not been

released, so this report utilizes the Washington State Office of Financial Management (OFM) population estimates. On the first of every April, OFM forecasts are issued and are often used for revenue distribution and program administration for local governments. According to the OFM, the 2010 population estimate of Cowlitz County was 100,000. From 2000 to 2010, the population increased 7.05% (Table 6) as retirees and commuters moved to Cowlitz County to take advantage of low housing costs, accessibility to nearby cities (Portland, Vancouver, Olympia, and Seattle/Tacoma), abundant recreation opportunities, and charming communities. Most people in Cowlitz County (58%) live in one of the incorporated cities of Longview, Kelso, Castle Rock, Kalama, or Woodland, while approximately 42% live in unincorporated Cowlitz County. The population in these unincorporated areas is increasing nearly 50% faster than in incorporated cities. This suggests that more people are becoming susceptible to hazards due to the lack of infrastructure and services that can aid in disaster relief

Table 5.
Cowlitz County Population Growth, 1960-2010

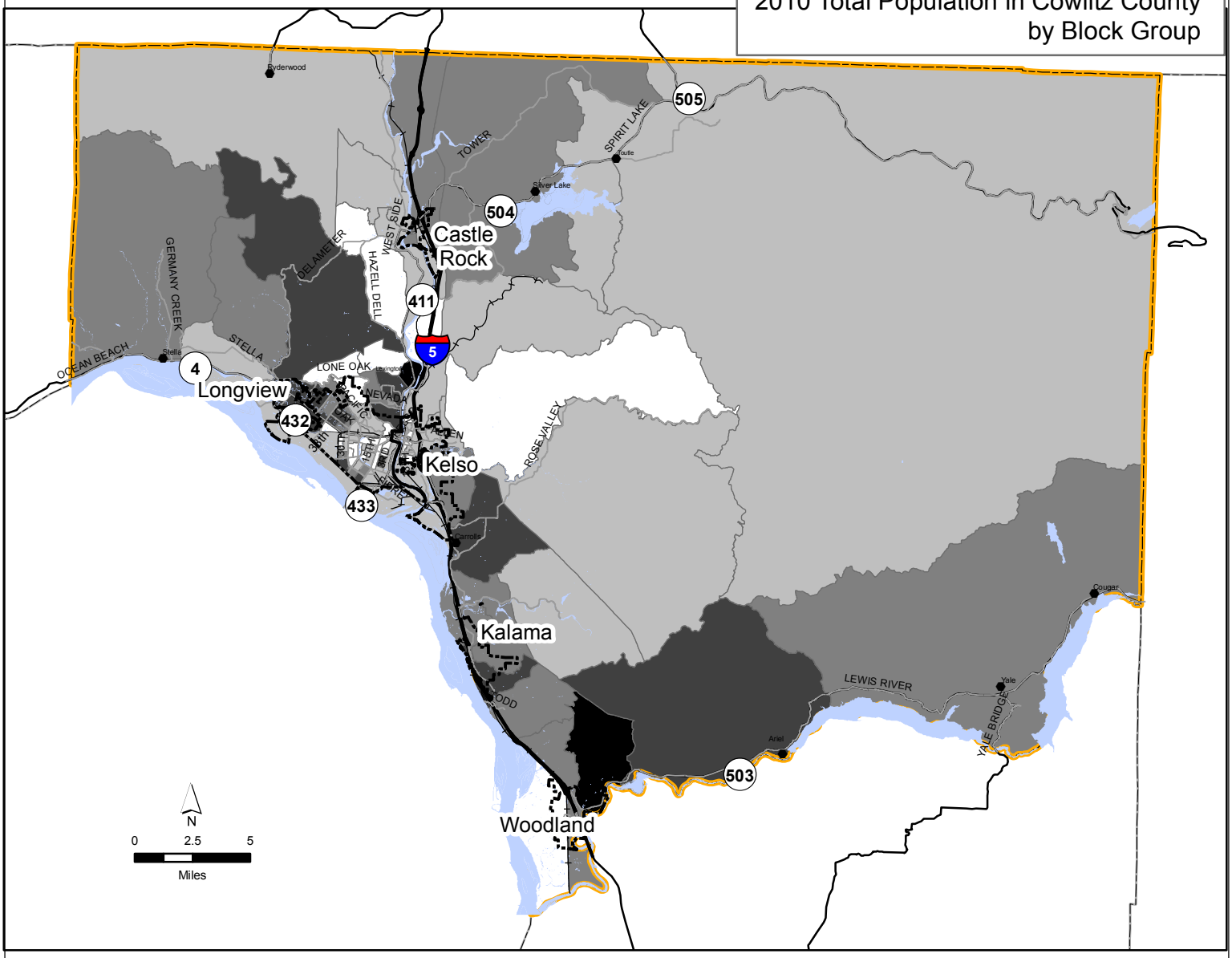
	1960	1970	1980	1990	2000	2010*
Total	57,801	68,616	79,548	82,119	92,948	100,000
Change		10,815	10,932	2,571	10,829	7,052
Percent Change		18.71%	15.93%	3.23%	13.19%	7.05%

Population figures from USA Decennial Census except 2009 population courtesy WA office of Financial Management

Table 6.
April 1 Population of Cities, Towns, and Counties

	Census 2000	OFM Estimate 2010	Percent Change 2000-2010
Cowlitz	92,948	100,000	7.05
Unincorporated	38,792	42,295	8.28
Incorporated	54,156	57,705	6.15
Castle Rock	2,130	2,150	0.90
Kalama	1,783	2,510	28.96
Kelso	11,895	11,780	-0.9
Longview	34,660	36,100	3.90
Woodland (*part)	3,688	5,165	28.59

Figure 2
2010 Total Population in Cowlitz County
by Block Group



City Limits
Major Roads
Interstate Five (I-5)
Rail
Rivers/Lakes

2010 Total Population (OF

POP2010

239 - 765
766 - 1064
1065 - 1451
1452 - 1890
1891 - 3395

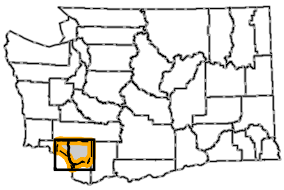


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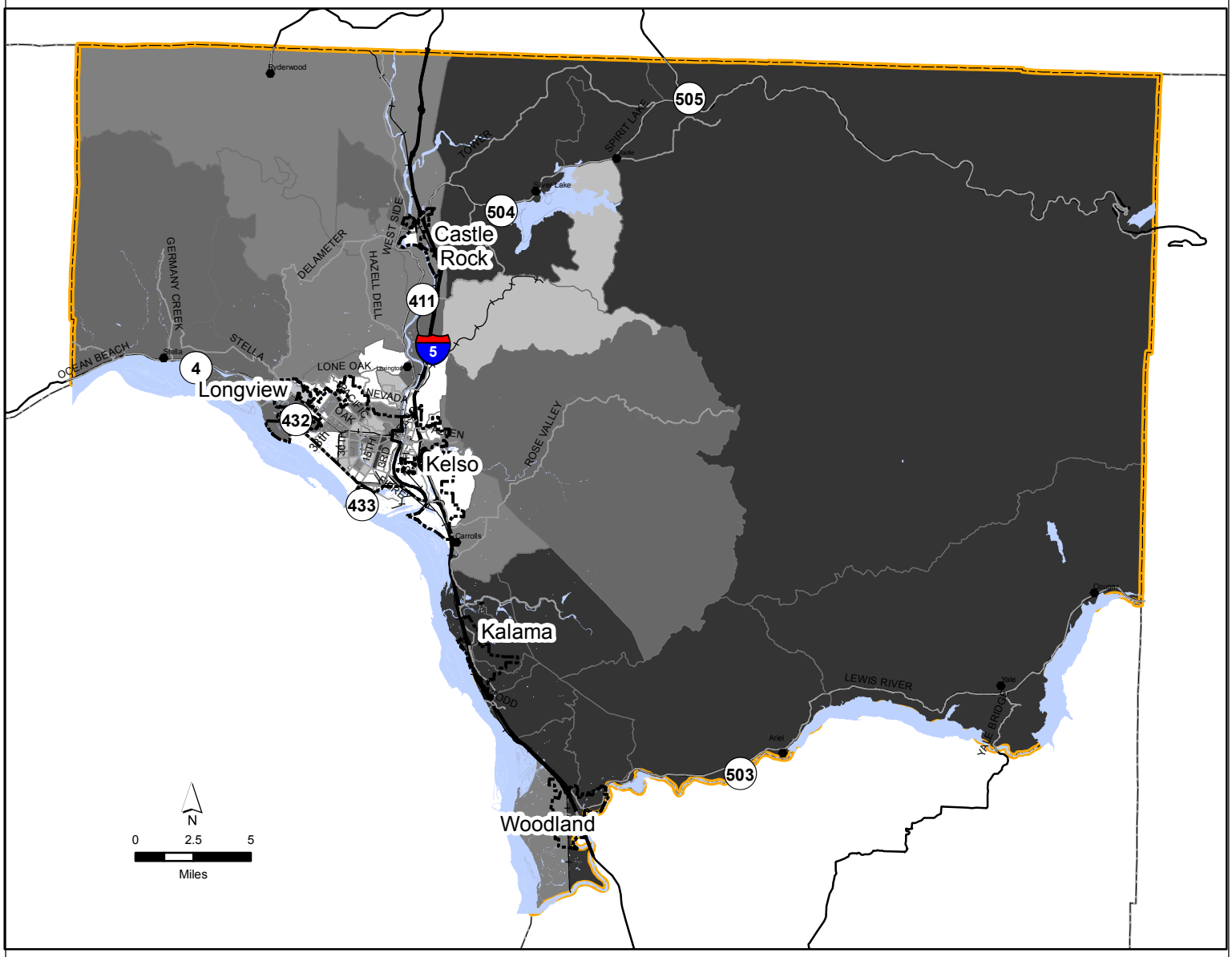
Figure 3
Percent Population Increase in Cowlitz County
by Block Group, 2000 - 2010



City Limits
Major Roads
Interstate Five (I-5)
Rail

Rivers/Lakes

2000 - 2010 % Population Increase (OFM)

PCPOP00_10

-0.6% - 0
0.1% - 2.3%
2.4% - 7.9%
8.0% - 15.2%
15.3% - 43.7%

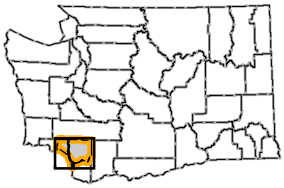


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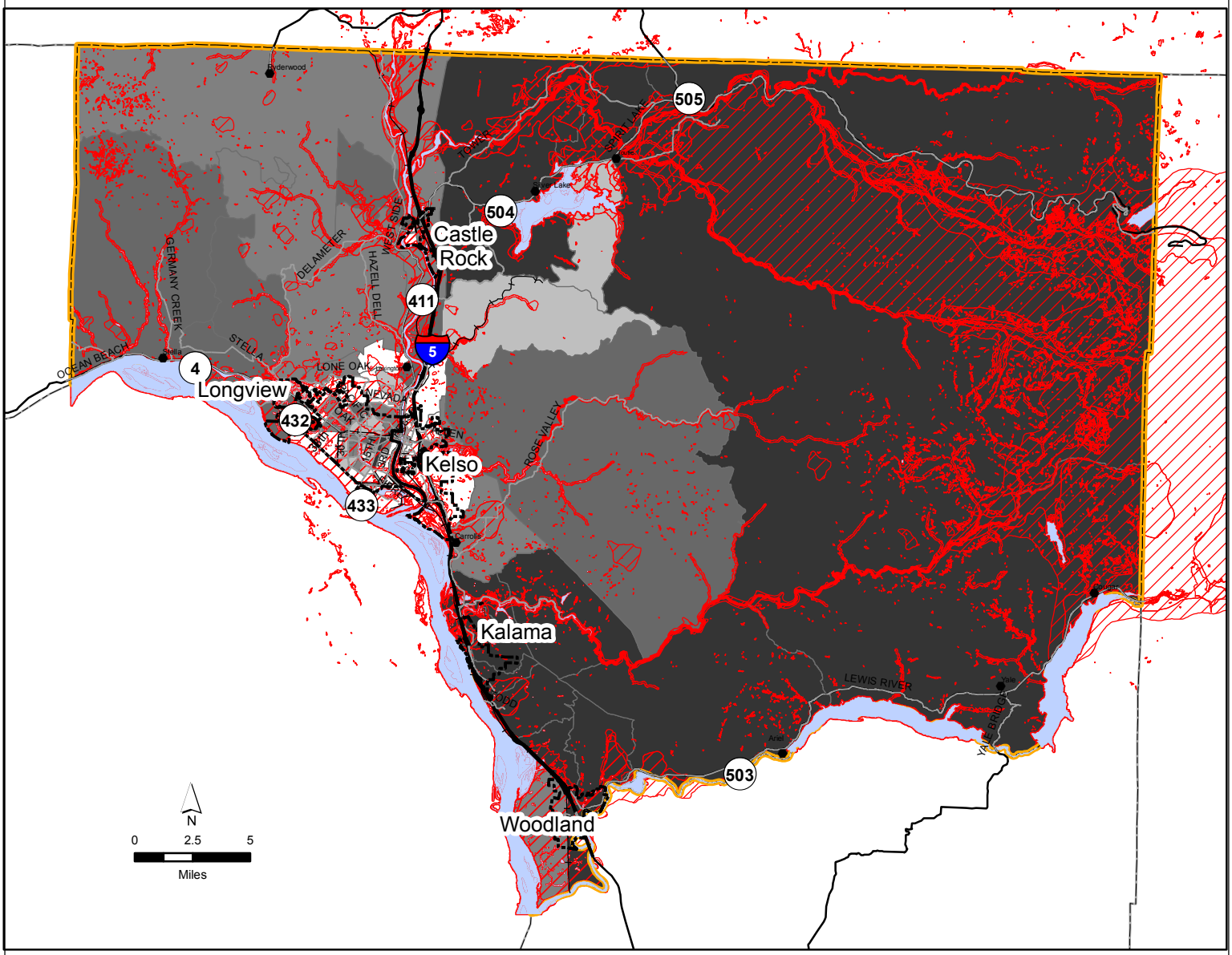
Figure 4
2000 - 2010 Population Increase
in Relation to Potential Natural Hazard Areas

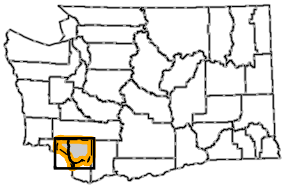


City Limits
Major Roads
Interstate Five (I-5)
Rail
Rivers/Lakes
Potential Natural Hazard Areas

2000 - 2010 % Population Increase (OFM)

PCPOP00_10

-0.6% - 0
0.1% - 2.3%
2.4% - 7.9%
8.0% - 15.2%
15.3% - 43.7%



Shared/Planners/Haz_Mit/January/Figures/Pop_Increase_Hazards

Potential Special Needs Population

It is important to consider members of populations with special needs and attempt to identify where they reside in relation to potentially hazardous areas. For the purposes of this plan "special need" populations are members of a demographic group that will likely have special needs in times of a natural disaster, including populations that have functional limitations in the following areas:

- Maintaining independence
- Communication
- Transportation
- Supervision
- Medical Care
- Persons with disabilities who are:
  - Living in institutionalized settings
  - Elderly
  - Children
  - From diverse cultures
  - Limited English proficiency or are non-English speaking
  - Transportation disadvantaged.

A functional need refers to a restriction or limited ability to perform activities normally considered routine.

Cowlitz County intends to expand the scope of the Emergency Response Plan to include a strategic, functional planning approach for responding to persons with special needs before, during and following a disaster. Cowlitz County DEM will work with the Cowlitz-Wahkiakum Council of Governments to inventory the locations of special needs populations in relation to potential hazardous areas and provide decision makers a range of policy options intended to minimize risk of the elderly population's exposure to natural hazard dangers. Included in this report is preliminary data from existing resources that demonstrates the need exists for a more detailed planning effort.

Elderly Population

The median age (the point where half the population is older and half is younger) in Cowlitz County is 36.9. This is marginally higher than the overall state median age of 35.5. According to the U.S Census Bureau, 2006-2008 American Community Survey, approximately 13.5% of the Cowlitz County population is age 65 or older, which is slightly higher than the percentage of both Washington State's and the United State's populations, which are 11.8% and 12.6%, respectively.

In its 2006 *Washington Senior Housing Profile*, the Washington Center for Real Estate Research attribute the increased elderly population in Cowlitz County because young people tend to migrate to jobs in urban areas while parents and grandparents stay in place. Additionally, Cowlitz County has recently experienced an influx of older families without children. The report discusses the following challenges:

- Seven percent of the elderly population was living below the poverty line in 2005;
- According to Census Bureau definitions, 21% of the population between ages 65 and 74 and 27% of the population over age 75 are disabled;
- By 2025, 17.3% of the population is forecasted to be over age 65;
- One-third of householders living alone are elderly;

Obviously, some of the challenges listed above are relevant to Hazard Mitigation Planning. The report concludes that "an unfortunate side effect of aging is the physical deterioration of the body, which can lead to increased health problems including physical and mental disabilities. Many elderly persons will eventually find they require some type of assisted living arrangement. In light of these issues, information about the senior population will be crucial in making policy decisions regarding the elderly population".

Cowlitz DEM will continue to work with various long-term care facility's staff to prevent, prepare and respond to natural hazard events in accordance with Washington State Department of Social & Health Services guidelines provided online at http://www.aasa.dshs.wa.gov/professional/EmergencyPlanning/.

Table 7 identifies the nursing home facilities in Cowlitz County in relation to potential hazard areas.

Table 7
Nursing Homes in Cowlitz County in Relation to Potential Hazard Areas

Facility	Flood	Wildfire	Lahar	Steep Slope	Earthquake	Jurisdiction	Fire Department	Diking District
Americana Health & Rehabilitation Center	500	No	No	No	M – H	L	L	CDID #1
Frontier Rehabilitation & Extended Care	500	No	No	No	M – H	L	L	CDID #1
Northwest Continuum Care Center	No	No	No	No	V Low	C	C2F&R	No
Park Royal Health & Rehabilitation Center	500	No	No	No	M – H	L	L	CDID #1
Woodland Convalescent Care	500	No	No	No	M – H	W	W	DID #1

Flood: 500 = 500 year
Earthquake: M-H = Moderate to High; V Low = Very Low
Jurisdiction: L = City of Longview; C = Cowlitz County; W = City of Woodland
Fire Department: L = City of Longview; C2F&R = Cowlitz 2 Fire & Rescue; W = City of Woodland
Diking District: CDID #1 = Consolidated Diking District 1; DID #1 = Diking District 1

Table 8
Adult Family Homes in Cowlitz County in Relation to Potential Hazard Areas

Facility	Flood	Wildfire	Lahar	Steep Slope	Earthquake	Jurisdiction	Fire Department	Diking District
34th House	500	N	N	N	M–H	L	L	CDID #1
A Time Honored Adult Family Home, LCC	N	Y	N	N	VL	C	C2F&R	N
Adelines Gardens LLC	500	N	N	N	M-H	W	W	DID#1
Cedar Gardens Adult Family Home	500	N	N	N	M–H	L	L	CDID #1
Cedar Gardens AFH	500	N	N	N	M–H	L	L	CDID #1
Conteh Care Adult Family Home	500	N	N	N	M-H	W	W	DID#1
Cowlitz Gardens AFH	N	N	Y	N	M-H	C	C2F&R	N
Lakeside Adult Foster Home	500	N	N	N	M-H	L	L	CDID#1
Mabel's Gardens	500	N	N	N	M-H	L	L	CDID#1
Mt. Solo Adult Family Home	500	N	N	N	M-H	L	L	CDID#1
Ocean Beach Adult Family Home	500	N	N	N	M-H	L	L	CDID#1
Pacific Country Home LLC	N	N	N	N	M-H	L	L	N
Pacific Country Homes	N	N	N	N	M-H	L	L	N
Really Living Adult Care	500	N	N	N	M-H	C	RFD #1	DID #5
River Bend Adult Family Home Inc.	500	N	N	N	M-H	L	L	CDID #1
River Bend Adult Home	500	N	Y	N	M-H	C	C2F&R	L
Riverside Gardens	100	N	Y	N	M-H	C	C2F&R	N
Rose Hill	N	Y	N	Y	VL	C	C2F&R	N
The Walker House	500	N	N	N	M-H	L	L	CDID #1
TU Family Country Home	N	Y	N	N	VL	C	RFD #6	N
Your Home Adult Family Care LLC	500	N	N	N	M-H	L	L	CDID #1
Zoe Adult Family Home	100	N	N	N	M-H	W	W	N

Flood: 500 = 500 year 100= 100 year
Earthquake: M-H = Moderate to High; V Low = Very Low
Jurisdiction: L = City of Longview; C = Cowlitz County; W = City of Woodland
Fire Department: L = City of Longview; C2F&R = Cowlitz 2 Fire & Rescue; W = City of Woodland
Diking District: CDID #1 = Consolidated Diking District 1; DID #1 = Diking District 1

Group Quarters

According to the OFM, on April 1, 2010 there were 1,267 persons living in group quarters in Cowlitz County. A group quarters is a place where people live or stay, in a group living arrangement, that is owned or managed by an entity or organization providing housing and/or services for the residents. This is not a typical household-type living arrangement. These services may include custodial or medical care as well as other types of assistance, and residency is commonly restricted to those receiving these services. People living in group quarters are usually not related to each other. Group quarters include such places as college residence halls, residential treatment centers, skilled nursing facilities, group homes, military barracks, correctional facilities, and workers' dormitories.

Residential Treatment Centers for Adults

Residential facilities that provide treatment on-site in a highly structured live-in environment for the treatment of drug/alcohol abuse, mental illness, and emotional/behavioral disorders. They are staffed 24-hours a day. The focus of a residential treatment center is on the treatment program.

Residential treatment centers do not include facilities operated by or for correctional authorities.

Table 9
Residential Treatment Centers
in Relation to Potential Hazard Areas

Facility	Flood	Wildfire	Lahar	Steep Slope	Earthquake	Jurisdiction	Fire Department	Diking District
INPATIENT TREATMENT								
Toutle Ranch	N	Y	N	N	MOD	C	RFD #6	N

Flood: 500 = 500 year 100= 100 year
Earthquake: M-H = Moderate to High; V Low = Very Low
Jurisdiction: L = City of Longview; C = Cowlitz County; W = City of Woodland
Fire Department: L = City of Longview; C2F&R = Cowlitz 2 Fire & Rescue; W = City of Woodland
Diking District: CDID #1 = Consolidated Diking District 1; DID #1 = Diking District 1

Group Homes Intended for Adults

Group homes are community-based group living arrangements in residential settings that are able to accommodate three or more clients of a service provider. The group home provides room and board and services, including behavioral, psychological, or social programs. Generally, clients are not related to the care giver or to each other. Group homes do not include residential treatment centers or facilities operated by or for correctional authorities.

The locations of group homes should be mapped in relation with potential hazard areas.

Emergency and Transitional Shelters (with Sleeping Facilities) for People Experiencing Homelessness

Facilities where people experiencing homelessness stay overnight. These include:
1) shelters that operate on a first-come, first-serve basis where people must leave in the morning and have no guaranteed bed for the next night;
2) shelters where people know that they have a bed for a specified period of time (even if they leave the building every day); and
3) shelters that provide temporary shelter during extremely cold weather (such as churches). This category does not include shelters that operate only in the event of a natural disaster. Examples are emergency

and transitional shelters; missions; hotels and motels used to shelter people experiencing homelessness; shelters for children who are runaways, neglected or experiencing homelessness; and similar places known to have people experiencing homelessness.

Table 10
Homeless Facilities & Transitional Housing Resources in Relation to Potential Hazard Areas

Facility	Flood	Wildfire	Lahar	Steep Slope	Earthquake	Jurisdiction	Fire Department	Diking District
Emergency Shelters								
Community House on Broadway (Longview)	500	N	N	N	MOD	L	L	CDID 1
Emergency Support Shelter (Kelso)	N	N	N	N	LOW	K	C2F&R	N/A
Transitional Housing								
Home Court Triplex (Kelso)	500	N	N	N	MOD	K	C2F&R	DID 1
Home Court House (Kelso)	500	N	N	N	MOD	K	C2F&R	DID 1
284 18th (Longview)	500	N	N	N	MOD	L	L	CDID 1
235 Carolina (Longview)	500	N	N	N	MOD	L	L	CDID 1
Country Run Apartments (County)	500	Y	Y	N	MOD	C	C2F&R	LEX.
Toutle River Ranch (County)	100	Y	N	N	V LOW	C	FRD # 6	N/A
PPW Facility, Broadway Campus (Longview)	500	N	N	N	MOD	L	L	CDID 1
Mint Place THOR units (Longview)	500	N	N	N	MOD	L	L	CDID 1
Permanent Supportive Housing								
HIV Housing Units (Longview)								
Chinook Apartments (Kelso)	N	N	N	N	MOD	K	C2F&R	N/A
PACT – 18th Avenue (Longview)	500	N	N	N	MOD	L	L	CDID 1
PACT – 10th Avenue (Longview)	500	N	N	N	MOD	L	L	CDID 1
PACT – 1st Avenue (Kelso)	500	N	N	N	MOD	K	C2F&R	DID 1
Phoenix House (Kelso)	500	N	N	N	MOD	K	C2F&R	CDID 1
LCMH Group Homes – 2 bldgs. (Longview)	500	N	N	N	MOD	L	L	DID 1

Source: Cowlitz County Annual Report to CTED, 2008; CWCOG telephone interviews, 2009

Flood: 500 = 500 year 100= 100 year
Earthquake: M-H = Moderate to High; V Low = Very Low
Jurisdiction: L = City of Longview; C = Cowlitz County; W = City of Woodland
Fire Department: L = City of Longview; C2F&R = Cowlitz 2 Fire & Rescue; W = City of Woodland
Diking District: CDID #1 = Consolidated Diking District 1; DID #1 = Diking District 1

English as a Second Language

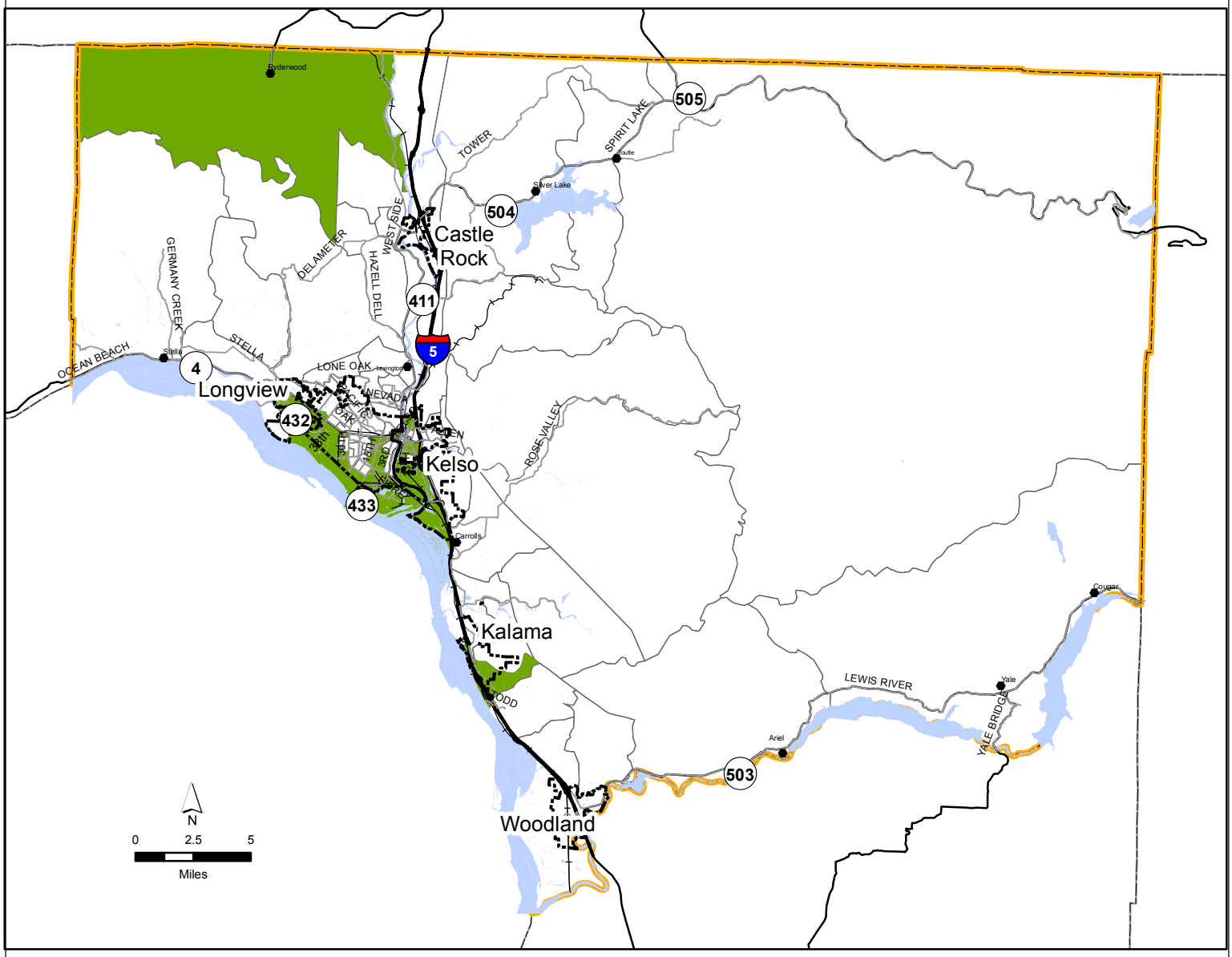
Cowlitz County is much less ethnically diverse than the state as a whole. In Cowlitz, approximately 92 percent of the population is white. When looking at the state population as a whole, the white percentage falls to 85 percent. Hispanics are the only other ethnic group which has significant representation in the county. In Cowlitz they comprise 4.6 percent of the population and 7.8 percent at the state level. Like the rest of the state, certain Cowlitz non-white populations have grown much faster than the white population during the 1990s. The white segment of Cowlitz grew at 8 percent, but the African American population expanded by 67 percent and Hispanics by 153 percent.

For the purposes of Hazard Mitigation planning, identifying where minority populations live is necessary in order to know where to provide weather or evacuation alerts in languages other than English.

Poverty

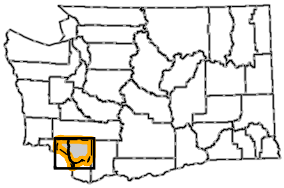
According to the US Census Bureau, in 2008 14.8% of the Cowlitz County population lived below the poverty level, as compared to 11.3% in Washington State. People living in poverty are considered a special needs population because they will likely need assistance preparing for and responding to a natural hazard event. Specifically, members of this population will likely need assistance evacuating, if necessary.

Figure 5
2000 - Census Block Groups
with Populations > 50% Living in Poverty



CWCOG
COWLITZ-WAHKIAKUM COUNCIL OF GOVERNMENTS

City Limits
Major Roads
Interstate Five (I-5)
Rail
Rivers/Lakes
Block Groups
Low Income Design
> 50%
0-50%



Shared/Planners/Haz_Mit/January/Figures/Pop_BG_Below_Poverty

Chapter 4: Risk Assessment

Chapter Contents

This Risk Assessment Chapter is comprised of several sections as follows:

Section	Title
4.0	Risk Assessment Introduction
4.1	Earthquake Hazard Profile
4.2	Storm Hazard Profile
4.3	Flood Hazard Profile
4.4	Landslide Hazard Profile
4.5	Wildland Fire Hazard Profile
4.6	Volcanic Hazards Profile

Section 4.0 introduces the region's risk assessment and explains its role in this plan. This introductory section includes an overview of Federal Disaster Declarations, a description of the hazards that affect Cowlitz County, an overview of the hazard profile format and hazard analysis definitions. An explanation of how this chapter complies with the *Federal Disaster Mitigation Act Risk Assessment Planning Requirements* is also included in this section.

Sections 4.1 through 4.6 are individual hazard profiles for the six major hazards that are the focus of the region's planning partner's mitigation strategies.

4.0 Risk Assessment Introduction

A comprehensive risk assessment of the major natural hazards that threaten the region was developed for this plan. The entire chapter serves to provide local governments the factual basis to develop effective mitigation strategies. Planning regulation, 44CFR Section 201.6(c)(2) of the Disaster Mitigation Acts (DMA), requires local jurisdictions to:

> *…provide sufficient hazard and risk information from which to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards. This includes detailed descriptions of all the hazards that could affect the jurisdiction along with an analysis of the jurisdiction's vulnerability to those hazards. Local risk assessments do not need to be based on the most sophisticated technology, but do need to be accurate, current, and relevant. Local risk assessments, coupled with the local mitigation strategies, are the basis for the State's evaluation of its resources and facilitate the establishment of statewide goals.*

The content and structure of this plan's risk assessment was developed using the *Federal Emergency Management Agency's (FEMA) 2008 Local Multi-Hazard Mitigation Planning Guidance*. The table below shows the DMA Risk Assessment Planning Requirements that must be met in order for this plan to receive a "satisfactory" score. Each of these planning requirements will be addressed independently or jointly throughout this section. The inclusion of the requirements is intended to serve as a crosswalk for the plan reviewer.

Table 11 Federal Regulations	
DMA Section	**Requirement**
§201.6(c)(2)(i):	[The risk assessment shall include a] description of the type…of all natural hazards that can affect the jurisdiction…
§201.6(c)(2)(i):	[The risk assessment shall include a] description of the… location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future events.
§201.6(c)(2)(ii):	[The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i)of this section. This description shall include an overall summery of each hazard and its impact on the community.
§201.6(c)(2)(ii):	[The risk assessment in all] plans approved after October 1, 2008 must also address National Flood Insurance Program (NFIP) structures that have been repetitively damaged by floods.
§201.6(c)(2)(ii)(A):	[The plan should describe vulnerability in terms of] the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas…
§201.6(c)(2)(ii)(B):	[The plan should describe vulnerability in terms of] an estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate…
§201.6(c)(2)(ii)(C):	[The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.
§201.6(c)(2)(iii):	For multi-jurisdictional plans, the risk assessment must assess each jurisdiction's risks where they vary from the risk facing the entire planning area.
In general, the Federal DMA planning requirements with the word "shall" and "must" indicate that the item is mandatory and must be included in the plan, otherwise it will not be approved by FEMA. Regulations with the word "should" indicate that the item is strongly recommended to be included in the plan, but its absence will not cause FEMA to disapprove the plan.	

Federal Disaster Declarations

Since October 1962, Cowlitz County has been declared a Federal Disaster Area 19 times. Cowlitz County has received four Federal Disaster Declarations since the adoption of the *Cowlitz County Hazard Mitigation Plan in February 2005*. Table 12, below, summarizes the Federal Disaster Declarations since 1956 that have included Cowlitz County, by type. The number of Federal Disaster Declarations affecting the county provides some idea of the risk that natural hazards pose to the region.

Table 12 Summary of Federal Declarations for Cowlitz County		
1956-2009 by Type		
Major Disaster Declarations:	16	11 floods, 1 windstorm, 1 earthquake, 1 volcano, 1 wildfire, 5 landslides, 8 severe storms
Emergency Declarations:	2	1 threat of Spirit Lake flooding, 1 hurricane Katrina evacuees
Fire Suppression Declarations:	1	Ballpark fire

Hazard Identification

Several sources were referenced to identify the hazards that threaten the region. Hazard identification was principally derived from the *Washington State Enhanced Hazard Mitigation Plan* (2007). Other sources included the National Climate Data Center, the Hazards and Vulnerability Research Institute, the National Weather Service, the United States Geological Survey, FEMA, and the Washington State Departments of Natural Resources and Ecology.

Local governments and the communities of Cowlitz County are subject to a wide variety of natural and human-influenced hazards. Some hazards pose a greater threat to Cowlitz County communities than others. The following hazards have been identified as those most likely to occur in the region:

Earthquake - Washington State is situated near a tectonic collision boundary where the oceanic Juan de Fuca plate dives beneath the continental North American plate. The plate boundary is the Cascadia Subduction Zone which lies about fifty miles offshore, extending from near Vancouver Island to northern California. These plates are converging at a rate of 1 to 1 ½ inches per year. As the Juan de Fuca plate slides beneath the North American plate, cracks or faults develop at their boundary and at the surface in response to bending. The friction caused by this sliding movement tends to stick the two plates or two sides of a fault together. Over time, tremendous pressure builds up and friction is overcome. When this happens, one plate or one side of a fault moves relative to the other plate or side resulting in the sudden release of energy that is felt as an earthquake.

Flood – Of all natural hazards that affect Cowlitz County, floods are the most common and, on an annual average basis, the most costly. Two types of flooding occur in the county: riverine and groundwater.

Landslide – Landslides are the release of rock, soil, or other debris and its subsequent movement down a slope or hillside. They are generally caused or controlled by a combination of geology, topography, weather and hydrology and can be influenced by development practices. Landslides vary greatly in size and composition: from a thin mass of soil a few yards wide to deep-seated bedrock slides miles across. The travel rate of a landslide can range from a few inches per month to many feet per second depending on the slope, type of materials, and moisture content.

Severe Winter Storm – Destructive storms come in several varieties: wind, rain, ice, snow and combination. Nearly all destructive local storms occur from November through April when the jet stream is over the western United States and Pacific low pressure systems are more frequent. The trajectory of those lows determines their effect locally. The more southerly ones bring heavy rains while the more northerly ones bring cold air and the potential for snow and ice. Any winter storm, regardless of its trajectory, can pack high winds. Generally, winds above about thirty miles per hour can cause widespread damage and those above about fifty miles per hour can be disastrous. High winds of short duration, such as tornadoes and strong gusts from thunderstorms can also be destructive though generally not as widespread.

Volcanic Activity – A volcano is a vent in the earth's crust which ejects gases, ash, rock fragments, and magma from the earth's interior. Volcanoes are known to periodically erupt due to internal pressure from gas and molten rock. They are capable

of causing catastrophic destruction from events such as ash fall, lava and pyroclastic flows, debris avalanches, and lahars. Cowlitz County is susceptible to volcanic activity from Mount St. Helens, Mount Rainier, Mount Adams and Mount Hood.

Wildland Fire – A wildland or wildfire is any instance of uncontrolled burning in grasslands, brush, or woodlands. Wildland fires are most likely to occur during the local dry season – mid-May through October or anytime during prolonged dry periods causing drought or near-drought conditions. The likelihood of a destructive fire occurring depends on weather, fuel conditions, topography, and human activities such as debris burning, land clearing, camping and construction. Greater than four out of five forest and wildland fires are started by people, often due to negligent behavior such as failure to properly extinguish smoldering debris or campfires. More detailed descriptions for the hazards selected for this risk assessment are located in the Hazard Profiles.

Hazard Risk Assessments Included in this Chapter

The *2005 Cowlitz County Hazard Mitigation Plan* profiled the most destructive and frequently occurring natural hazards that affect the region: earthquake, flood, storm, and landslide. Budget resources and time constrained a full analysis of every potential hazard identified during the 2005 planning process. The update of this plan includes two additional hazard profiles, volcanic hazards (ash fall and lahar) and wildland fire hazard. Every hazard profile was reevaluated and updated with this plan update. Every hazard that is profiled in this plan meets one or all of the following criteria:

1. High probability of the natural hazard occurring in Cowlitz County within the next 25 years; and/or
2. Potential for significant damage to impacted buildings and infrastructure; and/or
3. Potential for loss of life.

The following natural hazards meet one or more of the above criteria and are profiled in this plan:

Table 13
Assessment of Natural Hazards

Hazard	Probability of Occurrence	Vulnerability	Risk
Earthquake	High	High	High
Severe Winter Storm	High	High	High
Flood	High	High	High
Landslide	Moderate	Low	Moderate
Wildland Fire	Low	Moderate	Moderate
Volcanic Event	Moderate	High	Moderate

Hazard Profile Format

The Hazard Profiles that follow in Sections 4.1 through 4.6 address the following DMA Risk Assessment Planning Requirements:

General Contents

The six hazard profiles contain information that is useful to understand the risks the county and local communities face from the hazards included in the subsequent sections. Each hazard is described in terms of its source, effects, severity, impact, probability of occurrence, historical impacts and occurrences, geographic extent or delineation, and the portion of the population, assets, and critical infrastructure that is potentially exposed to the hazard. This information is presented in a non-technical manner with narrative passages, figures, tabular data, and maps. The sum of all of the information contained in each hazard profile leads to a summary risk assessment.

Information to support the hazard profiles was obtained through a variety of sources including local agency personnel, federal and state scientists, existing plans, books, scientific journals, newspaper articles, federal and state agency websites, and online data archives. Endnotes are included to cite relevant sources of information. There are sections in the plan that lack sufficient information and data to adequately address some of the required components of the risk assessment. Information gaps are noted in the narratives. For more information on the data and procedures used to develop the risk assessment, refer to Chapter 4.0, Risk Assessment.

Structure of Hazard Profiles

Each Hazard Profile is formatted as follows (a brief description of relevant headings is provided):

Introduction

Hazard Identification

Definition: Each hazard is defined by its elements, effects, and the source or origin of its energy.

Severity: Severity describes or measures the strength or magnitude of hazard elements or hazard events. For example, wind speed can be measured in miles per hour, temperatures in degrees Fahrenheit, snow depth accumulations are measured in inches and, earthquakes are measured using the Richter Scale, etc. Severity can also describe the duration or spatial extent of a hazard effect. Severity is an important factor for assessing vulnerability.

Impacts: This principally describes the negative physical, economical, environmental, and social consequences resulting from the effects of natural hazards. The impacts are based on both actual past events in Cowlitz County (or neighboring Washington State communities) and potential impacts. Repetition of the same types of destructive impacts between isolated hazard events is a good indication of exposure or vulnerability. Sometimes there are long-term environmental benefits from certain natural disasters and these are noted where relevant.

Probability of Occurrence: Probability is an important component for evaluating risk. It is a statistical measure of the likelihood of a hazard event occurring during a specific period of time such as annually, every 25 years, or for a specific period of recorded observations. Numerically, it is expressed by the ratio of the number of actual occurrences to the total number of possible occurrences. It is described in both numeric and qualitative terms in this plan. The summary assessment (see below) considers probability for a 25 year interval.

Historical Occurrences and Impacts: Past events are perhaps the best indication of the type and extent of losses that local communities can expect to endure following future natural hazards. This section includes a chronological listing of notable past events that have impacted Cowlitz County and the Pacific Northwest. It is not an exhaustive list of all past events, but rather a representative history of hazard events that highlight the type, extent, location and cost of destruction.

Delineation of Hazard Area: This is a description of the geographical extent of the hazard area based on the hazard profile such as flood plains for the flood hazard, liquefaction zones for earthquakes, and lahar inundation zones for volcanic events, etc. This section describes which communities are most vulnerable to a hazard when appropriate. Tabular data showing proportion of land area by jurisdiction that is in and out of the hazard area is shown. Geographical extent is also depicted on one or more maps for every hazard except Severe Storm. More detailed maps of each jurisdiction's hazard zone are located in the respective jurisdiction annex.

Population and Employment in the Hazard Area: Tabular data is provided to assess an aspect of current and future vulnerability by providing data on the number of people living within the potential hazard area as compared to total population. More information about population and growth trends can also be found in Chapter 3, Cowlitz County Community Profile. Data for Severe Storm are not included as the entire county is vulnerable to the effects of storm. Total population affected by storm can be inferred from the "total" columns from the other hazard profiles.

Inventory of Assets and Dollar Value in the Hazard Area: Tabular data is provided to estimate the value of properties that may be located within a potential hazardous area. Staff discussed valuation issues with the Cowlitz County Assessor, who is also the Cowlitz GIS Manager, and it was decided that caution is necessary when trying to assign a value to properties and structures in potential hazardous areas. Much of the data depicting environmentally sensitive areas that is the foundation for identifying potentially hazardous areas was actually created at a national scale and is meant to only be used at large scale applications. Because of the limitations of the data, it is inappropriate to claim a certain property is within a hazard area and the neighboring property is outside the area. Other data is dated and no longer accurate in some places. The FEMA flood data for Cowlitz County was created in 1996 and many FIRM maps have been updated since then. With highly sensitive flood-related studies occurring throughout the county for a variety of reasons, staff cannot assign valuations using data that is known to be flawed. Instead, staff provided a range of values that estimates values in potentially hazardous areas.

Critical Facilities and Infrastructure in Hazard Area: Natural hazards can destroy or damage facilities that may be critical for responding to the disaster and for maintaining a safe environment and public order. Nearly all critical facilities in Cowlitz County have been mapped. Data on the types and quantities of critical facilities that occur in hazard areas is summarized in a table within each profile. Specific information about the location of critical facilities and infrastructure is maintained by Cowlitz County Department of Emergency Management.

Summary Assessment: A summary risk assessment is established for each Hazard Profile. This summary is based on a subjective examination of any given hazard's probability of occurrence combined with the region's overall vulnerability to the hazard. The risk rating is assigned on the probability of a hazard occurring over the next 25 years. This interval was chosen because it is the long term recurrence interval of a dangerous earthquake, the hazard of the greatest risk to Cowlitz County. More information about the summary assessment is included in the hazard analysis definitions.

Hazard Analysis Definitions

The adjective descriptors (High, Moderate, and Low) for each hazard's probability of occurrence, vulnerability, and risk rating were derived from Cowlitz County's DEM. The following terms are used in this plan to analyze and summarize the risk of the hazards considered:

Risk Rating: An adjective description (High, Moderate, or Low) of the overall threat posed by a hazard is assessed for the next 25 years. Risk is the subjective estimate of the combination of any given hazard's probability of occurrence and the region's vulnerability to the hazard.

- High: There is strong potential for a disaster of major proportions during the next 25 years; or history suggests the occurrence of multiple disasters of moderate proportions during the next 25 years.
- Moderate: There is medium potential for a disaster of less than major proportions during the next 25 years.
- Low: There is little potential for a disaster during the next 25 years.

Probability of Occurrence: An adjective description (High, Moderate, or Low) of the probability of a hazard impacting Cowlitz County within the next 25 years.

- High: There is great likelihood that a hazardous event will occur within the next 25 years.
- Moderate: There is medium likelihood that a hazardous event will occur within the next 25 years.
- Low: There is little likelihood that a hazardous event will occur within the next 25 years.

Vulnerability: Vulnerability can be expressed as a combination of the severity of a natural hazard's effect and its consequential impacts to the community. An adjective description (High, Moderate, or Low) of the potential impact a hazard could have on Cowlitz County. It considers the population, property, commerce, infrastructure and services at risk relative to the entire county.

- High: The total population, property, commerce, infrastructure and services of the county are uniformly exposed to the effects of a hazard of potentially great magnitude. In a worst case scenario, there could be a disaster of major to catastrophic proportions.
- Moderate: The total population, property, commerce, infrastructure, and services of the county are exposed to the effects of a hazard of moderate influence; or The total population, property, commerce, infrastructure, and services of the county are exposed to the effects of a hazard of moderate influence, but not all to the same degree; or An important segment of population, property, commerce, infrastructure and services of the county are exposed to the effects of a hazard. In a worst case scenario there could be a disaster of moderate to major, though not catastrophic, proportions.
- Low: A limited area or segment of population, property, commerce, infrastructure, or service is exposed to the effects of a hazard. In a worst case scenario, there could be a disaster of minor to moderate proportions.

Local Annexes

A local risk assessment is included in the local annex for each hazard mitigation planning partner. The annex describes each jurisdiction's risk where they vary from the risks facing the entire planning area. The format of the local risk assessment is consistent with the regional hazard profiles as described in the section titled "Structure of Hazard Profiles."

Chapter 4.1: Earthquake Hazard Profile

Introduction

Of all the natural hazards that affect the region, earthquakes cause the most widespread infrastructural damage and disruption of services and essential operations across all sectors of society. Washington State experiences more than 1,000 earthquakes a year,[1] but the majority of these events pass without notice. At least 20 damaging earthquakes have rattled the State in the last 125 years; most have occurred in western Washington. Cowlitz County, incurred significant damage from the effects of the 2001 Nisqually earthquake. Statewide, this magnitude 6.8 earthquake caused nearly 700 injuries. A precise damage figure for this earthquake is unknown, but estimates have been reported as high as $4 billion.[2]

Scientists still lack tools to predict the time, size, and location of earthquakes, but significant efforts have been made towards understanding their sources and effects. The western United States has been very proactive with earthquake mitigation. The mapping of known faults, soils, and liquefaction areas provides information that can assist communities with modifying building codes and developing appropriate land use zoning for high risk areas. Schools and public and private sector employers educate students and employees with earthquake safety drills and preparedness exercises.

The earthquakes of 1949, 1965, and 2001 are a clear indication that earthquakes of this magnitude are likely to reoccur within the 25 year planning horizon, a high probability of occurrence. Each of these events caused significant widespread damage. The 2001 earthquake revealed that the region remains highly vulnerable, therefore the region has a high risk rating for earthquakes.

Hazard Identification

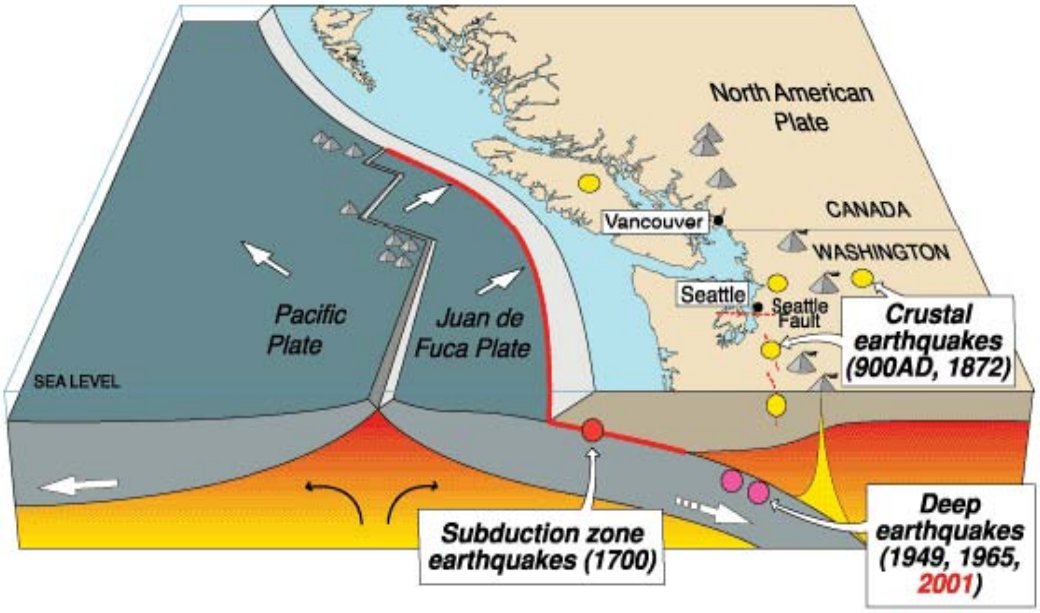
The Pacific Northwest is the most geologically active region in the contiguous U.S. Washington State is located on a convergent continental margin, the boundary between two colliding tectonic plates (Figure 6). This area is called the Cascadia Subduction Zone. It is located offshore, stretching from northernmost California to southernmost British Columbia. At this convergent zone, the North American continental plate collides with the Juan de Fuca oceanic plate. They converge at a rate of about two inches per year. A third, the Pacific plate, pushes the Juan de Fuca plate north causing a complex seismic strain where the plates converge.[3] The strain slowly builds up energy over time.

Definition

An earthquake occurs when the pressure of seismic stress is abruptly released. The seismic energy is dispersed in waves that move through the earth and cause the ground to shake violently. It is this shaking motion and the subsequent behavior of the earth's surface – liquefaction, landslides, ruptures, or ground failure that causes the destruction of buildings and other infrastructure.

When a fault ruptures, seismic waves radiate, causing the ground to vibrate. It is the vibration of these waves that cause the ground to shake during an earthquake. The

Figure 6: Cascadia Earthquake Sources Earthquakes



Source	Affected area	Max. Size	Recurrence
Subduction Zone	W.WA, OR, CA	M 9	500-600 yr
Deep Juan de Fuca plate	W.WA, OR,	M 7+	30-50 yr
Crustal faults	WA, OR, CA	M 7+	Hundreds of yr?

effects of ground shaking produce ground failures, tsunamis, and seiches. Shaking is strongest in areas of soft soils, such as in river valleys or along the shorelines of bays and lakes. Wave velocity is slower in soils than in the underlying rock of the earth's crust. Softer soils amplify ground shaking. The greater the wave velocity difference, the greater the amplification of ground surface shaking. Consequently, ground shaking in areas of soft soils underlain by stiffer soils or rock is generally stronger than in areas where there is little or no variation between the surface and lower layer.[4]

Ground failures include surface faulting, landslides, subsidence and uplifting. Surface faulting is the differential movement of two sides of a fracture - in other words, the location where the ground breaks apart. The length, width, and displacement of the ground characterize surface faults. Subsidence is the sinking of soils. Uplifting is the elevation of soils. Unstable and unconsolidated soils are most vulnerable to ground failures and surface faulting.

Liquefaction is the phenomenon that occurs when ground shaking causes loose soils to lose strength and act like viscous fluid. Liquefaction causes two types of ground failure: lateral spread and loss of bearing strength. Lateral spreads develop upon gentle slopes and entail the sidelong movement of large masses of soil as an underlying layer liquefies. Loss of bearing strength results when the soil supporting the structures liquefies. This can cause

structures to tip and topple. Liquefaction typically occurs in artificial fills and in areas of loose sandy soils that are saturated with water, such as low-lying coastal areas, lakeshores, and river valleys.

Tsunamis are large ocean waves generated by sudden changes in the sea floor elevation which displace a significant volume of water. Tsunamis can be caused by subduction zone earthquakes, submarine landslides, or a submarine volcanic explosion. A major earthquake from the Cascadia Subduction zone could cause a Pacific Northwest Tsunami. Tsunamis can be tens to thousands of kilometers in length and can threaten shorelines around the entire Pacific Rim. On December 26, 2004, a 9.2 magnitude earthquake occurred along a tectonic subduction zone where the India Plate, an oceanic plate, and the Burma micro-plate, part of the larger Sunda plate, collide. This event triggered the worst tsunami ever recorded in terms of lives lost. This tsunami ravaged coasts with waves as high as 20 to 30 meters and killed 230,000 people around the Indian Ocean.

The sources of Pacific Northwest Earthquakes are included below in the "Severity" section.

Severity

There are several common measures of earthquakes. The Richter Magnitude Scale (used in this hazard profile) is a mathematical scale which measures the intensity of ground motion. Because of the logarithmic basis of the scale, each whole number increase in magnitude represents a ten-fold increase in measured amplitude, and 31 times more energy released. The Modified Mercalli Intensity Scale measures the earthquake intensity by the damage it causes. Peak ground acceleration (PGA) is a measure of the strength of ground movements. It expresses an earthquake's severity by comparing its acceleration to the normal acceleration due to gravity.

The severity of an earthquake is also dependent upon the source of the quake. The severity of the vibration increases with the amount of energy released and decreases with distance from the causative fault or epicenter. Three kinds of earthquakes are recognized in the Pacific Northwest: crustal earthquakes, subduction zone earthquakes, and deep earthquakes (Figure 6).

1. Crustal (shallow) earthquakes occur along faults close to the surface of the North American plate. They have a maximum depth of about 19 miles, though most occur much closer to the surface. The majority of earthquakes in the Pacific Northwest are of the shallow type. They could potentially produce magnitudes as high as 7.5, though most are less than 3.0. Scientists are locating and studying active faults that are located within the Puget Sound lowlands. The Seattle fault is perhaps the most infamous as it lies under the most densely populated area of the state. A magnitude 6.0 or greater earthquake originating from a surface fault could render incredible destruction. More research is necessary to verify the existence of the Olympia fault structure and its probability of rupturing.

2. Subduction zone or interplate

earthquakes emanate from the boundary where the Juan de Fuca plate subducts eastward into the North American Plate. The width of the Cascadia Subduction Zone fault varies along its length, depending on the temperature of the subducted oceanic slab, which heats up as it is pushed deeper beneath the continent. As it becomes hotter and more molten it eventually loses the ability to store mechanical stress and generate earthquakes. An earthquake from this zone would be considered “the Big One,” as it could travel over hundreds of miles and last for several minutes. Subduction zone earthquakes are considered to be the most destructive with potential magnitudes of 9.0 or greater. The last subduction zone earthquake is believed to have occurred in 1700.

3. Deep earthquakes occur along faults in the Juan de Fuca plate as it sinks beneath the North American plate. These earthquakes are located under the North American Plate; therefore their energy translation to the surface is buffered by their depth. Their depths generally range from 16-62 miles. Magnitudes of 7.5 have been recorded. The 1949, 1965, and 2001 earthquakes all emanated from this zone. The 2001 Nisqually earthquake's focus was located about 32 miles deep below its epicenter on Anderson Island.

Impacts

The impact from earthquakes to communities is well evidenced by the catastrophic events in San Francisco and Los Angeles in the United States; Kobe, Japan; Chengdu, China; and Kashmir, Pakistan. Failed buildings, bridges, and other structures can trap or bury people causing injury and death. Damage to infrastructure such as roads, bridges, rail lines, runways, and almost all types of utilities is certain. Infrastructural failures can result in loss of public and private sector services and business. Communities are likely to face communication, electricity, motor fuel, and natural gas disruptions. Structural fires are a secondary hazard from earthquake destruction. Individuals and households may be displaced due to damaged homes. A subsequent economic downturn would likely result from major transportation disruptions and loss of revenue from suspended business and services.

In the Puget Sound Region, older unreinforced masonry structures such as buildings, walls, chimneys, and facades are vulnerable to crumbling from ground shaking. Areas with soft soils, such as downtown Longview and Kelso and adjacent neighborhoods have experienced these types of destruction during the 1949, 1965, and 2001 earthquakes.

Fire fighters, police, public works, and other safety and emergency personnel can quickly become over extended with response and recovery operations. Transportation disruptions will hinder emergency response to remote or hard to reach areas. Building and structural inspections will become priorities for public works and development services personnel and disrupt other operations.

The Washington State Hazard Mitigation Plan cites a study of an earthquake scenario of immense destruction and casualties. Should a magnitude 6.7

earthquake emanate from the Seattle Fault, a shallow crustal fault, the central Puget Sound could experience:

- Complete damage to at least 58,000 buildings, costing $36 billion
- More than 55,000 displaced households
- Possibly 2,400 deaths
- 800 injuries requiring hospitalization

Although tsunamis are known to impact the coast of Washington, the Region is unlikely to be impacted by this hazard. Should the Washington coast be struck, the entire region could be indirectly affected by evacuating populations. Local governments in Cowlitz County could likely be challenged with response and recovery support assistance to affected populations and communities.

Probability of Occurrence

Earthquakes are certain to impact the Region in the future. The following probabilities of occurrence for the three earthquake sources are offered by the Washington State Hazard Mitigation Plan:

- Crustal Earthquake - A magnitude 6.5 or greater earthquake is estimated to occur once about every 333 years in the Puget Sound Lowlands
- Subduction Zone Earthquake - A magnitude 9.0 earthquake is estimated to recur every 350 to 500 years.
- Deep Earthquakes - Five magnitude 6 or greater earthquakes have occurred in the Puget Sound basin since 1900. Since 2001, the Cowlitz region has been rocked by three deep earthquakes; spaced 16 and 36 years apart since 1949 and 1965 respectively (about every 26 years). It is estimated that a magnitude 7.1 earthquake (1949 type event) will occur every 110 years.

Regardless the source of earthquake, past events suggest that a destructive event reoccurs about every 26 years. Therefore, the overall probability of occurrence of a damaging earthquake is high.

Earthquake Historical Occurrences and Impacts

February 28, 2001, Federal Disaster 1361: Nisqually Earthquake

At 10:54 a.m. a magnitude 6.8 earthquake produced strong ground shaking across Washington State. The epicenter was located near Anderson Island, approximately 11 miles north of Olympia near the Nisqually River Delta. The focus was located nearly 32 miles underground. The depth of the earthquake minimized the intensity of the shaking and limited the impact to the built environment. In addition, drought conditions in Washington reduced the number of landslides and amount of liquefaction that would have otherwise been caused by a quake of that magnitude with saturated soils. Nevertheless, the observations of geotechnical engineers indicate that liquefaction was widespread in parts of the Puget Sound. Several significant lateral spreads, embankment slides, and landslides also occurred. The relatively long duration of the event and the relatively low cyclic resistances of some of the fills in the area are likely causes for the significant liquefaction and ground failure which occurred.

Cowlitz County was among the counties issued for emergency relief in the State. A federal disaster declaration was issued only one day after the event. Statewide, the

Nisqually earthquake resulted in 700 injuries (a dozen of them serious) and one confirmed death (a trauma induced heart attack). Federal Emergency Management Agency (FEMA) reported that 41,414 people registered for federal disaster aid, more than three times the number of a previous disaster in Washington.

One year after the earthquake, news reports put reported property damage at approximately $500 million. However, when factoring in unreported damage, actual losses may run significantly higher. A University of Washington study of damage to households only, estimates that the earthquake caused $1.5 billion in damage to nearly 300,000 residences.[5] This estimate does not include public and business sector losses. Other estimates of the combined losses to public, business, and household property have ranged from $2 billion to $4 billion. Most buildings performed well from a life-safety standpoint, in that the limited structural damage that occurred caused no loss of life or collapse. However, the economic cost of nonstructural damage, i.e., damage to nonessential building elements, such as architectural features, ceiling failures, shifting of equipment, fallen furniture/shelving, desktop computer damage, fallen light fixtures, and losses due to lost productivity, was high. In general, new buildings and buildings that had recently been seismically upgraded typically displayed good structural performance, but many still sustained non-structural damage.

April 29, 1965, Federal Disaster 196: Seattle Tacoma Earthquake

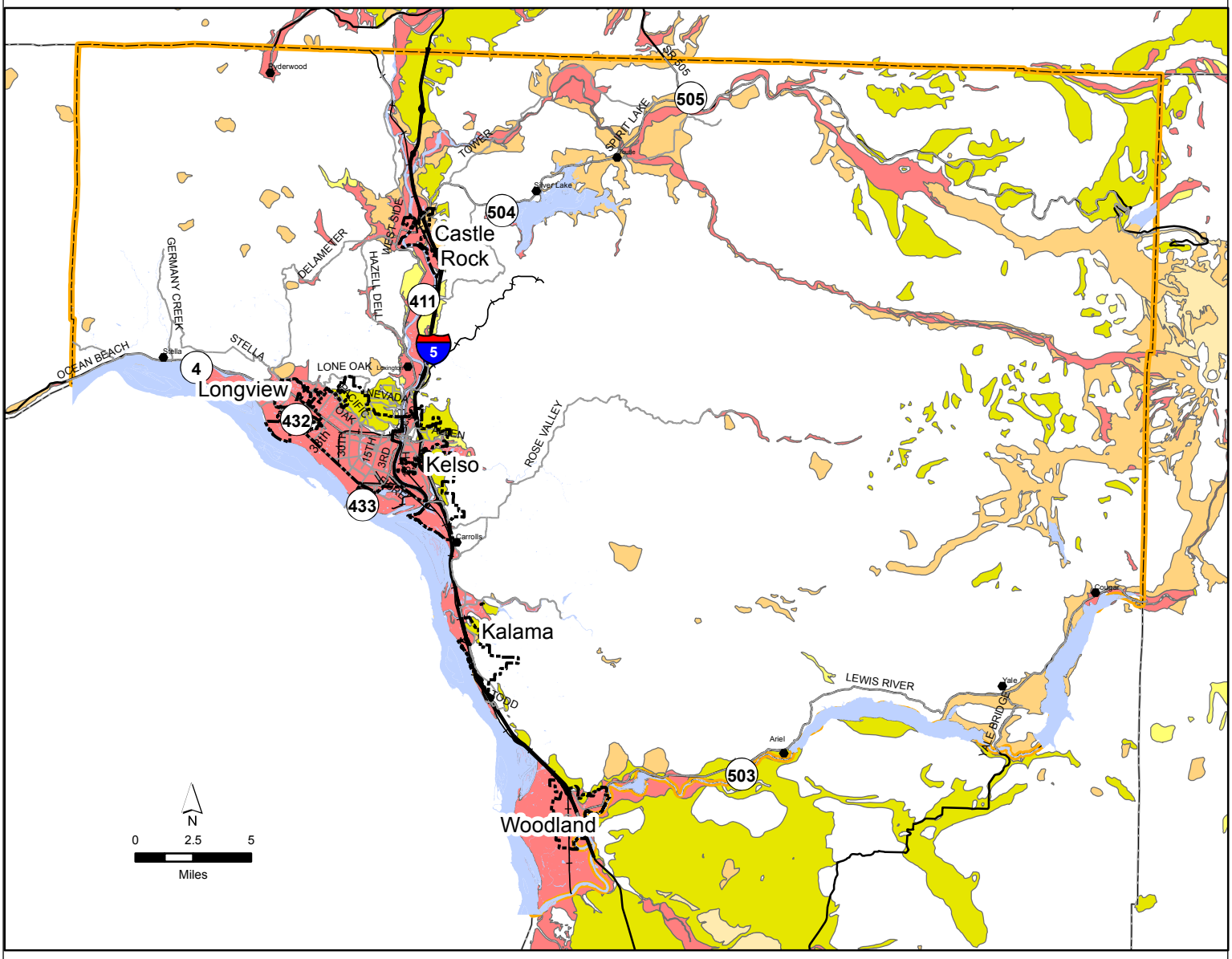
A magnitude 6.5 earthquake struck the Puget Sound Region at 7:28 a.m. The epicenter was located about 12 miles north of Tacoma at a depth of about 40 miles. Damage from the 1965 quake killed seven people and damage was estimated to be $12.5 million; with much of the loss in King County. In Olympia, the Union Pacific Railroad reported a hillside fall slid away from beneath a 400 foot section of a branch line just outside Olympia. Damage to the legislative building forced the closure of the legislative session. Governor Dan Evans closed the Capitol Campus and state government operations came to a standstill except for retention of key personnel and critical services.

April 13, 1949, Olympia Earthquake

A magnitude 7.1 earthquake rattled the region at 11:55 a.m. The epicenter was located about eight miles north-northeast of Olympia. Property damage likely exceeded $25 million (1949 dollars). One student was killed by falling bricks from at Castle Rock High School. An unanchored gable collapsed above the main entrance way, causing this tragedy. Streets were damaged extensively and water and gas mains were broken.

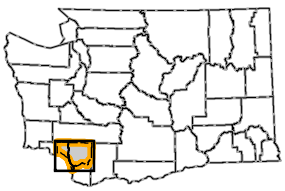
1949 earthquake, Washington State. Gables on a number of unreinforced masonry school buildings collapsed; fatalities recorded.

Figure 7
Potential Liquifaction Hazard Areas
in Cowlitz County



City Limits
Major Roads
Interstate Five (I-5)
Rail
Rivers/Lakes

Potential Liquification Zone
Susceptibility
high
moderate to high
moderate
low to moderate
low
very low to low
very low



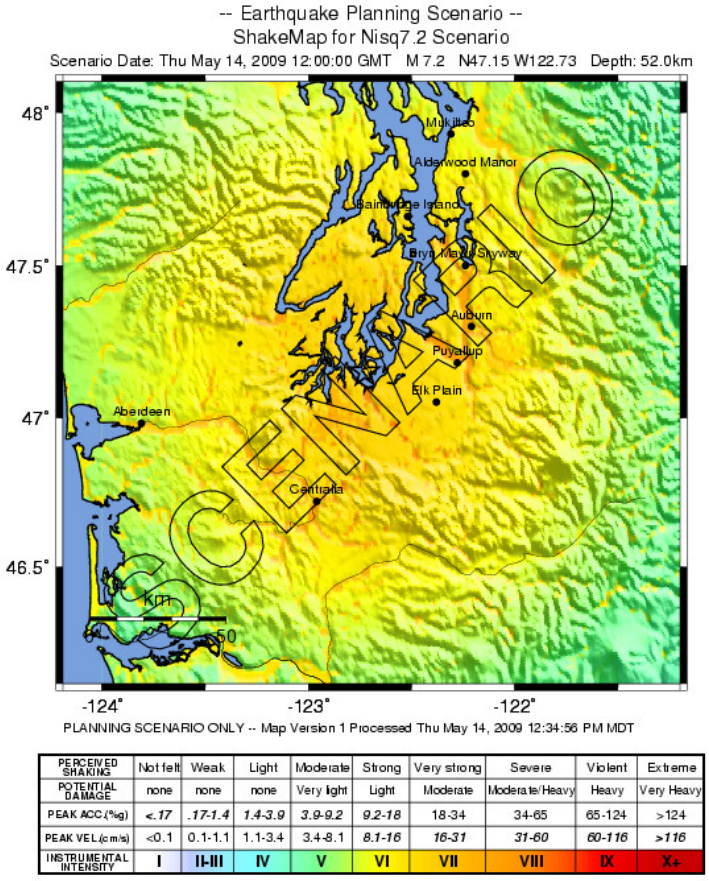
Shared/Planners/Haz_Mit/March/Maps/Earthquake

Delineation of Earthquake Hazard Area

In 2004, the hazard mitigation planning workgroup factored the location of damage from the 2001 Nisqually earthquake as a factor for determining which risk levels to use in defining the earthquake hazard area. Areas most damaged reflected liquefaction susceptibility levels. The previous plan's earthquake hazard extent was confined to the north urban core of the county, as the liquefaction susceptibility data was limited to this area. The data tables in this hazard profile reflect data for the entire county. The earthquake hazard area is defined by using a standardized classification scale ranging from "Low" to "High." The Potential Liquefaction Zones are depicted on the map of this section. Please note there are no areas within Cowlitz County designated as being a high potential risk, but that most of the urbanized areas are within areas designated a "Moderate to High" risk.

Figure 8

USGS ShakeMap for 7.2 Magnitude Earthquake on the Nisqually



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17-1.4*	*1.4-3.9*	*3.9-9.2*	*9.2-18*	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	*8.1-16*	*16-31*	*31-60*	*60-116*	*>116*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Communities Most Vulnerable to Earthquake

As discussed previously in the chapter, liquefaction is a phenomenon that occurs when the strength of a saturated soil is reduced by earthquake shaking or other rapid loading. The Euro-American traders and pioneers in Cowlitz County settled primarily along rivers, where the soils are prone to saturate. Because these settlements of the early to mid nineteenth century have evolved into the urbanized areas of today, approximately half of the county's population (50,700 of 100,000) is located in areas designated a "Moderate to High" risk to be adversely affected by a liquefaction event, including the populations of all the incorporated cities and the unincorporated Census Designated Areas of Ryderwood and Lexington.

The locations of certain special needs populations in relation to potential hazardous areas are identified and discussed within the *Community Profile* of Chapter 3. Included in the discussion is a map on page 31 titled, "Year 2000 Census Block Groups Containing populations with Greater than 50% Low Income Designation". The areas identified by those Census Block Groups are also identified as having a "Moderate to High" liquefaction risk as depicted in the map on page 45. Considering that these locations are comprised of population with the highest percentage of renters and the highest percentage of persons living in poverty, one can assume the structures are not being maintained to the greatest potential, thus further opening the possibility to be adversely affected by a liquefaction event.

The elderly is another special needs population that may be potentially vulnerable to a liquefaction event. In Chapter 3, Table 7, *Nursing Homes in Cowlitz County in Relation to Potential Hazard Areas,* and Table 8, *Adult family Homes in Cowlitz County in Relation to Potential Hazard Areas,* provided on pages 26 and 27, respectively, show that almost all elderly care facilities in Cowlitz County are located in areas designated a "Moderate to High" risk for a liquefaction event. Further identifying the locations of special needs populations with respect to potential hazard areas and drafting goals, policies and objectives for elected officials to consider when adopting emergency response plans will be performed in 2011.

Critical Facilities and Infrastructure in Hazard Area

The Washington State Emergency Management Division calculated the annualized earthquake loss for all Washington counties using a hazard loss estimation tool called HAZUS. This model factors for the probability of ground motion occurring in the study area and the consequences of the ground motion. Parameters include direct economic losses to buildings attributed to repair and replacement, damage of contents and loss of income. Note that this loss estimate represents a long term average and the analysis is based on state and federal data sets. The HAZUS-MH analysis indicates that the Annualized Earthquake Loss (AEL) to the national building stock is $5.3 billion per year. The majority (77%) of average annual loss is located on the West Coast (California, Oregon, Washington).[6] The state of Washington ranks second, behind California, in the amount of AEL with $366,431,000.

Based on historical earthquake community impacts, it is clear that earthquakes can

destroy or damage facilities that may be critical for responding to the disaster and for maintaining a safe environment and public order. Among these are communications installations; electrical generation and transmission facilities; water storage, purification, and pumping facilities; sewage treatment facilities; hospitals; and police and fire stations. In addition, earthquakes can seriously disrupt the transportation network; bridges can be knocked out, and roads and highways damaged or blocked by debris, further isolating resources. In a major earthquake, almost all surface means of transportation within a community may be disrupted, particularly in the initial stages of the hazard event.

The Cowlitz County Facilities Maintenance Department has begun to conduct a vulnerability analysis to identify weaknesses in the system that may be exposed or significantly impacted by a natural disaster. In winter 2010, a draft document titled Disaster Mitigation for Government Buildings in Cowlitz County was produced with the objective of establishing priorities for either retrofitting, repairing or relocating facilities. The document is included as Appendix A. The findings, conclusions and recommendations of that report are incorporated into this planning effort and the authors are active members of our Workgroup.

The Disaster Mitigation for Government Buildings in Cowlitz County report analysis focuses on the ability of Cowlitz County Facilities to withstand the three most common natural disasters, (earthquake, flood and wind) that we could experience in the next 5-to-50 years. The analysis evaluated the potential impacts on government buildings during an earthquake above 7.5 on the Richter scale with an epicenter within twenty miles of Longview, Kelso.

> *Expectations for government buildings during and after a hazard event are different than those for most buildings because these buildings house emergency response centers such as 911 and the Departments of Emergency Management and evacuation centers. Our buildings must be well thought-out, well built, and well maintained to meet the demands placed on the government during times of social crisis.*[7]

Table 14
Cowlitz County Critical Facilities in Relation To Potential Earthquake Hazard Areas

Building	Liquefaction Zone	Building Value ($)	Content Value ($)	Total Value ($)
Abernathy Radio Relay Station	None	98,992	113,214	212,206
Administration Building	Moderate to High	26,581,900	2,724,900	29,306,800
Annex Building	None	6,448,100	410,800	6,857,900
Camelot Drive Reservoir	None	20,800	1,000	21,800
Carrolls Road Radio Tower	None	13,758	12,399	26,157
Central Shop	Moderate to High	450,500	144,700	595,200
Columbia Heights Radio Tower	None	85,519	113,214	198,733
Coroner	Moderate to High	15,471	8,045	23,516
Davis Peek Radio Relay Station	None	126,731	0	126,731
Hall of Justice	Moderate to High	37,630,200	6,127,800	43,758,000
Health Dept/Human Services	Moderate to High	1,495,068	242,081	1,737,149
Juvenile Center	Moderate to High	10,038,000	703,900	10,741,900
Motor Pool	Moderate to High	17,770	12,747	30,517
Public Works Building	Moderate to High	1,594,200	458,500	2,052,700
Ryderwood Water Reservoir	None	1,040,000	0	1,040,000
Ryderwood Water Treatment Plant	Moderate to High	407,500	1,235,000	1,642,500
Ryderwood Sewage Treatment Plant	None	104,000	5,000	109,000
South Silver Lake Water Reservoir	None	520,000	0	520,000
Tower Road Reservoir	None	208,000	0	208,000
Toutle Sewer Treatment Plant	Moderate to High	182,400	475,000	657,400
Toutle Water Reservoir	Low to Moderate	1,040,000	0	1,040,000

*Please note the draft Disaster Mitigation for Government Buildings in Cowlitz County report evaluates potential impacts of natural hazard events on *all* county owned buildings. This planning effort attempts to evaluate potential impacts of *critical* facilities. Because of the different objectives of the two studies the total amounts will be different. Staff suggests the critical facilities totals be identified separately when the draft report is finalized.

Issues

The following issues were identified during studies on the potential impact of an earthquake above 7.5, on the Richter Scale, with the epicenter within 20 miles of Kelso/Longview:

- The Hall of Justice, Jail, Health Department and Public Works Office have major damage but remain operational.
- Juvenile Center may not remain in service due to lack of electrical and no natural gas for heating and the emergency generator.
- Conference Center, Maintenance Building and Administration Annex have significant damage and need repair before restoring operations.
- Administration Building is significantly damaged and/or collapsed. If the building does survive, electrical power, water supply and sewer are out of service for weeks if not months.
- The Allen Street & Sparks Drive Bridges are the only remaining operational bridges.
- Department of Emergency Management, 911 call center, Sheriffs' Office, Courts, Prosecuting Attorney Office, Offender Services remain operational, but lack water and sanitary sewer services.
- All other County services are not operational for weeks or months.
- The majority of the telephone system and intranet services are not operational for days, if not weeks.
- Natural Gas mains are closed. No Heating in the Jail and Juvenile Building. Juvenile emergency generator is not operational.

Table 15
Cost-Benefit of Improving County Buildings

Action	Benefit	Cost
Seismically retrofit the Administration & Annex Buildings or build new.	Reduces the risk of significant employee injury and /or death. Additionally, provides for the continuance of government "Based on 1991 seismic study"	Retrofit estimate is $27,750,000., and one and a half years to complete. New building estimate is $23,775,000 plus 1-1/2 years to complete. During retrofit of existing facilities, rental/lease office space for 1-1/2 years, depending upon availability of open office space locally. Possible rental/lease of office portables—hook up to electrical, water, and sewer services for 1-1/2 years. Moving costs. Cost est. = $1,000,000 + retro/new construction $$.
Seismically retrofit the Hall of Justice.	Minimizes injury and allows emergency services to continue operation. "Based on 1991 seismic study"	Estimated cost = $3,737,000
Seismically retrofit the Health Department and install an emergency generator	Reduces the chance of injury and the continuance of services.	Estimate $550,000.00
Seismically retrofit the Morgue or build new and install an emergency generator.	Allows for the coordination of the deceased during and after a disaster.	Retrofit and generator estimate is = $250,000 New building estimate = $1,600,000
Hall of Justice: Build mezzanine under existing north end, third floor to stabilize lateral movement of existing structural columns with relocation of electrical, emergency generators and HVAC equipment.	Keeps building operational.	Estimated cost = $3,737,000

*Please note the draft Disaster Mitigation for Government Buildings in Cowlitz County report evaluates potential impacts of natural hazard events on *all* county owned buildings. This planning effort attempts to evaluate potential impacts of *critical* facilities. Because of the different objectives of the two studies the total amounts will be different. Staff suggests the critical facilities totals be identified separately when the draft report is finalized.

Table 16
Potential Vulnerability of County Facilities During a 7.5 Seismic Event

Vulnerability	Before the Actions are Implemented	After the Actions are Implemented	Difference
Number of people affected by the hazard	495	64	431
Area affected sq feet by the hazard	394,000	140,000	254,000
Property damage amount ($)	$32,000,000	$2,700,000	$29,300,000
Loss of use (number of properties lost in number of days	2,980-days	850-days	2,130-days
Loss of life (number of people)	77	5	72
Injury (number of people)	50	10	40

Summary Assessment

History suggests a high probability of occurrence of another damaging earthquake sometime in the next 25 years. With the 2001 Nisqually earthquake still fresh in the region's memory, it is important to note that it was not the largest earthquake event possible in the region. It is conceivable that a similar magnitude earthquake could emanate from a shallow crustal fault which would result in much greater damages. Damage from the 1949, 1965, and 2001 earthquakes indicate that an earthquake of a greater magnitude would have a catastrophic impact on Cowlitz County. Considering that a large population lives and works in higher risk earthquake hazard areas, the entire region has a high vulnerability rating. Accordingly, a high risk rating is assigned.

Earthquake Endnotes

[1] Timothy Walsh, et al. 2008. Earthquakes in Washington. Washington State Department of Natural Resources, Division of Geology and Earth Resources
[2] Washington State Emergency Management Division. 2007. Washington State Hazard Mitigation Plan
[3] Timothy Walsh, et al. 2008.
[4] Stephen P. Palmer. 2004. Site Class Map of Thurston County. Washington State Department of Natural Resources, Division of Geology and Earth Resources. Open File Report 2004-20
[5] University of Washington. 2002. Nisqually Quake Damaged Nearly 300,000 Puget Sound Households. Newswise.com, November 20, 2002. Online article. http://www.newswise.com/articles/view/?id=QUAKE2.UWA
[6] Federal Emergency Management Agency (FEMA). Publication #366: HAZUS MH Estimated Annualized Earthquake Losses for the United States. April 2008.
[7] Draft Disaster Mitigation for Government Buildings in Cowlitz County. Facilities Maintenance Department of Cowlitz County. 2010

Chapter 4.2: Storm Hazard Profile

Introduction

Of all the natural hazards that occur, storm events are the only hazards that can be readily predicted. Advances in weather forecasting technology allow for relatively accurate predictions of pending storms, their area of impact, and their likely effects three to five days before they occur. This allows the general population time to take safety precautions. But even with advance notification, communities remain vulnerable as evidenced by storm impacts that have frequently buffeted this region over the last decade.

Severe weather events are the most frequent source of natural disasters for Cowlitz County and its communities. Between 1962 and 2009, 9 of 19 Presidential Disaster Declarations for Cowlitz County were attributed to damage resulting from the effects of winter storms (principally damage from floods). Storms cause injury and sometimes death, but also cause significant property damage and disrupt daily life. In 2007, severe storms killed 19, injured 15, and caused $197 million in damage statewide in Washington.[1] The high reoccurrence rate of Pacific Northwest storms, the record of historical damage, and the repetitive response and recovery costs associated with these destructive events make the region highly vulnerable to storm events. Thus the overall risk rating for severe storms in the region is high.

Heavy rain and snow can cause flooding and landslides. Floods and landslides frequently result from heavy rain and/or melting snow in Cowlitz County. These hazards are treated independently in this plan. Refer to the flood and landslide hazard profiles for more information.

Hazard Identification

A severe storm is a meteorological event generated by atmospheric conditions. The most destructive storms in western Washington occur from October through April delivering sustained high speed directional winds and higher than normal levels of precipitation. These storms cause significant property damage, power loss, and disruption of services across all sectors of local communities. Winter storms are deadly because sustained sub-freezing temperatures pose significant operational problems for transportation. They also greatly increase the risk of hypothermia for elderly, low income and homeless populations or much larger populations when electrical power is disrupted. Thunderstorms also occur in Cowlitz County. These storms deliver hail, lightning and tornados to the region, but thunderstorm events are much less common, shorter lasting and the impacts and damages are much more isolated than winter storms.

High winds, heavy rain, heavy snow, freezing rain, tornados, hail and lightning all impact the region. Each element poses a threat and merits inclusion in this hazard profile. Winter storms that impact Cowlitz County usually pack more than one hazardous element at a time or deliver stand alone elements in consecutive blows such as a snow followed by heavy rain followed by a windstorm. This section defines each element, its severity, its impacts, and its probability of occurrence.

1. High Winds/Windstorms

Definition

The National Weather Service defines high winds as "sustained wind speeds of 40 mph or greater lasting for 1 hour or longer, or winds of 58 mph or greater for any duration."[2] Generally, winds above 30 mph can cause widespread damage and those above 50 mph can lead to more serious disasters. Most large windstorms that affect the region are delivered by mid-latitude eastern Pacific cyclones. Northern Hemisphere cyclones are large-scale storms with winds that rotate counterclockwise around a central region of low atmospheric pressure. These cyclones obtain their energy from the large horizontal variation in temperature in the mid-latitudes (30° to 60° north). Mid-latitude cyclones are not as powerful as tropical hurricanes. However they can generate wind speeds in excess of 100 mph and can maintain their strength farther inland and affect a much larger area of land.[3] The Puget Sound Region's most powerful southerly and westerly winds typically come from these storm systems when their low pressure centers move from southwest to northeast and cross the coast between the northern tip of the Olympic Peninsula to central Vancouver Island. Other landfall trajectories from northern Oregon to the central Washington coast are also capable of causing wide spread destruction in Cowlitz County.

Severity

The coastal mountains afford Cowlitz County some protection from severe southerly and westerly winds. The coastal mountain range acts as a buffer and shields the region from extreme winds in excess of 80 mph. Cowlitz County does not encounter the 100 mph or greater winds that sometimes wreak havoc on Washington's Pacific coast communities. Nevertheless, the entire region is directly or indirectly susceptible to the effects of high winds. Neighborhoods with stands of tall conifer trees are the most vulnerable to property damage. All communities can suffer power outages and be left in the cold and dark for extended periods.

The average monthly wind speed at the Olympia Airport, as recorded over a 49 year period, is between 6 and 7 mph. Fifty-nine winter windstorm events have buffeted the Pacific Northwest from October 1950 to December 2007.[4] Nine of these events produced peak gusts over 58 mph at the Olympia Airport weather station. The most powerful windstorm in the last 100 years occurred on Columbus Day, October 12, 1962. This storm tracked northeast along the Washington coast and produced record peak wind gusts of 78 mph at the Olympia Airport. The Beaufort Scale is provided as reference for damage effects relative to wind speed.

Impacts

The region, like most of western Washington, is vulnerable to high winds because of the climatic conditions and the prevalence of 100 to 150 foot tall conifer trees. High winds weaken standing trees and structures that are weighted with snow or ice. Douglas fir and western hemlock tree species have shallow lateral root systems with top heavy crowns and entire trees are vulnerable to falling when soils are soaked from previous rainfall. Regular autumn rains saturate soils and decrease tree roots' ability to adhere to soil. Sustained high winds and gusts cause trees to sway significantly. Repetitive swaying motion can eventually weaken

a tree's root hold in the saturated ground and force it to topple. These tall columnar trees and their massive branches act like giant hammers and sever electrical transmission lines, crush vehicles, damage homes and buildings, and block transportation routes. Falling tree limbs and other flying debris can injure or cause the death of people and animals. Downed power lines have caused electrocutions elsewhere in the greater Puget Sound Region.

Widespread power outages can take several days to restore. The total mass of downed debris on the transportation network impedes the response capabilities of emergency personnel and utility crews. Electrical blackouts force the closure of government offices, businesses and schools. Power outages can disrupt traffic operations due to debris road blocks, unpowered traffic signals and traffic snarls resulting in thousands of motorists seeking few available alternate routes on local arterials and collectors. When power outages occur simultaneously with heavy stormwater flows, public works crews may struggle to provide auxiliary power to sewer lift stations to prevent backups or flooding in suburban and urbanized areas.

People without power may lack backup home heating systems and may suffer from hypothermia if temperatures persist below freezing levels. Out of desperation, some people may resort to heating their homes with BBQ grills unaware of the risks of carbon monoxide poisoning. The risk of home fires increases county-wide as people use candles to light their homes or start wood fires in stoves or fireplaces that are structurally faulty or have excessively dirty or blocked chimneys. Individuals with home powered life support systems, such as oxygen respirators or suction equipment, may be at risk of health complications if backup power systems are not available. Low income populations are particularly impacted by loss of food due to spoilage from lack of refrigeration.

Between 1960 and 2007, 79 windstorms have occurred in western Washington that caused at least $50,000 or more in damage area wide. The combined damages from these wind storms are estimated to have cost the region in excess of $27 million dollars (adjusted to 2007 dollar value).[5]

Probability of Occurrence

The Washington State Natural Hazard Mitigation Plan identified Cowlitz County and 22 other counties as susceptible to high winds. Counties that were considered most vulnerable to high winds are those with an annual high wind recurrence rate of 100%. The state plan indicated that Cowlitz County's annual high wind recurrence rate is 175%. At least 18 notable Pacific Northwest cyclones have impacted the region in the last 25 years, thus probability of occurrence is high.

Table 17 Beaufort Scale			
Force	**Wind Knots (MPH)**	**Classification**	**On Land**
0	Less than 1 (<1)	Calm	Calm, smoke rises vertically
1	1-2 (1-3)	Light Air	Smoke drift indicates wind direction, still wind vanes
2	3-6 (4-7)	Light Breeze	Wind felt on face, leaves rustle, vanes begin to move
3	7-10 (8-12)	Gentle Breeze	Leaves and small twigs constantly moving, light flags extended
4	11-15 (13-17)	Moderate Breeze	Dust, leaves, and loose paper lifted, small tree branches move
5	16-20 (18-24)	Fresh Breeze	Small trees in leaf begin to sway
6	21-26 (25-30)	Strong Breeze	Larger tree branches moving, whistling in wires
7	27-33 (31-38)	Near Gale	Whole trees moving, resistance felt walking against wind
8	34-40 (39-46)	Gale	Whole trees in motion, resistance felt walking against wind
9	41-47 (47-54)	Strong Gale	Slight structural damage occurs, slate blows off roofs
10	48-55 (55-63)	Storm	Seldom experienced on land, trees broken or uprooted, "considerable structural damage"

2. Heavy Rain

Definition

The quantity of rainfall that constitutes heavy conditions varies by location and season. In general, heavy rainfall is any amount of rain produced in a relatively short period of time that exceed the capacity of natural systems' or infrastructural systems' ability to effectively and safely convey the flow of water. Excess water flows and accumulations can lead to hazardous conditions such as flooding and erosion. Excess rainfall can saturate soils on steep slopes which make them susceptible to mudslides or landslides. (See Flood Hazard Profile for more information on precipitation patterns related to flooding)

Severity

Prolonged heavy rains typically occur from November through February. The entire region is directly or indirectly affected by heavy rainfall. Properties are at greater risk if they are located in flood plains, areas with high ground water, areas with stormwater drainage problems, or are on or closely adjacent to steep slopes. The region overall is moderately vulnerable to flood.

Impact

The most common impacts from heavy rainfall are flooding and erosion. Prolonged rain delivered by weather systems north of the Hawaiian Islands dubbed "Pineapple Express" rainstorms, can rapidly melt snow in the Cascade Mountains and lowlands. This precipitation can cause rivers to rise quickly and cause flooding downstream in valleys and widespread landslides both in the uplands and the lowlands. Local rainfall also swells local creeks and streams exacerbating local flood potential. Refer to flood and landslide hazards for more information on these impacts.

Probability of Occurrence

Considering that 18 of 23 federal disaster declarations, for the period of 1962 to 2009, resulted in major flooding, damaging heavy rain has a 38 percent annual probability of occurrence. Damaging heavy rains have a high probability of occurring.

3. Freezing Rain

Description

Freezing rain occurs when rain descends through a cold air mass, cools and then subsequently freezes on contact with cold surfaces. An ice coat will continue to accumulate on surfaces as long as conditions exist. Ice can accumulate to thicknesses well over one inch.

Severity

The entire county is susceptible to the effects of an ice storm of the magnitude experienced on December 26, 1996. This storm resulted in ice accumulations of one-quarter to three-quarter inch thick. The December 2008 winter storm delivered freezing rain, but accumulations of ice were less than 1 to 3 mm. Ice can accumulate on nearly every surface including tree branches, power lines, roof tops, motor vehicles, streets, sidewalks and traffic signals and signs. Transportation networks are especially vulnerable to freezing rain as it coats nearly every exposed paved surface.

Impacts

The weight of thick ice accumulations can stress structures causing trees and power lines to snap. Downed live power lines can ignite fires. Dangerous driving conditions and power outages almost guarantee the closure of government offices, businesses and schools. Despite the issuance of sound advice in travel alerts to avoid travel, the demand for emergency assistance to respond to traffic accidents can quickly overwhelm the capacity of local fire and law enforcement personnel.

Probability of Occurrence

Although trace freezing rain events occasionally occur, the December 26, 1996 event was the most damaging Pacific Northwest ice storm in the last 50 years. The scarcity of an event of this magnitude suggests that the annual recurrence rate may be 1% to 2% or occur every 50 to 100 years. Therefore the probability of a major destructive freezing rain event in the next 25 years is low.

4. Heavy Snow

Definition

The Washington State Hazard Mitigation Plan defines heavy snow as four inches of snowfall in 12 hours or six inches in 24 hours for non-mountainous areas. This amount is sufficient to disrupt activities in Cowlitz County. In general, heavy snow is any amount of snowfall that exceeds the ability of communities to maintain relatively normal levels of public and private sector services.

Falling snow mixed with high winds produces a blizzard. According to the National Weather Service, a blizzard occurs with the following conditions ". [Three hours or more of] sustained wind or frequent gusts to 35 miles an hour or greater; and considerable falling and/or blowing snow (i.e., reducing visibility frequently to less than 1 mile)."

Severity

Heavy snowfall affects all of Cowlitz County. Snowfall in the Puget Sound lowlands typically occurs from mid-November through early March, with most accumulations occurring from December through February. Light snow, less than four inches deep, can temporarily disrupt normal traffic operations on roads and streets until public works departments clear priority routes. In general, snow hazards and road clearing abilities become more problematic with decreasing temperatures, increasing snow depth and increasing length of time that snow remains on the ground. Even when priority routes are clear, numerous neighborhood streets and local collector streets can remain impassable for many motorists when snow depths exceed one foot.

The average annual snowfall for Cowlitz County is 18 inches (Olympia Airport Weather Station 1948-2007). Most periods of snowfall generally do not exceed four to six inches within a 24 hour period. However, accumulations that exceed one foot do occur with the right combination of Pacific moisture and cold arctic air. Weather station records indicate that this has happened at least six times in Cowlitz County since 1948. December 1968 to January 1969 is the period of record. A total of 81.5 inches of snow fell during the two month period resulting in snow depths likely exceeding the 24 inches officially recorded at the Olympia Airport (OLY) weather

station. Snow remained at least one foot deep through the first two weeks of February. It should be noted that data from the Olympia Airport weather station is limited and more extreme snow conditions are likely to occur elsewhere in the county. Larger snowfalls and greater depths typically occur at higher elevations and distances further away from the Puget Sound.

Impacts

Blizzard like conditions dramatically reduces motorists' visibility, especially in the dark and can lead to motor vehicle accidents. Blizzards affect all modes of transportation. Heavy snowfall, even in windless conditions, presents serious hazards. Icy road conditions can lead to vehicle accidents resulting in property damage, injuries and fatalities. Significant snowfall can disrupt surface transportation networks for several days and overwhelm the snow removal capabilities of public works entities, delay public transit services, as well as delay response times and/or the overall mobility of emergency responders. Truck freight distribution can also be delayed and could result in shortages of certain goods such as fuel. Deep snow and sustained freezing temperatures can force the suspension or closure of both public and private sector services for several days. Excessive snow loads on structures can cause roofs and utility lines to collapse. Structural collapses are more likely when snow loads gain additional weight from subsequent absorption of rain. Flat roofs, sheds, carports and awnings are vulnerable to collapse from excessive snow loads. During the melting period, snow can block storm drains and cause localized flooding.

Probability of Occurrence

Between the period of 1948-1994, 23 snow events with depths greater than four inches and five snow events with depths greater than one foot were recorded at the Olympia Airport weather station (snow data not collected at this station from 1996 to present). The annual recurrence rate for depths greater than four inches is 50% and 11% for depths greater than one foot. There is a high probability that a heavy snow event will occur in the next 25 years.

5. Tornado

Definition

The National Weather Service defines a tornado as "a violently rotating column of air, usually pendant to a cumulonimbus [cloud], with circulation reaching the ground. It nearly always starts as a funnel cloud and may be accompanied by a loud roaring noise. On a local scale, it is the most destructive of all atmospheric phenomena." Tornados are the most unpredictable weather phenomena.

Severity

The extent and severity of a tornado depends on its location, the length of touchdown time, and the strength or wind speed of the tornado event. The Fujita scale classifies tornados according to their wind speed. In western Washington, tornados have occurred during the months of March, April, May, June, August, September, October, November and December. A total of 94 tornados have been documented in Washington State between 1950 and 2005.[6] Of these, 46 were F0, 29 were F1, 12 were F2, and 3 were F3. Damaging tornados are rare in

Cowlitz County. No tornados have adversely affected densely populated areas of Cowlitz County and historic damage was isolated to small areas. Storm records suggest that a tornado could potentially touch down anywhere in the lowlands of the county, but would not likely exceed a Fujita scale 1 (F1).

No deaths or serious injuries resulting from tornados have occurred in the county. Although tornados are rare in Cowlitz County, disastrous tornados have occurred elsewhere in western Washington. On January 10, 2008 an F1 tornado touched down near Vancouver Lake and continued to skip across Vancouver, Washington finally ascending around Hockinson after destroying a marina and causing a lot of damage across Vancouver. On June 29, 1989 near La Center, WA a tornado touched down during the afternoon of the 29th of June, moving through northern Clark County. This tornado caused uprooting of trees and minor property damage. On April 5, 1972, an F3 tornado (wind speed 158-206 mph) touched down in Portland, Oregon and created a nine mile path of destruction north to Vancouver. In Vancouver, the tornado ripped through a grocery store, a bowling alley, a shopping mall and an elementary school. It caused six deaths, 300 injuries, and nearly $50 million in damages.[7]

Impacts

High speed rotating winds can rip apart buildings, fences, street signs and vegetation. The tornado and the circulating winds in its vicinity can project debris several hundred feet away from the source of destruction. People and animals can be injured or killed by flying objects.

Table 18
Fujita Scale

F-Scale	Wind Strength	Description of Damage
F0	40-72 mph	Minimal Damage – Some damage to chimneys, TV antennas, roof shingles and windows. Breaks branches off trees, pushes over shallow-rooted trees, damages sign boards.
F1	73-112 mph	Moderate Damage – Automobiles overturned, carports destroyed, trees uprooted, peels surface off roads, mobile homes pushed off foundations or overturned, moving autos pushed off the roads.
F2	113-157 mph	Major Damage – Roofs torn off framed houses, sheds and outbuildings are demolished, mobile homes overturned or destroyed, boxcars pushed over; large trees snapped or uprooted, light object missiles generated.
F3	158-206 mph	Severe Damage - Exterior walls and roofs blown off well-built houses, metal buildings collapsed or are severely damaged, trains overturned, forests and farmland flattened, heavy cars lifted off the ground and thrown.
F4	207-260 mph	Devastating Damage – Few walls, if any, standing in well-built houses, structures with weak foundations blown off some distance, large steel and concrete missiles thrown far distances, cars thrown.
F5	261-318 mph	Incredible Damage – Homes leveled with all debris removed, strong frame houses lifted off foundations and carried considerable distances to disintegrate. Schools, motels, and other larger structures have considerable damage with exterior walls and roofs gone, steel reinforced concrete structures badly damaged. Automobile sized missiles fly through the air in excess of 100 meters, trees debarked.

Probability of Occurrence

Based on little published data available from the National Climate Data Center, the annual probability of a tornado occurring in Cowlitz County is seven percent, thus a low probability rating is assigned.

6. Hail

Description

Hail is precipitation that takes the form of ice balls or clusters of ice clumps. They can range in size from 5 mm to several inches in diameter. Hail forms in cumulonimbus or thunderstorm clouds that have strong updrafts.

Severity

Most hail storms in Cowlitz County produce small non-destructive hail. The records of damaging hail storms are scant and suggest that damage from these events is limited and only small geographical areas are likely to be affected. Although it is possible that a hail storm could unleash destructive hail to any portion of the county, the extent of the damage would likely be limited.

Impacts

Hail poses the greatest risk during its descent. Large hailstones can cause serious injury by striking people and animals and damage structures and vehicles. Hail storms may damage crops, but the extent or cost estimates of any past agriculture related damage within Cowlitz County is unknown.

Probability of Occurrence

Damaging hail storms are rare in Cowlitz County. Based on the historical information available, a hail storm producing hail greater than 0.75 inches in diameter has a five percent annual recurrence rate. The probability of a damaging hail event is low.

7. Lightning

Description

Lightning is an atmospheric discharge of electricity that typically occurs with thunderstorms. A lightning bolt can travel at 60,000 meters per second and reach temperatures of 54,000°F.

Severity

Lightning storms in Cowlitz County are short lived and events generally only affect a small area. However, the entire county is potentially vulnerable to lightning strikes. Lightning has not caused widespread damage and historically it has not posed a serious threat to the region. Historic records indicate that lighting storms in Cowlitz County are most likely to occur from April through September. This time period coincides with the dry season so it is conceivable that a larger than normal wildfire could result from lightning strikes over Cowlitz County forest lands.

Impacts

There are no documented lightning fatalities in Cowlitz County. Multiple lightning events have resulted in some injuries and damage in various locations

throughout the region.[8] Lightning can strike people causing burn injuries, paralysis, or even death. It can also start fires, split trees, and disrupt power transmission. Since 1973 at least 19 wildland fires were ignited by lightning in Cowlitz County. A total of 17 acres are known to have burned. The largest fire burned 15 acres on private timberland in a remote area of southeast Cowlitz County in June 2004.[9] Damage estimates for these fires are unknown.

Probability of Occurrence

Destructive lightning storms are rare in Cowlitz County. The annual recurrence rate for a lightning related injury is 4%. The annual recurrence rate for a lighting strike resulting in a small fire is 47%. The overall probability of a lightning event causing damage or injury is moderate.

Historical Occurrences and Impacts of Storm Hazards in Cowlitz County

Several notable storms have impacted the region over the last few decades. It is important to highlight the effects and damages of these storms to emphasize the severity, cost, and vulnerabilities associated with these events. Estimates of potential dollar losses for future storm events were not calculated as part of the storm hazard risk assessment. Previous storm events perhaps offer the best indication of the types of future losses that local communities are likely to experience with future storms.

January 6-16, 2009, Federal Disaster 1817: Severe Winter Storm[10]

On January 21, 2009, Governor Christine O. Gregoire requested a major disaster declaration as a result of a severe winter storm that yielded widespread and damaging effects from flooding, mudslides, landslides, avalanches, high winds, and freezing rain, during the period of January 6-16, 2009. The Governor requested a declaration for Individual Assistance for nine counties and Hazard Mitigation for all counties. PDAs estimate damages immediately after an event and are considered, along with several other factors, in determining whether a disaster is of such severity and magnitude that effective response is beyond the capabilities of the state and the affected local governments, and that federal assistance is necessary.[11] Cowlitz County received approximately $600,000 in disaster relief.

December 12-27, 2008, Federal Disaster 1825: Severe Winter Storm[12]

Near record snowfalls, freezing rain, and rain combined with sustained subfreezing temperatures froze the region for a period of nearly two weeks making it one of the worst snow-laden winter storms in decades. Governor Gregoire declared a state of emergency on December 24. On March 2, a Presidential Disaster Declaration was declared for 27 counties, including Cowlitz County.

November 2-11, 2006 Federal Disaster 1671: Severe Winter Storm, Flooding, Landslides, and Mudslides

On November 6, 3.4 inches of rain fell; a 24 hour rainfall record for that day of the year. The heavy rains caused flooding of urban roads and streets throughout the region. Preliminary damage assessments for personal and business property damage exceeded $300,000.

December/January 1996/1997 Federal Disaster 1159, Ice, Wind, Snow, Landslides, and Flooding

Snow, ice, and freezing rain crippled Cowlitz County on December 26. This storm produced the worst freezing rain event to hit the region in decades. Sub-freezing temperatures and power outages persisted for over a week into early January.

December 12, 1995 Windstorm Federal Disaster 1079

A windstorm caused widespread destruction from northern California to British Columbia. Wind gusts of 57 mph rattled the region causing widespread power outages to nearly 45,000 households and businesses. Road closures from fallen trees and limbs forced the closure of many local and state government offices and area businesses.

February 1 to 8, 1989, Snow Storm

Arctic air pushed southward across Oregon between the 1st and the 3rd of the month. Heavy snow fell over all of Oregon. Some coastal areas had 6 to 12 inches of snow, an event of which is almost unheard. Salem reported 9 inches of snow and over a foot settled over the state. Numerous record temperatures were set. Strong winds produced wind chill temperatures of between 30 and 60 degrees below zero. There were extensive power failures as well as considerable home and business damage throughout the state resulting from frozen plumbing. Damage estimates exceeded well over a million dollars. Several moored boats sank on the Columbia River because of ice accumulation. There were five weather-related deaths, three in auto accidents caused by ice and snow and two in which women had frozen to death.

November 13-15, 1981

The strongest wind storm since the infamous Columbus Day storm of 1962 struck the Pacific Northwest with a one-two punch combination. The first punch was delivered Friday, November 13, and early Saturday, November 14, when an intense low-pressure area tracked northward 150 to 200 miles west of the Oregon coast. The central pressure of the low was 958 millibars (mb), 2 mb lower than the 1962 storm, but the storm track was about 90 miles farther west of the 1962 storm track. The second punch was delivered on Sunday, November 15, when a second somewhat weaker low pressure area following a track similar to the first storm causing strong winds over the area again. These winds occurred as people were still recovering from the effects of the first storm.

Strong winds spread into the Pacific Northwest from the south the evening of Friday, November 13. Winds spread into Washington during the morning of November 14. Hoquiam reported wind gusts to 70 mph, Seattle to 67 mph and Olympia to 64 mph. Strong winds also spread as far east as Boise and Reno, where gusts to near 100 mph were reported.

The second storm spread winds near 60 mph along the Oregon coast beginning Saturday morning, November 15. Portland recorded wind gusts to 57 mph, Boeing Field near Seattle had wind gusts to 48 mph, SEA-TAC airport had gusts to 51 mph and Olympia airport had wind gusts to 58 mph.

The November 13-14 storm did the most damage. However, the one-two punch of the two storms resulted in more damage from the weaker, second storm than

normally would have been expected. Eleven people were killed and $50 million in damage were reported as a result of the two wind storms. This compares to 38 fatalities and damage in excess of $200 million for the 1962 Columbus Day storm.

Numerous injuries resulted from wind-blown debris in western Washington and Oregon. Damage was widespread, including hundreds of downed trees and power lines across the Pacific Northwest. Roof damage was common. For example, on November 14, winds ripped off the 2,500 square feet roof of the Homestead Restaurant in North Bend, Oregon. Downed power lines caused massive power outages. Estimates indicated that nearly 500,000 homes were without power for at least a short time during the weekend. Damage to standing timber was extensive from Washington to northern California.

Many airports across Oregon and Washington suffered damage. At the Hillsboro airport, one airplane was flipped upside down and several hangars were damaged. Three light planes at Salem's McNary Field were damaged by winds that flipped them on their backs Friday night. While damage was extensive throughout western Oregon and Washington as a result of the strong winds, it was still considerably less than that resulting from the 1962 Columbus Day storm.

October 12, 1962 - The Columbus Day Wind Storm

A generation of Washingtonians received searing memories that day. This quintessential windstorm became the standard against which all other statewide disasters are now measured. Wind gusts reached 116 mph in downtown Portland. Cities lost power for two to three weeks and over 50,000 dwellings were damaged. Agriculture took a devastating blow as entire fruit and nut orchards were destroyed. Scores of livestock were killed as barns collapsed or trees were blown over on the animals.

- The mother of all wind storms this century, the wind storm all others are compared to
- Strongest widespread non-hurricane wind storm to strike the continental U.S. this century
- Struck from northern California to British Columbia
- Claimed 46 lives, blew down 15 billion, yes, 15 billion board feet of timber ($750 million worth - 1962)
- Total property damage in the region $235 million
- Recorded wind speeds (before power went out) Naselle - Gust to 150 MPH Bellingham and Vancouver - Gust 92 MPH

Delineation of Storm Hazard Area, Population and Assets Data

Winter storms affect every jurisdiction in the county. As a result, storm hazard area tables were not developed. The "Total" columns in the population provided in Table 6 of Chapter 3 provide useful information in assessing the population at risk from a countywide hazard.

Critical Facilities and Infrastructure in Hazard Area

Based on the community impacts which historical occurrences of natural hazards caused, it is clear that natural hazards can destroy or damage facilities that may be critical for responding to the disaster and for maintaining a safe environment and public order. Among these are communications installations; electrical generating and transmission facilities; water storage, purification, and pumping facilities; sewage treatment facilities; hospitals; and police stations. In addition, natural hazards can seriously disrupt the transportation network; bridges can be knocked out, and roads and highways damaged or blocked by debris, further isolating resources. In a major disaster, almost all surface means of transportation within a community may be disrupted, particularly in the initial stages of the hazard event.

All critical facilities in Cowlitz County are located within the storm hazard area. Specific information on the location of critical facilities and infrastructure is housed with the Cowlitz County Department of Emergency Management.

Summary Assessment

The probability of each storm element's occurrence varies, but winter storms frequently pack several hazardous elements across a period of consecutive days or weeks, therefore the overall probability of winter storm occurrence is high. The overall impacts described in both the hazard profile and the brief record of historical occurrences demonstrate that the region's vulnerability is also high. Therefore, the overall risk rating for severe winter storms is high.

Thunderstorms do occur in Cowlitz County, but the probability of occurrence of the storm elements is low. Even thunderstorms that produce a combination of the listed elements rarely cause destruction beyond isolated areas. Therefore, the overall probability of occurrence, the vulnerability rating and the overall risk for thunderstorms are all low.

Storm Endnotes

1 National Weather Service. 2009. Natural Hazard Statistics: Washington State, 2007. http://www.weather.gov/os/hazstats.shtml

2 National Weather Service. 2008. Weather Glossary. http://www.srh.noaa.gov/fwd/glossarynation.html. All NWS weather element definitions were derived from this source.

3 Cliff Mass. 2008. The Weather of the Pacific Northwest. The University of Washington Press, Seattle, WA

4 Wolf Read. 2004. The Strongest Windstorms in the Western Pacific Northwest 1950-2004. From the "Storm King" Series on: http://www.climate.washington.edu/stormking/. Results derived from tabular data for period of 1950 to 2004, appended with current data 2005-2007) from other storm summaries from Wolf Read's recent "Storm King" reports.

5 Hazards & Vulnerability Research Institute. 2008. The Spatial Hazard Events and Losses Database for the United States, Version 6.2 [SHELDUS Online Database]. Columbia, SC: University of South Carolina. Available from http://www.sheldus.org.

6 Cliff Mass. 2008.

7 Washington State Emergency Management Division. 2007. Washington State Hazard Mitigation Plan

8 Hazards & Vulnerability Research Institute. 2008.

9 Washington State Department of Natural Resources. 2008. Fire Prevention and Fuel Management Mapping System.

10 Preliminary Damage Assessment for Declaration 1817. Federal Emergency management Agency (FEMA). January 2009

11 The preliminary damage assessment (PDA) process is a mechanism used to determine the impact and magnitude of damage and resulting needs of individuals, businesses, public sector, and community as a whole. Information collected is used by the State as a basis for the Governor's request for a major disaster or emergency declaration, and by the President in determining a response to the Governor's request (44 CFR § 206.33).

12 Thurston County Emergency Management. 2009. Supplemental Justification Report.

Chapter 4.3: Flood Hazard Profile

Introduction

Of all natural hazards that affect Cowlitz County, floods are the most prevalent. Between 1962 and 2009, Cowlitz County has received 11 Federal Disaster Declarations related in some part to flooding. On average, the region experiences a major river flood event about every two and one-third years. On an annual average basis floods are also the most costly natural disaster in the region. Statewide, the Federal Emergency Management Agency (FEMA) has provided over $72 million in aid to flood victims, businesses and local governments for the December 2007 floods and over $12.8 million in assistance as of April 2009 for the January 2009 floods.

Future floods are inevitable and more research is required to understand fundamentals such as the extent of flood plains and areas that are vulnerable to groundwater flooding. The hydrodynamics of riverine and groundwater flooding in Cowlitz County are complex and not completely understood. Each flood event is unique. Numerical hydrological models are needed to provide data to better inform land use decisions that will serve to protect environmentally critical areas and protect the public's health. Model forecasts and simulations will enhance Cowlitz County's understanding of the timing, frequency, duration, and location of riverine and high groundwater flooding.

Comprehensive flood hazard management must address an entire watershed because rivers and their flood plains span multiple administrative boundaries. Activities outside of Cowlitz County's border such as forestry, development and stormwater management practices can adversely influence the local flood severity for communities downstream within Cowlitz County. There are multiple affected stakeholders and a variety of interests must be considered. Flood hazard management is a complex process that must balance resource protection, environmental enhancement, flood damage protection, and land use development. The region is just beginning to address flood management with such an approach for the Cowlitz River Basin.

Hazard Identification

In general, a flood is a temporary condition in which a normally dry area of land or infrastructure is inundated by excess standing or flowing water. Floods can occur during any season and at any time. Two types of flooding occur in Cowlitz County and are addressed individually in this hazard profile: riverine flooding and groundwater flooding.

1. Riverine Flooding

Riverine or river and stream flooding is the effect of excess flow and volume of water exceeding a river channel's normal capacity to contain the water. As a consequence, excess water crests over a river's bank and inundates areas within the river's floodway, flood plain and other low lying areas (may be outside FEMA's mapped floodplains, but are in the river's natural floodplain). An extended period of intense precipitation is the most common cause of riverine floods in Cowlitz County. Historically, Cowlitz County must experience two or three days of rainfall averaging 2-5 inches per day for river and stream flooding to occur. These precipitation events are commonly delivered by storms containing warm moisture laden air originating from the tropics and subtropics of the Pacific Ocean. A low-

pressure storm system originating from the Pacific Ocean, north of the Hawaiian Islands, is commonly referred to as a "Pineapple Express" (see storm hazard profile). This storm phenomenon considerably raises surface air temperatures into the upper 50 degrees F and sometimes mid-60 degrees F. It also raises the freezing level above 6,000 feet. All Cowlitz County rivers are affected by this rapid warming effect and the intense precipitation that falls as storm fronts cross western Washington. The warm rain and air rapidly melts shallow lowland snow accumulation and causes local streams and creeks to crest their banks in a relatively short period of time.

Table 19
Flood Terminology Used in this Plan

There is often confusion about flood terms and flood frequency. The following terms are used in this risk assessment:
Flood Plain: A strip of relatively smooth land bordering a stream, built of sediment carried by the stream and dropped in the slack water beyond the influence of the swiftest current.
100-Year Floodplain: Lands which are subject to a one percent chance of flooding in any year. These areas are mapped as the "A" zone on the Flood Insurance Rate Maps (FIRM) of the Federal Emergency Management Agency.
500-Year Floodplain: Lands which are subject to a 0.2 percent chance of flooding in any year. These areas are mapped as the "B" zone on the FIRM of the Federal Emergency Management Agency.
Flood Stage: The stage at which overflow of the natural stream banks begins to cause damage in the reach in which the elevation is measured. Flood stages for each USGS gauging station are usually provided by the National Weather Service.
Floodway: The portion of the floodplain adjoining and including the river channel which discharges the flood water and flow of the river. It does not include portions of the floodplain where water is just standing. These areas are mapped as "Floodway" on both the Floodway and the FIRM of the Federal Emergency Management Agency.

Cowlitz County Rivers[1]

There are six major river systems in Cowlitz County that experience episodic flooding: the Columbia, Cowlitz, Coweeman, Lewis, Kalama, and the Toutle. The Federal Emergency Management Agency has mapped the Special Flood Hazard Areas (SFHA) for each of these rivers.

Mayfield and Mossyrock reservoirs on Cowlitz River in Lewis County are required by their Federal Power Commission license to be operated so as to regulate flows at Castle Rock, Washington to 70,000 cubic feet per second (CFS) or less. No flood regulation is provided by the three power projects located on Lewis River. They are operated exclusively for power generation. Levee projects have been constructed at various locations along Lewis, Kalama, Cowlitz, and Coweeman rivers. Some additional levee work, such as levee repair, realignment, and strengthening is authorized.

The Northwest River Forecast Center, Portland, Oregon, is responsible for the flood warning and river forecasting service in Cowlitz County. Of the streams investigated, forecasts are available during flood seasons for the Lewis, Cowlitz and Columbia rivers. Specific forecasts are available to the areas of Kelso, Longview, and Kalama. Only general warnings are available for the smaller communities in Kalama, and Coweeman river basins.

The Columbia River

Columbia River at mile 52.0 drains an area of approximately 256,000 square miles on the west slope of the Continental Divide in the northwestern part of the United States and southwestern Canada. Major parts of the states of Washington, Idaho, and Oregon, and small parts of Montana, Wyoming, Utah, and Nevada, in addition to southeastern British Columbia, are within the Columbia River drainage basin. The area above the upstream limit of the study reach, mile 87.0, is approximately 251,000 square miles. Table 20 shows the reach of Columbia River investigated. The basin terrain varies from flat or gently rolling farmland to high, rugged, wooded mountains. A large portion of the area is devoted to agricultural or related uses. The watershed boundaries throughout the basin are a series of rugged mountains. The highest elevation in the basin is 13,766 feet and the average elevation of the basin is approximately l,200 feet. The total fall in Columbia River from the Canadian border, mile 750, to the mouth is 1,300 feet, or an average fall of 1.75 feet per mile. In the 35-mile study reach, Columbia River has an average fall of 0.3 foot per mile at flood stage. At low water, tides reverse the slope of the river during a 2-hour period.

The most significant tributaries of Columbia River within the study reach in a downstream order are Lewis, Kalama, and Cowlitz rivers. Pertinent drainage areas in the study reach are shown in the table on the following page.

Columbia River flow is affected materially by upstream existing storage projects located on the Columbia River and its tributaries. Additional control will be provided on completion of all storage projects presently under construction. Further protection is provided by numerous bank protection and levee projects in the Longview-Kelso area, including the lower reaches of Cowlitz River affected by Columbia River backwater, and other susceptible flooding areas. Some of the levees were constructed entirely by local interests. Others were either constructed or

improved with Federal funds in cooperation with local interests.

River forecasts are issued daily year round for the Columbia River at Vancouver, Washington. Forecasts, especially during high water, are given widespread dissemination by the local press, radio, and television stations.

The flood elevation can be determined from the profile for any location along the river.

Major urban developments directly affected by Columbia River are Longview and Kelso. Besides a few scattered developments elsewhere, most of the remaining flood plain is agricultural land.

Great Northern-Northern Pacific and Union Pacific railroads' and Interstate Highway No. 5 lie within or adjacent to the flood plain from the upstream limit of the study reach to mile 68 at the Kelso-Longview area.

Table 20
Drainage Areas in Watershed of Columbia River

Stream	Location	Mile Above River	Drainage Area sq. mi.
Columbia River	Mouth	0.0	259,000
	Lower limit of study area	52.0	256,000
	Above Cowlitz River	68.0	253,500
	Upper limit of study area	87.0	251,000
	Vancouver	106.5	241,000
Lewis River	Mouth	0.0	1,000 (*approx.)*
Cowlitz River	Mouth	0.0	200 (*approx.)*
Kalama River	Mouth	0.0	2,500 (*approx.)*

The Coweeman River

Coweeman River, with a drainage area of 127 square miles at its mouth, joins Cowlitz River at mile 1.3. The stream flows west from its source on the northwest slopes of Elk Mountain. All of the drainage area lies in Cowlitz County. The upper limit of the study is at mile 6.8 and the drainage area at that point is approximately 118 square miles. Table 21 shows the reach of Coweeman River investigated.

At the mouth of Coweeman River, the lower end of the study reach, the drainage area is 127 square miles. The watershed is kidney-shaped, 25 miles long and 8 to 10 miles wide. Only a small portion of the area is devoted to agricultural or related uses.

The topography of the watershed is mountainous and rugged. The highest elevation in the basin is 4,538 feet, and the average elevation is 1,230 feet.

The total fall of Coweeman River from its headwater to its junction with Cowlitz River is 4,538 feet with an average gradient of 125 feet per mile. In the lower 6.8 miles studied, Coweeman River has an average gradient of 3 feet per mile.

The headwater section of the drainage basin is mountainous and the streams flow through canyons with steep and rugged sides. High benches of comparatively level land exist in the middle and lower sections of the basin. The width of the valley through the study reach averages 1 mile. The widest flood plain is in the vicinity of Kelso, Washington.

Coweeman River is the eastern city limit of Kelso. Pertinent data on Coweeman River drainage areas are given in the following table.

Table 21
Drainage Area in Watershed of Coweeman River

Stream	Location	River Mile	Drainage Area sq. mi.
Columbia River	Mouth	0.0	127
	Upper limit of study area	6.8	118
	Gaging station “near Kelso”	7.5	119

The Cowlitz River

Cowlitz River, with a drainage area of 2,180 square miles at its mouth, flows into Columbia River at river mile 68.0. Principal tributaries that flow into Cowlitz River within the study reach are Toutle River at mile 20.0, and Coweeman River at 1.3. At Cowlitz-Lewis county line, upper limit of the study reach, the drainage area is 1,700 square miles. About 70% of Cowlitz River basin area is in Cowlitz County. Cowlitz, Toutle, and Coweeman rivers all have their headwaters in the Cascade Range. Toutle and Coweeman rivers have drainage areas of 512 and 127 square miles, respectively. Table 22 shows the reach of Cowlitz River investigated.

The main axis of the 1,700-square-mile area above the study reach lies east and west; the area is trapezoidal in shape, 65 miles long, 10 miles wide at the lower end, and 27 miles wide at the upper end. Of the total drainage area, approximately 75% is mountainous terrain. The remainder of the area is bottom land and rolling foothills. Large areas of the

bottom land are being used for agricultural purposes.

The topography of the watershed is rugged and timber covered. The highest point in the basin is Mount Rainier, elevation 14,408 feet. The average elevation of the basin is approximately 3,400 feet, and the lowest elevation is less than 50 feet.

The fall in Cowlitz River from mile 134.0 to the mouth is 1,340 feet. This is an average gradient of 10 feet per mile, which varies from several hundred feet per mile in the upper reach to less than 2 feet per mile in the lower reach. In the 26.1-mile reach investigated in Cowlitz County, the fall is 60 feet for an average gradient of 2-3 feet per mile.

The two significant tributaries to Cowlitz River within Cowlitz County are the Coweeman and Toutle rivers. Those streams are discussed separately in following sections of this report.

The valley in Cowlitz County has an average width of about 3 miles and is widest between Castle Rock and the Kelso-Longview area. After 1968, flooding has been infrequent along lower Cowlitz River below Mayfield Dam because floods the magnitude of flood stage or lesser magnitude, will be regulated to bankfull stage at Castle Rock.

Besides the four industrial, commercial and business enterprises in the three largest urban centers, the remaining valley area is primarily agricultural. Most of the bottom land area is cropland, consisting largely of grain and forage for livestock, with small acreages of sweet corn and other more intensively cultivated crops. About 10% of the cropland is irrigated.

The main line of Great Northern-Northern Pacific and Union Pacific Railroad from Seattle to Portland traverses the entire length of the valley. Columbia and Cowlitz Railroad, a logging railroad, connects the Kelso-Longview area to the foothills at the confluence of North and South Fork Toutle Rivers. It crosses Cowlitz River at mile 7.1.

Interstate 5 parallels the valley to the east. State Highway 411 provides access along the valley to the west. Secondary roads make up the balance of the transportation network. Five highway and three railroad bridges cross Cowlitz River in the lower 27 miles. The bridges do not seriously obstruct streamflow. Head losses at each bridge during major floods are less than 1 foot.

Table 22
Drainage Areas in Watershed of Cowlitz River

Stream	Location	Mile Above River	Drainage Area sq. mi.
Cowlitz River	Mouth	0.0	2,480
	At Kelso	5.0	2,350
	At Castle Rock	17.3	2,238
	Above Toutle River County line	20.0	1,720
	(Lewis-Cowlitz)	26.1	1,700
Coweeman River	Mouth		127
Toutle River	Mouth		512

The Lewis River

Lewis River, with a drainage area of l,046 square miles at its mouth, flows into Columbia River at mile 87.0. About one-fourth of the total drainage area lies in Columbia National Forest, and one-tenth of the total drainage area lies in Cowlitz County. The stream flows southwest from its source on the northwest slopes of Mount Adams and is joined by East Fork Lewis River at mile 3.5 about 3 miles south-southwest of Woodland, Washington. The upper limit of this study is at mile 14.5. Drainage area above the upper limit of study is approximately 800 square miles.

The Lewis River watershed is boot-shaped, 40 miles long, 30 miles wide at the downstream end, and 15 miles wide at the upstream end. A small portion of the basin is used for agricultural or related purposes.

Topography of the basin is mountainous and the watershed divides consist of rugged and well-defined ridges. The highest elevation in the basin is 12,307 feet, whereas the average elevation is 2,360 feet. High benches of comparatively level land lie in the middle and lower sections of the basin. The valley width through the study reach averages one mile. The widest flood plain in the study reach is in the vicinity of Woodland, Washington.

Total fall of Lewis River from its headwater to its junction with Columbia River is 7,900 feet, an average of 112 feet per mile. In the lower l4.5-mile study reach, Lewis River has an average fall of 2 feet per mile.

The most significant tributary of Lewis River within the reach investigated is East Fork Lewis River which contains little more than one-fifth of the total basin area. Great Northern-Northern Pacific and Union Pacific railroads serve the area. Interstate 5 passes through Woodland, and State Highway 503 provides access along Lewis River to the east.

The Lewis River has a gage located near the Woodland Airport. This gage is monitored by the Northwest River Forecast Center.

Table 23
Drainage Areas in Watershed of Lewis River

Stream	Location	River mile	Drainage Area sq. mi.
Lewis River	Mouth	0.0	1,046
	Above Mud Lake outlet	2.0	1,041
	Below East Fork Lewis River	2.4	1,040
	Above East Fork Lewis River	3.5	828
	Upper limit of study	14.5	800
Mud Lake Outlet	Mouth	0.0	5.28
East Fork Lewis River	Mouth	0.0	212
	Below La Center bridge		199
	Bottom Road bridge		154

The Kalama River

Kalama River, with a drainage area of 205 square miles at its mouth, joins Columbia River at mile 73.1. The watershed is rectangular in shape, 30 miles long and 6 miles wide. Nearly all of the drainage area lies in Cowlitz County. The stream flows westerly from its source on the southwest slope of Mount St. Helens and joins the Columbia River about 2 miles north of Kalama, Washington. The upper limit of the study reach is mile 6.6. The drainage area at that point is about 190 square miles.

Topography of the watershed is mountainous. Ridges are well defined, rugged, and forested. The highest elevation in the basin is 8,365 feet, and the average elevation of the basin is 1,880 feet.

The total fall of Kalama River from its headwater to its Junction with Columbia River is 9,677 feet, an average of 215 feet per mile. In the 6.6-mile study reach, Kalama River has an average fall of 8.5 feet per mile.

The most significant tributary of Kalama River within the study reach is Hatchery Creek which has a drainage area of approximately 6 square miles. Canyons in the headwaters are steep and rugged. High benches of comparatively level land exist in the middle and lower sections. The valley width through the study reach averages less than 1 mile. The widest flood plain in the study reach is near the mouth.

A double-track system serving Great Northern-Northern Pacific and Union Pacific railroads traverses the flood plain near the mouth. Nearly paralleling the railroad a few hundred feet upstream is a major highway, Interstate 5. Several secondary roads provide adequate access locally.

One railroad and four highway bridges cross Kalama River in the reach included in this study. Except for the possibility that debris from logged and forested areas might float downstream during large floods and pile up against bridge piers, none of the bridges across Kalama River are serious obstructions to streamflow. The lowest members of the bridges are above the water surface elevation of the base flood elevation.

Table 24
Drainage Areas in Watershed of Kalama River

Stream	Location	Mile Above River	Drainage Area sq. mi.
Kalama River	Mouth	0.0	205
	U.S. Hwy 99 bridge	1.2	205
	Faller Road bridge	4.2	200
	Below Hatchery Creek	4.9	198
	Above Hatchery Creek	5.0	192
	Upper limit of study	6.6	190
Hatchery Creek	Mouth	0.0	5.96

The Toutle River

Toutle River, with a drainage area of 512 square miles, joins Cowlitz River at mile 20.0. Toutle River is formed by the junction of North Fork Toutle River with South Fork Toutle River at mile 17.2. Both forks have their headwaters in Gifford Pinchot National Forest on the northwestern slope of Mount St. Helens. This investigation covers the lower 8.1 miles of the North Fork, lower 5.5 miles of the South Fork, and the entire 17.2 miles of Toutle River.

The streams flow in a general westward direction. Toutle River Basin is long and narrow, about 37 miles long and up to 18 miles wide. About 80% of the basin lies in Cowlitz County. Elevations in the basin range from a maximum of 8,365 feet, on Mount St. Helens to 40 feet at the mouth of Toutle River. Within the reaches investigated, slope of the rivers averages 26 feet per mile on North Fork Toutle River, 30 feet per mile on South Fork Toutle River, and about 25 feet per mile on Toutle River. The river valleys on the tributaries are narrow at the upper ends of the reaches of the tributaries studied, but begin to broaden considerably near the junction with Toutle River. The valley width of Toutle River averages about 1 mile.

Table 25
Drainage Areas in Watershed of Toutle River

Stream	Location	Mile Above River	Drainage Area sq. mi.
Toutle River	Mouth	0.0	512
	Stream gage 14-2425 (near Outlet Creek) Below	16.4	474
	Outlet Creek	16.7	474
	Above Outlet Creek	16.8	432
	Upper limit of study	17.2	430
N. Fork Toutle River	Mouth	0.0	300
	Below Wyant Crrek	0.1	300
	Above Wyant Creek	0.2	288
	Upper limit of study	8.1	280
Wyant Creek	Mouth	0.0	12
S. Fork Toutle River	Mouth	0.0	130
	Below Studebaker Creek		129
	Above Studebaker Creek		120
	USGS gage at Toutle		118
	Below Johnson Creek		118
	Above Johnson Creek		109
	Upper limit of study		108
Studebaker River	Mouth	0.0	9.00
Johnson Creek	Mouth	0.0	9.64

Levee System[2]

The May 18, 1980 eruption of Mount St. Helens in Washington in 1980 resulted in approximately 3.8 billion cubic yards of earth materials being released in a massive landslide. The resulting debris avalanche deposit has continued to erode and introduce sediment materials into the Toutle-Cowlitz-Columbia river system. These sediment materials continue to filter down the river basin and ultimately settle on the river bed along the way. Increasing sediment on the river bed results in a rise of the water levels, over time.

The region is protected by levees on four rivers: The Cowlitz, Coweeman, Columbia and Lewis rivers. The levee systems protect a majority of the urbanized area from being inundated by rising flood waters. The table below displays the importance of these facilities in protecting Cowlitz County against its most susceptible natural hazard.

The U.S. Army Corps of Engineers (USACE) was directed by Congress to maintain an authorized level of flood

protection (LOP) in four communities along the Cowlitz River that is not less than described in the *Mount St. Helens, Washington, Decision Document (USACE 1985).* As shown in the figure below, the Cowlitz River levee reaches include the Castle Rock levee [River Mile (RM) 15.91 to 17.66], Lexington levee (RM 7.12 to 9.53), Kelso levee (RM 1.59 to 7.3), and the Longview levee (RM 1.59 to 5.57).

Table 26
Levee Locations

Designation	Index Point Description	River Mile
Castle Rock Levee		
CRIP 1	Approximately 1,500 ft. upstream of Castle Rock bridge	17.42
CRIP 2	Just downstream of Castle Rock bridge	17.00
CRIP 3	Road crossing by sewage treatment plant	15.91
Lexington Levee		
LXIP 1	Riverside Park	8.64
LXIP 2	Lexington across from Mobile Home Park	8.30
Longview Levee		
LVIP 1	Upstream end of county fairgrounds	4.90
LVIP 2	Downstream end of county fairgrounds	4.68
LVIP 3	Across from Highway 411	3.59
LVIP 4	Across from Highway 432	3.27
Kelso		
KLIP 1	Across from Rocky Point	7.00
KLIP 2	End of Pacific Avenue	6.19
KLIP 3	Upstream end of golf course	4.02
KLIP 4	Upstream end of golf course	3.70

Courtesy of US Army Corps of Engineers

In the 1980s and early 1990s, the levels of protection for Castle Rock, Lexington, Longview, and Kelso were determined using a deterministic approach in which median values of flood stages were compared to levee safe water levels (SWL). The SWL was evaluated as the highest flood level for which reasonable assurance could be made that the levee would not fail, and was restricted to no less than 3 ft below the levee top in order to provide freeboard for uncertainties. The SWL was often dictated by encroachments to the levees. The level of protection was evaluated as the highest average-return-period-event whose median-value flood profile was no higher than the SWL at all points along the levee.

Current Level of Flood Protection

Before the level of protection investigation was completed in the Flood Damage Reduction Analysis (FDA), the compiled hydraulic model results were compared to the levee assessments at various locations. The table below shows the results from the analysis of the Cowlitz River. These results help to display the qualitative value of the levees, using scientific modeling.

Table 27
Levels of Flood Protection

Index Point	River Mile	Top of Levee (Ft)	Safe Water Level	Authorized Level of Protection (LOP)	Discharge at LOP (cfs)	Expected Stage at Authorized LOP (ft)	Current LOP (1/years)	Probability of Containing the 0.4% (1/250-yr) Annual Change Exceedance Flood	Probability of Containing the 1.0% (1/100-year) Annual Change Exceedance Flood
Castle Rock 1	17.42	65.8	65.8	118	115,034	58.22	468	99.7%	100.0%
Castle Rock 2	17.00	57.3	60.9	118	115,034	56.15	109	68.3%	93.5%
Castle Rock 3	15.91	58.5	58.5	118	118,536	54.2	160	84.6%	99.1%
Lexington 1	8.64	38.2	45.7	167	126,094	37.77	202	88.5%	97.8%
Lexington 2	8.30	42.6	42.6	167	126,094	35.7	326	98.8%	100.0%
Kelso 1	7.00	37.7	37.7	143	122,426	30.6	>500	99.7%	100.0%
Kelso 2	6.19	37.4	40.3	143	122,426	29.36	>500	100.0%	100.0%
Kelso 3	4.02	33.5	34.5	143	122,426	26.29	>500	100.0%	100.0%
Kelso 4	3.70	30.4	33.4	143	122,426	25.87	470	99.4%	100.0%
Longview 1	4.90	35.1	35.1	167	126,094	26.75	>500	100.0%	100.0%
Longview 2	4.68	34.8	37.4	167	126,094	26.95	>500	100.0%	100.0%
Longview 3	3.59	32.8	32.8	167	126,094	25.68	>500	100.0%	100.0%
Longview 4	3.27	32.0	32.5	167	126,094	24.93	>500	100.0%	100.0%

The table above illustrated the dependency Cowlitz County and its cities have on the levee system. The region is most vulnerable to flooding, but is mitigated with dikes located at or near urbanized areas of the county. Several governments, entities and federal agencies are charged with the maintenance and upgrades of these critical infrastructures. Certification of these facilities is paramount to continued protection from flood waters.

Levee Certification[3]

In 2003, Congress passed a bill requiring levees to be certified to maintain the 100 year flood protection designation for the areas protected by the levee. Without certification, the developed properties protected by the levees, would be required to purchase flood insurance if they have a federally backed mortgage. Upon notification of this certification requirement, in June 2007, the diking, drainage, and flood control zone districts executed agreements with the USACE (April 2008) to provide the certification work on a reimbursable basis. The current cost for the USACE to do the work is estimated to be in the $210,000 to $250,000 range as compared to $400,000 to $2,100,000 for a private company to complete the certification. In May 2008, the USACE notified the districts that they were prohibited from doing the work unless a minimum of 5% of the cost of the work was paid for with federal funds. Over the next two years the county and districts worked with federal funding agencies to acquire the ability to utilize federal funds for the certification work. In September 2010, three of the districts were successful in receiving federal funds. The county is continuing to look for other federal funding sources for certification of the levees in the remaining three districts.

Severity

Many factors influence the severity of riverine flooding such as the pre-existing condition of the ground (saturated from previous rain, covered with snow, or frozen), the topography and size of the watershed, freezing level, and the influence of human activity on the landscape (development and logging practices).

Cowlitz County has three levels of flood severity:

1. **Minor flooding**: A river exceeds bank-full conditions at one or more locations, generally flooding fields and forests. Some roads may be covered but passable. There may be enhanced erosion of some river banks.
2. **Moderate flooding**: Individual residential structures are threatened and evacuation is recommended for selected properties. Some roads may be closed. Moderate damage may be experienced.
3. **Major flooding**: Neighborhoods and communities are threatened and evacuation is recommended for residents living on specified streets, in specified communities or neighborhoods, or along specified stretches of river. Major thoroughfares may be closed and major damage is expected.

Table 28
Estimated Areas and Valuations of Levee Districts Compared to Total Cowlitz County

Entity	Area (Acres)	Percent Area	2010 Population	Percent Population	2010 Valuation	Percent Valuation
Cowlitz County	746,240	100%	100,000	100%	9,363,185,718	100%
CDID 1	11,000	1.5%	34,198	34.2%	4,062,327,770	43.4%
CDID 2	8,070	1.1%	5,250	5.3%	476,274,770	5.1%
CDID 3	1,360	0.2%	4,000	4.0%	392,487,660	4.2%
DID 1	264	0.0%	2,500	2.5%	89,618,770	1.0%
DID 15	876	0.1%	293	0.3%	9,396,450	0.1%
Lexington Flood Control District	2,450	0.3%	3,500	3.5%	263,732,450	2.8%
TOTAL	**24,020**	**3.2%**	**49,741**	**49.7%**	**5,293,837,870**	**56.5%**

The following table displays the severity of flood in Cowlitz County as compared to the 39 Washington State counties. This table utilizes multiple qualitative data sets to determine that Cowlitz County is the 8th most susceptible county in the state for flooding.

Table 29

Jurisdictions Most Vulnerable to Flood							
County	Approx. Frequency of Occurrence	% Area in Flood Plain	# Flood Insurance Policies	# Flood Insurance Claims	# Repetitive Flood Loss Properties	# Severe Repetitive Loss	Score
Snohomish	4 Yrs.	5.70%	2061	841	135	10	22
Skagit	5 Yrs.	4.40%	4457	766	112	10	22
King	3 Yrs.	3.00%	3779	1406	139	9	21
Lewis	3 Yrs.	4.50%	1607	1102	75	3	18
Grays Harbor	3 Yrs.	7.50%	2958	335	24	1	17
Pierce	4 Yrs.	4.20%	1696	474	35	0	14
Thurston	3 Yrs.	6.80%	575	195	15	0	13
Cowlitz	4 Yrs.	2.90%	1655	480	24	2	12
Whatcom	5 Yrs.	3.50%	1196	318	36	0	12
Clark	8 Yrs.	7.50%	1131	160	4	0	10
Mason	4 Yrs.	4.80%	280	119	15	0	10
Pacific	5 Yrs.	3.10%	794	130	5	1	9
			Legend				
	3 Yrs.	6.5% or More	> 2,000	> 750	> 100	10 or more	4 pts each
	4 Yrs.	4.0 – 6.4%	1,000 – 1,999	300 – 749	50 - 99	7 - 9	3 pts each
	5 Yrs.	3.0 – 3.9%	500 – 999	100 – 299	20 - 49	4 - 6	2 pts each
	6 – 7 Yrs.	2.0 – 2.9%	250 – 499	50 – 99	0 - 19	3	1 pt each

Courtesy of Army Corps of Engineers

Impacts

River floods kill people in the United States every year. People caught unprepared and isolated by swift moving or flash flood waters can die from drowning, hypothermia, or trauma. The February 1996 flood caused nine deaths in the Pacific Northwest. Fortunately, advances in weather forecasting technology and hydrologic modeling are producing more accurate flood forecasts that can serve to provide communities with advance warnings. Radio broadcasts, television, and other tools can provide residents of flood prone properties critical information to take necessary precautions to safeguard some belongings and evacuate to safer ground.

Fast rising flood waters can also eliminate opportunity to provide for the safety of domestic animals. Floods kill livestock and pets causing both economic and emotional hardship. Carcasses can become a public health problem if not disposed of quickly and adequately.

Major and moderate flooding frequently inundates low lying roads around Cowlitz County resulting in area-wide transportation disruptions. Major state routes such as State Routes 411, 503, 504 and Interstate 5 have both closed multiple times due to floods. As flood waters recede, woody debris and other objects left behind can pose hazards to bridge structures and culverts. Electric, gas, water, and communication utilities are also subject to damage and disruption.

2. Groundwater Flooding

Definition

Groundwater flooding occurs whenever there is a high water table and persistent

heavy rains. The situation is caused in areas where an upper, thin layer of permeable soils overlays an impermeable layer of hard pan. As the ground absorbs more and more rainwater, the groundwater table raises from beneath the ground surface which results in standing water in areas where the land surface is below the water table.

Modes of Groundwater Flooding in Cowlitz County

Two types of groundwater flooding trigger events have been identified by Cowlitz County using the County's own data, as well as historical data provided by the National Oceanic and Atmospheric Administration. These events are occurring in two scenarios. They are discussed in further detail below.

Short Duration Storms that Occur in Succession

These storms are characterized by a weather phenomenon locally called the "Pineapple Express". This is a pattern that draws tropical moisture from an area near Hawaii in the Pacific Ocean and conveys it directly to Western Washington and Oregon. These winter patterns, once established, tend to usher a wet winter pattern that usually results in warm temperatures and heavy rainfall for a period of up to a week at a time. These systems rapidly melt any snow that may have accumulated as well as produce rainfall that generally exceeds six inches in a 24-hour period. Normal high groundwater levels occur in mid to late March so if a large storm coincides with this normal peak in groundwater, the capacity of the system is exceeded and groundwater flooding will likely occur in susceptible areas.

It should be noted that this storm pattern has been increasing in frequency over the past decade and it appears that the overall intensity of the events is also increasing based on the collected data. It should also be noted that these types of events are the driving factors of pronounced groundwater flooding.

Persistent Low-intensity Precipitation Pattern

This type of weather pattern is less common; however, it produces similar flooding results as the short duration storms. It is characterized by weeks of low intensity rainfall in which there is some measurable rainfall every day for several weeks. These events gradually overwhelm the groundwater system by saturating the soil column. In most cases, this weather pattern causes more widespread flooding throughout the County, both in areas that routinely flood and in areas that are generally not susceptible to groundwater flooding.

Impacts

In general, the damaging effects of groundwater flooding are similar to riverine flooding. Some homes may be inundated if they are not elevated above flood levels. Even if a home is elevated above floodwaters, crawl spaces and basements are subject to flooding. Deep water may surround the properties and make it near impossible to enter and exit the property without a boat or makeshift elevated walkway. Septic tanks can become fouled and wells can render useless from contamination. Underground utilities, drainage facilities, and storage tanks are also casualties of groundwater flooding. In many ways groundwater flooding impacts can be worse than surface floods because mitigation is nearly impossible. Sandbagging and pumping have little effect on groundwater flooding and often time the

best course of action is temporary relocation or evacuation of affected areas.

National Insurance Program and Repetitive Loss Properties

§201.6(c)(2)(ii):	[The risk assessment in all] plans approved after October 1, 2008 must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged by floods.

National Flood Insurance Program

Communities that regulate new development in their floodplains are able to join the National Flood Insurance Program (NFIP). In return, the NFIP provides federally backed flood insurance for properties in participating communities. The following table summarizes the number of NFIP policies and coverage amounts.

The NFIP's Dwelling Form offers coverage for:

1. Building property up to $250,000; and
2. Personal property (Contents), up to $100,000. The NFIP encourages people to purchase both types of coverage.

Cowlitz County participates in the NFIP and enforces floodplain management through its Floodplain Management Ordinance codified in Cowlitz County Code (CCC) Chapter 16.25 and its Critical Areas Ordinance, CCC 19.15. One of its stated purposes of CCC 16.25 is "To fully implement floodplain management requirements of the Federal Emergency Management Agency to qualify existing and proposed homes and businesses for participation in the regular national flood insurance program." To that end, Cowlitz County's regulations include:

1) Identifying the Director of the Department of Building and Planning as the administrator of the Floodplain Management Ordinance.

2) Designating frequently flooded areas using the Flood Insurance Rate Maps (FIRM) and also areas identified by the director. The FIRM maps were adopted in 1980 and Cowlitz County is currently working with FEMA to update the maps. The scheduled DFIRM effective date is November 28, 2013.

3) Implementing the Washington State Flood Control Zone Permit Program pursuant to the requirements of RCW 86.16.080 and Chapter 508-60 WAC.

4) Guiding development to areas with lower risk of flood hazard and minimizing exposure to flood-related damage.

5) Determining whether proposed development activities are located in flood hazard areas;

6) Reviewing development proposals to ensure compliance with the requirements of applicable floodplain management regulations and building codes;

7) Requiring that new subdivisions and development proposals with more than 50 lots or larger than five acres include BFEs;

8) Issuing or denying permits for floodplain development;

9) Inspecting all development in flood hazard areas to ensure compliance;

10) Maintaining records of issued permits, elevation data, inspections, and enforcement actions;

11) Assisting in the preparation and revision of floodplain maps; and

12) Helping residents obtain information on flood hazards, floodplain map data, and compliant construction measures.

Table 30
National Flood Insurance Program Participants

Community	Number of Policies	Amount of Coverage	Total Losses	Floodplain Management Ordinance
Castle Rock	45	$11,385,500	29	Chapter 15.24 FLOOD DAMAGE PREVENTION
Kalama	4	$1,052,700	3	Chapter 14.16 Floodplain Management
Kelso	222	$45,961,100	45	Chapter 18.12 FLOODPLAIN MANAGEMENT
Longview	380	$99,145,900	39	Chapter 17.24 FLOOD DAMAGE PREVENTION
Woodland	428	$89,144,200	69	Chapter 14.40 FLOOD DAMAGE PREVENTION
Cowlitz County, Unincorporated	785	$187,933,700	225	Chapter 16.25 FLOODPLAIN MANAGEMENT
County Total	1,864	$434,623,100	410	

Repetitive Loss Properties

The Federal Emergency Management Agency (FEMA) defines a repetitive loss property as, "… those [properties] for which two or more losses of at least $1,000 each have been paid under the National Flood Insurance Program (NFIP) within any 10-year period since 1978." A property is defined as a "severe repetitive loss property" when it meets one of these conditions:

1. Four or more separate flood claim payments have been made and each claim payment exceeds $5,000; or
2. At least two flood claim payments have been made and the cumulative payments exceed the value of the property.

According to FEMA, Cowlitz County has 29 repetitive loss properties. Twenty-eight properties are shown in the following table, due to one property not having an address.

Table 31
Repetitive Loss Properties by Zip Code

Zip	Number of Losses	Total Amount Paid
98611	38	1,583,400.30
98626	34	928189.79
98625	5	193431.77
98674	2	13,628.28
98632	2	32,796.06

Flood Prone Property Purchases

After the 1980 eruption of Mount St. Helens many properties were purchased that lay in and adjacent to the floodplains of the Cowlitz and Toutle rivers. These properties were purchased by the State of Washington for dredge spoil disposal sites, by FEMA for buyout of insured properties and to reduce damage claims and by Cowlitz County to consolidate the state and FEMA purchased properties.

The approximately 100 properties that were purchased by the state and later deeded to the county, City of Castle Rock, and other public agencies are required to be held for public use and future dredge spoil disposal sites.

Approximately 20 properties were purchased with FEMA funds that are required to be held for flood control purposes and public use, with buildings limited to restrooms and other minor structures. Two properties were purchased by the county and are being held for public use and open space. These properties total about 650 acres.

Cowlitz County will continue to work on funding opportunities for the purchase of private property(s) located in the floodway and floodplain.

Figure 9: State, FEMA & County Purchased Properties at LT-1

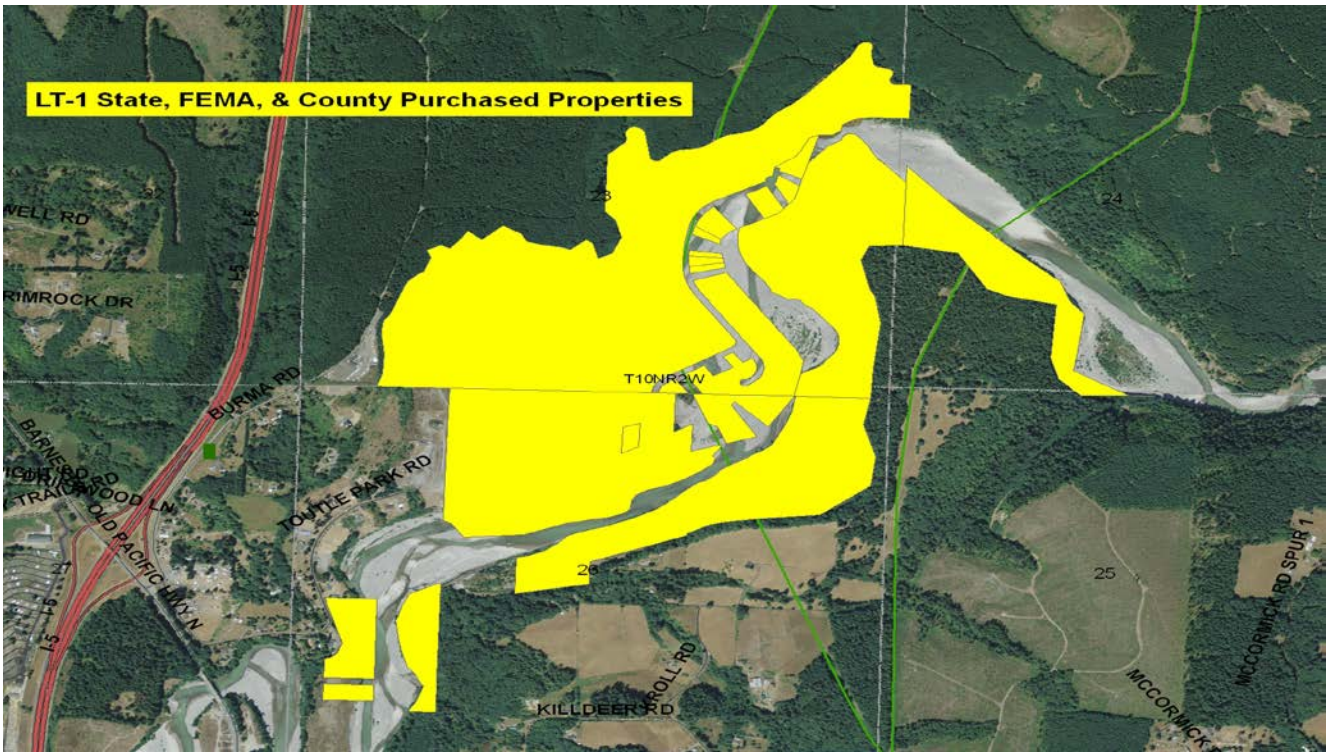
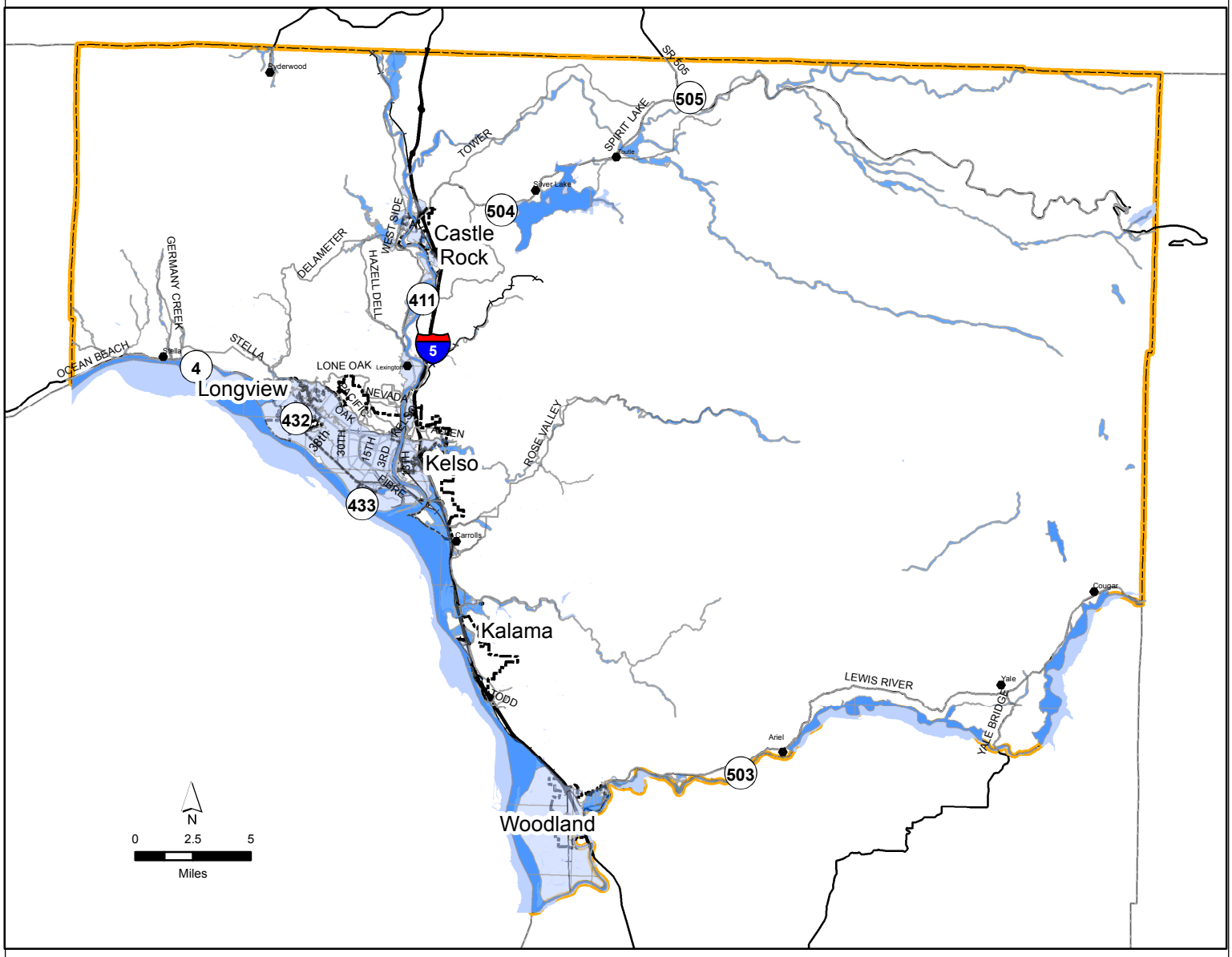


Figure 9
Potential Flood Hazard Areas
in Cowlitz County



100 Year
500 Year
City Limits
Major Roads
Interstate Five (I-5)
Rail

Shared/Planners/Haz_Mit/January/Figures/flood

Delineation of Flood Hazard Area

The flood hazard area consists of those parcels in the county in 100- and 500-year floodplains. No new flood inundation data is available. Areas delineated on the map shown to be located within a floodplain may be protected by a levee system. FEMA data does not account for the existing levees and the protection from flooding for which they serve.

Issues Related to Critical Facilities

The following issues were identified in the draft Disaster Mitigation for Government Buildings in Cowlitz County report for a 500 Year flood that breaches the Kelso/Longview levee system:

- At the Hall of Justice building, the 911 center and DEM are flooded. The Sherriff's Office, Records, Parole, District Court, Superior Court, Training Center and Maintenance departments are without power and utilities and possibly off for weeks and/or months. The emergency generators are underwater and there is significant damage to the basement electrical infrastructure. All items currently stored in the basement are water logged.

- The jail is without electrical power and natural gas and utilities are down for weeks, if not months. The building is not habitable. The emergency generator is significantly damaged along with all primary electrical switch gear. Complete destruction of all security and telephone equipment and components in the security equipment vaults behind maintenance room may likely occur.

- The office of Public Defense is flooded and without electrical power and utilities for weeks. All paper files are wet and will mildew.

- The Juvenile jail is without electrical power, natural gas and other utilities for weeks, if not months. The emergency generator is significantly damaged and the building is not habitable. The Juvenile jail will be without emergency power or heat until natural gas and electricity are restored.

- The Conference Center and Expo, Morgue and WSU are without electrical power and utilities for weeks, if not months. The Conference Center is not habitable until services can be restored.

- The Health and Human Service building is without power and utilities until primary service is restored.

- All computers and phones and 911 terminals are damaged beyond repair.

- All major highways into Longview/Kelso are not passable until the water recedes.

- All paper files located in the flood-affected buildings will be wet and will mildew.

Table 32
Cowlitz County Critical Facilities in Relation To Potential Flood Hazard Areas

Building	FEMA FIRM Zone	Building Value ($)	Content Value ($)	Total Value ($)
Central Shop	X	450,500	144,700	595,200
Conference Center	X	2,951,648	56,252	3,007,900
Coroner	X	15,471	8,045	23,516
Hall of Justice	X	37,630,200	6,127,800	43,758,000
Health Dept/Human Services	X	1,495,068	242,081	1,737,149
Industrial Way Pump Station	X	208,000	0	208,000
Jail	X	15,256,100	1,413,800	16,669,900
Juvenile Center	X	10,038,000	703,900	10,741,900
Maintenance Main Shop	X	342,499	53,575	396,074
Motor Pool	X	448,200	196,000	644,200
Office of Public Defense	X	553,311	0	553,311

Zone X = 500 year flood
Zone AE = 100 year flood with base flood elevation determined

Table 33
Cost-Benefit of Initiatives

Action	Benefit	Cost
At the Hall of Justice, relocate all primary electrical switch gear, emergency generators and primary HVAC equipment housed below the floodplain to a mezzanine below the north end of the old jail.	Building can remain fully operational.	$3,437,000
At the Hall of Justice relocate 911 communications, DEM, Sheriff evidence, District & Superior Court documents storage currently in the basement (floodplain) to a remodeled 3rd floor at the Hall of Justice.	911- Communications, Department of Emergency Management remain fully operational, Sheriff evidence, District and Superior Court Records are secure.	$1,083,000
At the Jail Annex, relocate all electrical switch gear, security equipment and generator to the roof level.	Even though the jail would flood, it could be operational in 3-6 months instead of a year or more.	$1,875,000
At the Juvenile Center, relocate all electrical switch gear, security equipment and generator to the roof level.	Even though the jail would flood, it could be operational in 3-6 months instead of a year or more.	$1,875,000
At the Morgue, determine best location out of the floodplain and construct a new building.	Morgue remains fully operational during disaster.	$1,600,000
At the Maintenance Shop, determine best location out of the floodplain and construct a new building.	Maintenance remains fully functional during disaster.	$496,000
At Health and Human Services, relocate all electrical switch gear and install a generator to the roof level.	Even though the building would flood, it could be operational in 3-6 months instead of a year or more.	$1,680,000

At the Administration and Administration Annex Buildings, install an emergency generator to power both buildings.	The Staff from the Health & Human Service, Jail, and Juvenile will house in these two buildings, until their buildings are restored.	$200,000
Hire an Engineering firm to conduct an analysis of the options to prevent loss of County Government functioning during a 500 year flood event.	Utilize exiting historical data, previous facility survey and seismic study to propose the best low cost solution.	$100,000
Add river gauges to Coweeman and Lewis County Rivers.	Additional means of warning for potential flooding event.	$25,000
Design and improve a State Highway 4 detour route.	Alternative emergency evacuation route.	Unknown

*Please note the draft Disaster Mitigation for Government Buildings in Cowlitz County report evaluates potential impacts of natural hazard events on *all* county owned buildings. This planning effort attempts to evaluate potential impacts of *critical* facilities. Because of the different objectives of the two studies the total amounts will be different. Staff suggests the critical facilities totals be identified separately when the draft report is finalized.

Table 34
Potential Vulnerability of County Facilities During a 500 Year Flood Event

Vulnerability	Before the Actions are Implemented	After the Actions are Implemented	Difference
Number of people affected by the hazard	418	183	235
Area affected sq feet by the hazard	301,800	133,000	168,000
Property damage amount ($)	$17,000,000	$6,000,000	$11,000,000
Loss of use (number of properties lost in number of days	2,555-days	1,806-days	1,469-days
Loss of life (number of people)	Variable depending on intensity	Variable depending on intensity	Variable depending on intensity
Injury (number of people)	Variable depending on intensity	Variable depending on intensity	Variable depending on intensity

Summary Assessment

The history of major flooding within Cowlitz County clearly demonstrates a high probability of future occurrence. The December 2006 and January 2009 floods suggest that the region remains vulnerable to floods. Several flood events have occurred on Cowlitz County rivers which have exceeded the 100 year flood event. Because of the relative land area and population affected, the county is exposed to a major flood every 4 years, based on the history of the last 41 years (1968 to 2009). Overall, this data clearly indicates that the probability of occurrence of major flood events in the region is high. Therefore, flooding in our region is assigned an overall high risk ranking.

[1] Flood plain information, Columbia River and tributaries, Cowlitz County, Washington, United States Army Corps of Engineers, Portland District. 1969

[2] Mount St. Helens Project, Cowlitz River Levee Systems: 2009 Level of Protection Update Summary. United States Army Corps of Engineers, Portland District. 2010

[3] Kenneth Stone. Director Office of Asset Management. Cowlitz County. Personal Notes. November 2010.

Chapter 4.4: Landslide Hazard Profile

Introduction

The views of local rivers, Mount St. Helens, and the Cascade Mountains attract people to build their homes on the hillsides of Cowlitz County to capture the Pacific Northwest through living room windows. Living on a sloping shoreline or a hillside does present risks. The landscape of western Washington provides ample evidence that the surface of the earth is indeed constantly being rearranged by geomorphic and climatic processes. The forces of nature that create the beauty also pose hazards to people and communities when homes, utilities, and roads fall victim to the effects of natural hazards such as landslides.

Landslides cause $1 to $2 billion in damages and more than 25 fatalities on average each year in the United States.[1] Local governments' Critical Area Ordinances are intended to prevent the expansion of urban and rural developments into steep hillsides and other landslide hazard areas, but significant residential development, roads, and utilities preceded current environmental regulations. The high probability of occurrence of landslides combined with their destructive, but localized impacts results in an overall moderate risk rating.

Hazard Identification

Definition

Landslides result when slope instability and loading combine to produce a failure of the slope and a release of material. Topographic and weather conditions in Washington make landslides a frequent problem throughout the state. The term landslide encompasses a variety of forms of movement of soil, rock, and related materials downslope. Landslides may be sudden and dramatic, such as debris flows rushing down mountain stream channels, or slow and continuous, moving large volumes of earth over the course of years.[2]

Landslides are the movement of rock, soil, or other debris, down a slope. In general, the term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Mudflows (or debris flows) are flows of rock, earth, and other debris saturated with water. They develop when water rapidly accumulates in the ground, such as during heavy rainfall or rapid snowmelt, changing the earth into a flowing river of mud or "slurry" which can travel at avalanche speeds, growing in size as it picks up trees, rocks, and other materials along the way. Gravity acting on an overly steep slope is the primary cause of a landslide. However, they are influenced by both natural factors (geology, topography, and hydrology) and human activity (mining and construction of buildings, railroads, and highways). Landslides can be initiated by heavy rain or snow, fires, earthquakes, volcanoes, and various human activities that modify the

environment.

The following factors contribute to landslides and the movement of earth:

- **Erosion** – Erosion caused by rivers, glaciers, or ocean waves.
- **Earthquakes** - Ground shaking from earthquakes creates stress that makes weak slopes fail.
- **Volcanic eruptions** - Eruptions produce loose ash deposits and debris flows.
- **Increase of load** - Weight of rain/snow, falls, vegetation, stockpiling of rock or ore from waste piles or from man-made structures may cause weak slopes to fail.
- **Hydrologic factors** – Rain, high water tables, little or no ground cover, and numerous freeze/ thaw cycles may cause weak slopes to fail.
- **Human activity** – These include development activities such as poor drainage control, cutting, filling, and grading along roads, and logging practices that remove timber from steep slopes. Such activities can drastically modify landforms and groundwater conditions which can cause weak slopes to fail.
- **Removal of lateral and underlying support** - Erosion, previous slides, road cuts, and quarries can trigger failure of weak slopes.
- **Increase of lateral pressures** – Hydraulic pressures, tree roots, crystallization, swelling of clay soil may cause weak slopes to fail.
- **Regional tilting** – Geological movements can trigger weak slopes to fail. It is difficult to predict precisely when and where a landslide will occur, however most landslides occur during the wet season, typically from October through April, but peak in December through February. The United States Geological Survey has researched past landslides and rainfall levels to identify when these types of landslides are likely to occur. One such measure is a formula called the precipitation threshold. The cumulative precipitation threshold measures precipitation over the previous 18 days and indicates when the ground is saturated enough to be susceptible to landslides. Between 3.5 and 5.3 inches are required to exceed this threshold.

Understanding the Hazard[3]

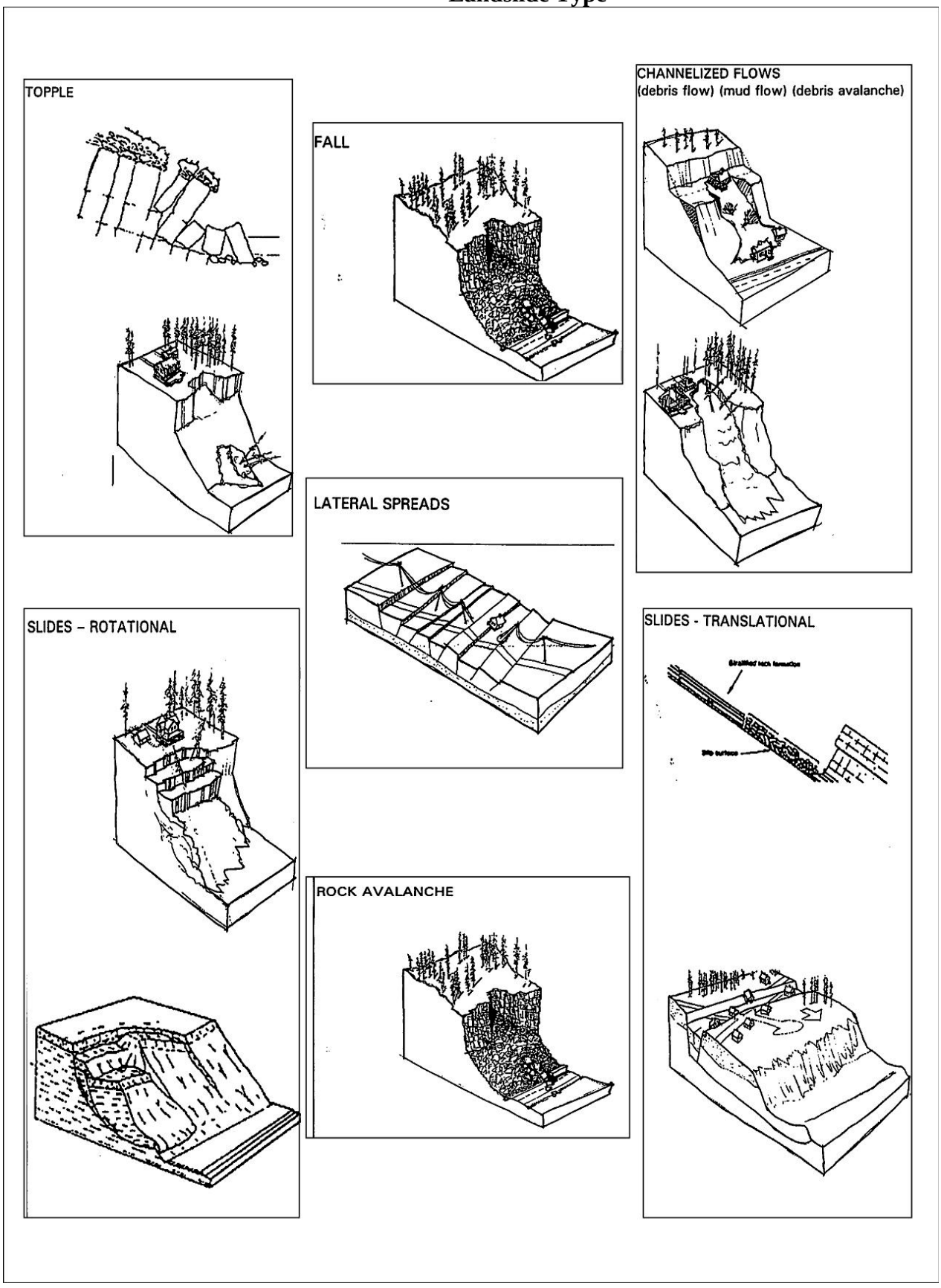
Landslides basically include any type of slope movement. To a significant degree, the various types of landslides are influenced by the underlying geology. Basic geological characteristics result in a general correlation between landslide types and the geologic characteristics. In southwest Washington, our geology is characterized by older geologic sedimentary units prone to shallow and deep seated landslides.

Table 35
Landslide Type

Type	Material Type	Failure Mechanism	Speed	Runout	Terrain
Fall	Rock	Detachment of rock from steep slope. Caused by displacement from water and ice in cracks. Descent by bouncing or rolling down fall line of slope.	Rapid	Depends on size and velocity of material and gradient of runout area; runout generally equals the height of the slope.	Very steep rocky slopes; rock outcrops and faces; and roadcuts
Topple	Rock	Forward rotation of rock or soil away from slope face caused by displacement from water or ice in cracks. Descent by bouncing or rolling down fall line of slope	Rapid	Same as Fall	Same as Fall
	Soil		Rapid	Same as Fall	Precipitous slopes, e.g., coastal bluffs, river bluffs, glacial and fluvial terraces
Rock Avalanche	Rock	Downward movement of broken rock which follows a well-defined channel. May include debris avalanche	Rapid	Same as Fall	Same as Fall
Rotational Slide	Rock	Downward movement of rock or soil mass along a typically deep-seated curve and concave-up failure surface. Generally forming in previous unfailed native and fill materials.	Moderate to Slow	Typically ranges from 2 to 10 times the vertical offset.	Undercut steep to precipitous shoreline bluffs, glacial, and fluvial terraces; fill embankments.
	Soil				
Transitional Slide	Rocks (weak, layered)	Downward movement along inclined planar or undulating surface of rupture. Failure is typically shallow and through weak or previously failed rock or soil. Displaced mass rapidly disintegrates as velocity and water increase. Failure surface often the contact between bedding planes in rock and/or soil units.	Rapid to Moderate	Less than topples or falls but greater than rotational slides, typically approximately 1/2 of slope height.	Moderate to Steep Slopes
	Soil (colluvium overlying rock substrata)				
Lateral Spread	Soil and Rock	Extension and separation of more or less intact blocks of cohesive soil and/or rock on a nearly flat zone of weak underlying material. May result from seismic liquefaction. Spread may develop into flow at toe.	Slow to Rapid	Runout from associated flows	Low gradient slopes. Terrace surfaces
Channelized Flow	Soil	Soil flows occur as dry soil or water- saturated events. Both flow types follow or develop well-defined channels.	Rapid	Depends on flow viscosity, soil volumes, and slope gradient. Large volume flows can travel great distances.	Initiate on moderately steep slopes.

Figure 11

Landslide Type



Severity

There is no standard approach to measure the severity of a landslide. Severity can be measured in total cost of damages, impacts to transportation or utility systems, or in terms of injuries and fatalities. The severity of a landslide can also be measured in terms of its size and composition: from a thin mass of soil a few yards wide to deep-seated bedrock slides miles across. Despite the difficulty in predicting landslides, the environment provides visual indicators of where the earth is moving. Discovering sites of prehistoric landslides is difficult as telltale signs are often obscured by vegetation or human development.

The travel rate of a landslide can range from a few inches per month to many feet per second depending on the slope, type of material, and moisture content.

Impacts

The impacts of landslide hazards in Cowlitz County are numerous. Landslides can injure or kill people caught in the path of rapid moving earth. No deaths have occurred from a landslide in Cowlitz County. In January 1997 a family of four on Bainbridge Island was buried and killed by 2,000 cubic feet of earth. The fast moving landslide slammed into the back of their home in the early morning hours while the family was still in bed. Past landslides highlight the fact that many homeowners lack insurance covering landslide hazards. Many Cowlitz County residents have lost their homes due to the damaging effects of landslides. Landslide damage can render the property unstable and permanently uninhabitable. Rebuilding onsite is often not an option, so the financial loss for some homeowners is immense. People can suffer great emotional stress and anguish from losing both their home and their property. Small business owners also face similar financial losses and stress.

Landslides can physically damage or destroy almost any infrastructure including buildings, utilities, streets, rail lines, bridges, and tunnels. Communities at large can face transportation disruptions from the loss of critical travel corridors, like State Route 4 near the Wahkiakum County line, resulting in lengthy detours. Public health and safety can be compromised from loss of energy, communications, water, and uncontrolled wastewater discharge.

Local governments, public works, building inspectors, and other safety officials can become overwhelmed if a landslide hazard impacts a significant portion of the community. Landslide events necessitate monitoring. Buildings and other infrastructure must be inspected to determine whether they are safe for occupancy or use. If a building is deemed unsafe, law enforcement personnel may need to increase patrols to decrease the risk of theft or criminal trespassing.

Table 36
Potential Damage By Landslide Type

Damage:	Slide Type										
	Fall	Topple		Rock Avalanche	Rotational		Translational		Lateral Spreads		Channelized Flows
	Rock	Rock	Soil	Rock	Rock	Soil	Rock	Soil	Rock	Soil	Soil
Damage to structures from impacts	•	•	•	•			•	•	•	•	•
Damage to utilities from impact	•	•	•	•			•	•	•	•	
Obstruction/displacement of transportation facilities							•	•	•	•	•
Obstruction/alteration of roads	•	•	•	•	•	•	•	•	•	•	
Obstruction of watercourses	•	•	•	•	•	•	•	•	•	•	
Loss of ground support					•	•					
Displacement of buried utilities							•	•	•	•	
Water and mud inundation											•
Fish habitat destruction due to extreme erosion and/or sediment deposition											•

Probability of Occurrence

A review of local newspaper media, internet sources, Department of Natural Resources landslide data, and Federal Disaster Declarations for Cowlitz County suggest that the incidences of landslides are concurrent with winter storms, flooding, and earthquakes. The majority of landslides in the region are triggered by heavy precipitation in the winter months. The 1998 Aldercrest-Banyon Landslide represents a large scale, but infrequent event for the region. Many smaller landslides regularly block roads with debris or washout transportation facilities and rupture utility pipes. Landslides are a continued concern for Cowlitz County residents, due to the vast majority of mountainous terrain and heavy rainfall. Therefore landslides have a high probability of occurrence and are certain to reoccur within a 25 year period.

Landslide Historical Occurrences and Impacts

Several landslides have impacted the region over the last two decades. It is important to highlight the effects and damages from these hazards to note their severity, costs and point out the region's vulnerabilities. Previous landslide events perhaps offer the best indication of the types of losses that local communities are likely to experience in the future.

April 1998: Aldercrest-Banyon Landslide, Kelso, WA[4]

The first signs of a slide came in February 1998 when the city's public works department staff inspected a sewer line break. At that time no slope movement was observed. A month later homeowners began to experience jammed doors and to notice cracks in foundations and driveway slabs. Then in April, a landslide scarp developed; an offset of more than 18 inches split right through the foundation of one house. The dramatic land movement prompted the city to hire a technical team of engineering geologists and geotechnical engineers to investigate the conditions. The technical team conducted field reconnaissance, inspected numerous residences, and reviewed historical documents and references related to geological problems in the area. What the geologists found in the area was a deep seated landslide that had been inactive for many hundreds or thousands of years. Subsequent analysis of the slide area and laboratory testing results indicated that the movement had been triggered by moisture saturation on the slopes. The area had experienced three years of above-average rain, which was as much as 60% above the 75-year average.

The investigation concluded that, in the area where the primary slide occurred, the movement was generally a translational movement of the old slide debris on the surface of a stiff clay layer, also known as the Cowlitz Formation. As the movement increased, it took other forms including debris flow, block-glide, and near-fluid flows in some areas. Rotational landslides also occurred in the area of the ancient landslides headscarp as the old slide debris moved down the slope. The landslide movement was continuous, but not rapid. Over a nine-month period, April 1998 to January 1999, the scarp expanded to about 3,000 feet in length and displaced about 100 feet vertically.

Delineation of Landslide Hazard Area

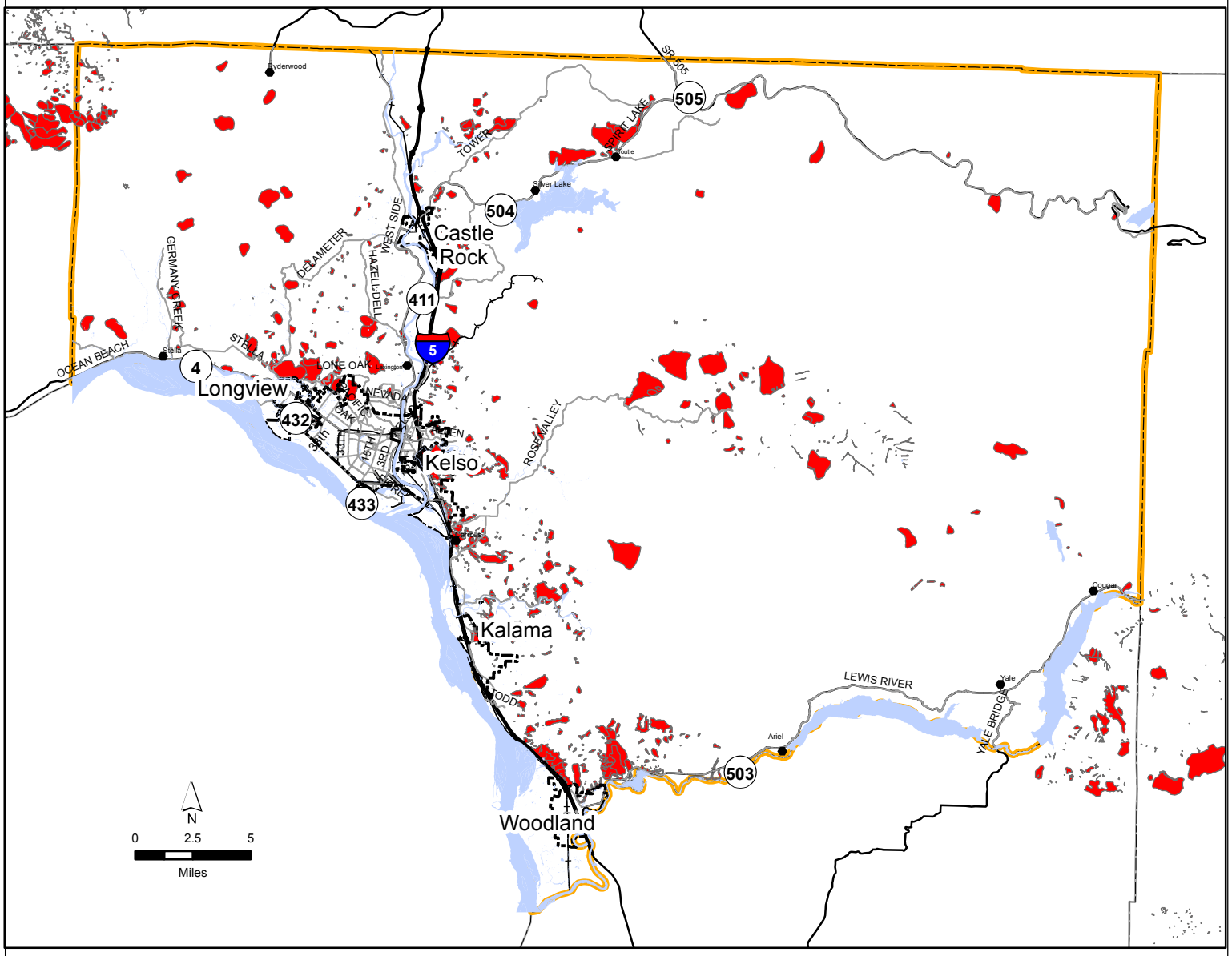
In general, landslide hazards occur throughout the county. For the purposes of the landslide hazard risk analysis, the landslide hazard area has been defined by the Washington State Department of Natural Resources - Division of Geology and Earth Resources. Elevations were determined utilizing a 10-meter Digital Elevation Model prepared by the U.S. Geological Survey. Data is derived from contour lines at 40-foot or finer intervals on 7.5' maps. Vertical accuracy corresponds to the accuracy of the underlying 1:24,000 USGS topographic map used to produce the 10-meter Digital Elevation Model. Commonly the data is referred to as the "Wegmann Data." This geographical delineation was then related to parcel data that was used to identify the critical facilities and the assets that fall into the hazard area. This delineation is used by most Cowlitz County jurisdictions to identify geologic hazard areas, along with contour data.

Communities Most Vulnerable to Landslides

The Washington State Department of Natural Resources Division of Geology and Earth Resources has mapped shallow and deep seated landslide occurrences and landslide landforms throughout Cowlitz County. Though useful, the data is not a comprehensive summary of all landslide events and hazards. Geologists mapped data based on interpretation of aerial photos,

topography and field visits. The unpublished data is intended to be used as a reconnaissance-level screening tool. The data is no substitute for site-specific geological evaluation of local conditions. Each of the five cities in the county experience landslides near their urban fringe. This is a result of the mountainous terrain of Cowlitz County. The cities of Cowlitz County were settled on relatively flat land. As development and populations increased, the city's footprints spread to the base of the hillsides.

Figure 11
Potential Landslide Hazard Areas
in Cowlitz County



City Limits
Major Roads
Interstate Five (I-5)
Rail
Potential Landslide Hazard Areas

Shared/Planners/Haz_Mit/January/Figures/Landslide

Population in the Hazard Area

Approximately 18% of the total county parcel acreage is susceptible to landslide. In many instances, only a portion of a parcel is at risk. For the purpose of this planning effort staff is assuming the development permits issued in areas designated as steep slope have been reviewed and approved in accordance with protective regulations. The use of GIS for identifying population in the hazard area is not an appropriate technique because of the data constraints.

Critical Facilities and Infrastructure in Hazard Area

Table 37
Critical Facilities in a Steep Slope Area

List of Critical Infrastructure/Equipment:	Building Value ($)	Content Value ($)	Total Value ($)
Toutle Water Reservoir – 500,000 Galloon	1,040,000	0	1,040,000
Ryderwood Domestic Water System – 32,053 LF of conveyance	407,500	1,235,000	1,642,500
Woodbrook Sanitary Sewer System – 5,481 LF of conveyance	52,000	2,000	54,000

Cowlitz County has not located any of its critical facilities associated with emergency response in areas designated as steep slopes. As included in Table 37, some facilities associated with water treatment or reservoirs have located in areas designated as steep slope due to its role in the hydrologic system.

Summary Assessment

The history of landslides within Cowlitz County clearly demonstrates a moderate probability of future occurrence. Although the region is mountainous, our probability of occurrence is mitigated through the adoption of Critical Area's Ordinances (CAO). CAO adopted by the cities and county provide a mechanism for limiting development near steep slopes. Because of the relative land area and population affected, the county is exposed to a major landslide periodically, based on the history of the last 41 years (1968 to 2009). Overall, this data clearly indicates that the vulnerability of major landslide events in the region is low. The region's overall risk ranking of landslide remains moderate.

Landslide Endnotes

[1]United States Geological Survey. 2009. Landslides Hazard Program. http://landslides.usgs.gov/
[2]Washington State Community, Trade and Economic Development, Optional Comprehensive Plan Element for Natural Hazard Reduction. June 1999
[3]Optional comprehensive plan element for natural hazard reduction / Department of Community, Trade and Economic Development. Washington (State). Dept. of Community, Trade, and Economic Development. 1999
Karl Wegmann Digital Landslide Inventory for the Cowlitz County Urban Corridor — Kelso to Woodland (Coweeman River to Lewis River), Cowlitz County, Washington: 2003 version 1 vector digital data
[4]Landslide hazards and Planning. James C. Schwab, Paula L. Cori and Sanjay Jeer. 2005. American Planning Association. Report Number: 533/534

Chapter 4.5: Wildland Fire Hazard Profile

Introduction

A wildland fire, also known as a wildfire, can damage or destroy open space and natural resource lands. Although wildland fires can be ignited by natural means such as lightning, they are more frequently the result of ignition due to poor judgment or a lack of understanding of fire hazard potential, such as residential debris burns left unattended. Large uncontrollable fires can destroy timberlands, recreational areas, habitat, watersheds, and cherished scenic views. The Washington State Hazard Mitigation Plan reports that approximately 17,000 acres of state-owned or protected land is burned annually at the cost of $28 million in combined damages and suppression activities.[1]

The region has been spared the destructive force of a major wildfire, but numerous wildland fires occur annually throughout the entire region. Areas of human development interface with extensive forest lands, prairies, and other open space areas throughout the county. As the region's population grows and the potential for drought from warmer, drier, and longer lasting summers (due to the effects of climate change), the risk for hazardous wildland fires is likely to increase. Under the right conditions, it is conceivable that a large wildland fire could consume more forest, grasslands, homes, and other public and private owned assets within the Region than previously documented. Due to the high probability of occurrence, the number of urban interface communities that are moderately vulnerable, the overall wildland fire risk rating for the region is moderate.

Hazard Identification [2]

The Washington Department of Natural Resources and its federal and local partners determined that Cowlitz County and its communities are at high risk after evaluating them for fire behavior potential, fire protection capability, and risk to social, cultural and community resources. Risk factors included area fire history, type and density of vegetative fuels, extreme weather conditions, topography, number and density of structures and their distance from fuels, location of municipal watershed, and likely loss of housing or business. The wildland fire hazard is unique from other hazards in Cowlitz County in that:

- It is the most frequent occurring hazard; approximately 35-100+ wildland fires start per year[3]
- It can be prevented; over 99 percent of fires are started due to poor human judgment or accidental ignition
- It is the only hazard that can be actively contained or suppressed in real time. To date local fire districts and the Washington State Department of Natural Resources have effectively extinguished fires prior to becoming larger scale hazards

The 1991 fire storm in Spokane County and the 1995 fires in Chelan County vividly demonstrated that Washington, like Oakland and Southern California, is vulnerable to disastrous fires. But such disasters are not a new occurrence. Large, destructive fires have been recorded as far back as 1902 and all portions of the state experienced natural wildfires prior to the arrival of our modern

cultures. In the period 1970-1994, more than 400,000 acres burned, resulting in fatalities and loss of homes, other property, and crops. According to records kept by the Department of Natural Resources (DNR) 30 of Washington's 39 counties have a high or extreme risk of wildfire danger, making fire a truly statewide hazard.

Historically, wildfires were generally started by lightning strikes. The vast majority of fires today (approximately 85% on DNR-protected lands) can be attributed to human causes. While most of these are accidental, arson fires do pose a significant risk.

The most expensive wildfires occur in locations on the edges of communities. This zone, the urban-wildland interface, may be defined in either of two ways:

1. *From an urban planning/design perspective:* The region on the fringe of urban development where structures occur in a primarily undeveloped landscape.
2. *From a fire management perspective:* Any area where potentially dangerous combustible fuels are found adjacent to combustible homes and other structures.

The urban-wildland interface may be distinguished from rural development by the wild or unmanaged quality of the landscape and the fire danger posed by that landscape. Figure 12 illustrates the concept of structures mingling with the combustible landscape that characterizes the interface.

In recent years, growing numbers of formerly urban residents have been drawn to interface areas by scenic beauty, inexpensive land, and relief from urban stress. As the population has shifted to the urban-wildland interface, an increasing number of homes are being lost to wildfires, and this trend is expected to continue. Development in these areas not only places structures in the path of existing fire patterns — it also adds numerous potential sources of ignition and complicates the fire control mission. Wildfire suppression costs are escalating as suppression strategies change to protect homes.

An additional significant problem is the limits placed on infrastructure (e.g., access roads and water services) and staffing resources in fringe communities by their small tax bases. Fringe areas, especially those undergoing rapid growth, tend to be under-served by fire protection. Such communities may also have a more difficult time recovering from fire disasters. According to DNR, 80% of communities in the state are served by volunteer fire-fighting forces.

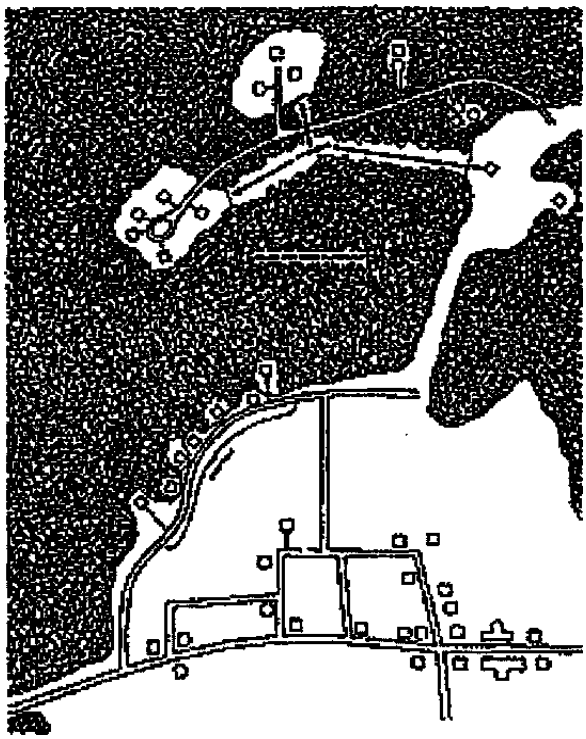
Definition

A wildland fire hazard is an uncontrolled fire that spreads through areas in which development is typically limited. These areas may include infrastructure such as roads, railroads, power lines, and similar facilities, but population and employment density are typically low. Wildfires can begin unnoticed and spread quickly.

Indeed, ecologists, foresters, and other natural resource land managers view wildland fires as a natural process necessary to sustain the health of forest, woodland, or grassland ecosystems. Nevertheless, when a fire threatens managed natural resources, property, and human life, the natural process transforms to a hazard.

Wildland Urban Interface (WUI) communities are geographical areas where human development meets or mixes with wildlands such as grass lands, shrub lands, woodlands and forest. These communities and the adjacent wildlands are at risk because the fire hazard can spread bidirectional. Fires may originate in the wildland area and spread to structures and dwellings and vice versa. People understandably are attracted to less developed areas and seek to build homes in undisturbed natural settings for the aesthetic and scenic value. The desired landscaping, consisting of tall large native trees and shrubs that are prolific on properties throughout rural (and urban) Cowlitz County, can serve as a conduit for wildfire if not properly spaced or maintained at defensible distances away from structures. All five of Cowlitz County cities, Castle Rock, Kalama, Kelso, Longview, and Woodland are listed in the Washington State Enhanced Hazard Mitigation Plan as having a high risk to Wildland Fires.

Figure 13
Structures at the Urban-Wildland Interface



Structures and vegetation intermingle in the interface creating a dangerous mix of fuel and ignition sources

Source and Factors of Wildland Fires: All fires require fuel, oxygen and an ignition source. Less than one percent of all recorded wildland fires in Cowlitz County have occurred from natural occurrences such as lightning strikes. In Cowlitz County, fires are predominantly ignited by human activities such as: debris burning (32%); miscellaneous activities such as fireworks, sparks from engines, and electric fences (28%); children (16%); and recreational activities such as camping and hunting (11%). Other lesser causes include arson, smoking, and railroad operations.

The Washington State Hazard Mitigation Plan identifies fuel, weather, and terrain as essential elements that influence the behavior of a wildland fire. The following excerpt from the

State plan succinctly summarizes these factors:[4]

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 west of the Cascades, but more prolific east of the Cascades. In 2005, about 2.4 million acres of the state's 21 million acres of forestland contained trees killed or defoliated by forest insects and diseases.

Weather:

West of the Cascades, strong, dry, east winds in late summer and early fall produce extreme fire conditions. East wind events can persist up to 48 hours with wind speed reaching 60 miles per hour; these winds generally reach peak velocities during the night and early morning hours.

- Thunderstorm activity, which typically begins in June with wet storms, turns dry with little or no precipitation reaching the ground, as the season progresses into July and August.

Topography of a region or a local area influences the amount and moisture of fuel.

Barriers, such as highways and lakes, can affect the spread of fire.

- Elevation and the slope of the land allows a fire to spread more easily as it moves uphill than downhill.

Severity

The severity of a wildland fire depends upon the extremity of the factors listed above, the extent of the fire, the size of the population, the value of structures that are at risk, and the ability of fire fighters to effectively mobilize and suppress the fire. In general, the cooler, wetter climate of western Washington is less prone to wildland fires because fuel sources have higher moisture content and are less susceptible to ignition. Eastern Washington has a longer and drier fire season and is more vulnerable to lightning strikes than west of the Cascades.

Physical damages include loss of valuable timber, wildlife habitat, and recreational areas such as trails, parks, and campground facilities. Smaller rural communities can suffer economic losses from destroyed natural resource lands because their economies are dependent on the timber industry or tourism. Buildings and their contents, utility lines, and parked vehicles are also destroyed. Power and communication disruptions can occur, even in areas unaffected by fires, if major transmission lines are damaged or destroyed. The loss of vegetation on steep slopes increases the risk for mudslides or landslides during the fall and winter months. Stream and creek channels could fill with sediment and debris increasing flood risks. It could take years for fish habitat to recover

Although a major wildland fire has not affected Cowlitz County in modern times, wildland fires are a common occurrence. They have been documented to occur during every month of the year, particularly during prolonged dry periods due to drought or near-drought conditions. Wildfires are common during the local dry season, mid-May through mid-October, but 75% of all wildfires occur

between July and September when temperatures are higher.

In the region, the following conditions influence the extent and severity of wildland fires:

Soil Conditions - The region has a large area of glacial outwash prairie. Prairies are typically vegetated with grasses and other low growing herbaceous plants and shrubs. Prairie soils drain quickly and the vegetation quickly dries out during the summer months. Several Cowlitz County prairies also interface with encroaching Douglas-fir stands, making these areas particularly vulnerable to wildland fires.

Vegetation Type - The severity of a fire is influenced by the composition and extent of fuels available. Vegetation is the primary source of fuels. Dry grasses are prolific; burns rapidly once ignited, and are capable of generating flames up to 40 feet tall.

Access - Road access and mobility for emergency vehicles is mission critical in wildfire suppression efforts. Limited access delays response time or limits the ability to successfully fight a fire when the necessary equipment and apparatuses cannot make contact with the affected area. There are residential communities in Cowlitz County that have only one road in and out. Limited access poses challenges for both evacuation of residents and the ability of fire fighters to mobilize to the affected area.

Impacts

The impact of a wildland fire varies depending upon the size and location of the fire. The heat from intense wind driven flames can destroy virtually any combustible material in its path. People caught off guard by a rapidly spreading fire could suffer burn injuries or other non-burn injuries trying to escape a fire, or possibly be killed. People recreating in remote roadless forest or range lands are especially at risk. The loss of a loved one or the loss of a home or a business is a traumatic experience and fire victims are likely to suffer post traumatic stress disorder following a fire-related loss.

Wildfires result from the interaction of the elements of the fire triangle: fuel, flame, and oxygen. A fire requires all three of these elements to begin and sustain itself. Fuel in a wildland setting is typically vegetation; the type and amount of fuel available and consumed controls the intensity of the fire. The various fuels that occur on a site are referred to as the fuel load. The initial flame may be supplied by lightning or human causes. Oxygen is rarely a limiting factor in wildfires, but a fire's dependence on it does control its behavior, leading to a generally wind-driven and upslope burn pattern.

Wildfire spread is controlled by fuel, weather, and topography. A dry and hot weather pattern or climate can contribute to fire outbreak by increasing the combustibility of fuels. Strong winds can propel the fire quickly across the landscape; gusty, shifty winds can lead to erratic fire behavior that make the fire management and control tasks much more dangerous. Fires will in general burn upslope towards ridge tops in hilly or mountainous areas (although strong winds can alter this). Narrow canyons are especially efficient fire conveyors as they create a chimney-effect to carry the fire forward.

Wildland fires occur in three main forms — as understory fires, crown fires, and ground fires. In general, wildland fires under natural conditions burn at relatively low intensities,

consuming grasses and other herbaceous plants, woody shrubs, and dead trees. Such understory fires are natural occurrences in many environments and often play an important role in plant reproduction and wildlife habitat renewal. Left to themselves, these fires will burn themselves out when the fuel load is depleted or they are doused by rain or snow. Crown fires, where whole living trees are consumed, are less frequent but considerably more destructive. These are typically what is pictured when people think of large, disastrous fires. In areas with high concentrations of organic material in the soils, ground fires may burn in this material, sometimes persisting for long periods out of sight until a surface fire is ignited. As is often the case with natural phenomenon, most fires will exhibit some combination of these characteristics rather than falling neatly into a category.

Figure 14
Structure Vulnerability on Ridges

Structures on narrow ridges are especially vulnerable to fire.

Wildfires may spawn secondary hazards, such as flash flooding and landsliding, long after they have been extinguished. Vegetation provides a number of physical functions which contribute to the hydrologic and slope stability regimes of an area. When this vegetation is consumed in high intensity wildfire, resulting changes may include decreased rainfall interception and infiltration; faster concentration times and greater volume of peak flows; increased volume and velocity of overland runoff; and loss of reinforcing deep roots. The intense temperatures of wildfire may also cause chemical changes in the soil, resulting in hydrologic changes similar to those described above.

Successful prevention of wildfires depends on the control and elimination of one or more of the elements of the fire triangle. Before a fire begins, the fuel load can be managed through either controlled, intentionally set fires (referred to as prescribed burns) or manual or mechanical harvesting. Breaks in the vegetative cover (fire breaks) are often constructed on ridge tops, as fires will tend to burn upslope. Control of ignition sources can also be effective prevention through restriction of hazardous activities during high-risk periods.

Once the fire is underway, there are limited options for the control and suppression of the blaze. Obviously, nothing can be done to change the weather or topography of the fire site. Control and suppression of burning fires must be accomplished through removal of the fuel load (as above, including the intentional use of small, low-intensity fires to consume fuel) and suffocation (elimination of oxygen) by application of water and suppression chemicals.

In urban settings, fire fighters generally deal with structural fires which are fought directly with water readily available from fire mains and hydrants. Rapid response is a key element in extinguishing fire while it is still manageable. In wildland settings, fire fighters use more indirect techniques to contain the fire within a perimeter and deprive it of fuel.

Multiple fire fighting organizations or agencies may be involved, requiring a high level of communication and coordination of resources.

Urban-wildland interface fires offer a mix of conditions that are not wholly suited for either technique. Although structures are often involved, an urban-level of water and staff resources is rarely available, especially when multiple structures are threatened. Even if sufficient resources are present, rapid response is often compromised by the distances and qualities of roads available in the area. In addition, wildland techniques, which require the sacrifice of some areas for strategic gain, are not suited to preserving structures scattered throughout the fire zone. Fire managers may find themselves with difficult choices between saving structures or large tracts and their natural resources. The situation may also be complicated by residents who are unfamiliar with the level of fire protection available. They assume that the urban standards with which they are familiar apply, and fail to take adequate precautions (such as storing water on site and clearing a defensible space around their home). When limited resources are challenged by high-intensity fire storms, they are easily overwhelmed, resulting in evacuations and loss of property.

Historically, wildfire management has meant immediate fire suppression. When wildland fire control and prevention are successful, the risk of dangerous, high-intensity fires can actually increase as fuel loads build. These high-intensity fires take on an entirely different character than their low-intensity cousins, consuming all vegetation in their paths and erupting as fire storms. Such conflagrations are driven by winds that they produce and can move quickly and erratically. It may not be possible to stop them once they begin, and it may be impossible or foolhardy to try to save structures that lie in their paths; winter rains and snow might provide the only viable suppression technique. Unfortunately, large fuel loads are often associated with the fringes of the urbanizing areas due to historical suppression efforts setting the stage for high-intensity interface fires. To avoid the possibility of these high-intensity fires, land managers and oversight agencies practice and promote vegetation management techniques that maintain the fuel load at an appropriate, controllable level.

Probability of Occurrence

Firefighting can consume significant local and state resources. Even a small wildland fire in Cowlitz County requires rapid containment or suppression in order to protect property. Local fire districts often rely on DNR assets such as helicopters to reach remote areas or provide rapid response. Should multiple wildland fires occur simultaneously in different areas during an extremely warm and dry season, local capabilities could quickly become overwhelmed. This is particularly more problematic when major wildland fires on federal lands require the mobilization of fire fighting assets across the western U.S., further stretching local fire fighting capacity.

The documented record of wildland fires in Cowlitz County suggests that approximately 97 percent of future fires will be five acres or less. The region can expect at least one fire exceeding 100 acres over the next 25 years. A warmer and drier future climate may create more suitable conditions for more frequent or larger fires.

Wildfire/Forest Fire Historical Occurrences and Impacts

Cowlitz County has not experienced a major wildfire with complete destruction of timber, structures, personal property, wildlife habitat, recreational areas, and watershed areas coupled with a substantial negative impact of commerce and infrastructure. Major wildland fires also have not occurred in modern times for the surrounding Wahkiakum, Lewis, and Clark counties.

Historic Western Washington Wildfires

While major forest fires are not common in Western Washington, the Yacolt Fire in Clark and Skamania counties are the largest known Washington fires in recorded history. In 1902, the Yacolt Fire burned 238,900 acres (373 square miles) resulting in 38 deaths. More recently, the Jordan Creek Fire occurred near Marblemount in Skagit County and burned 1,162 acres of forest land and threatened several homes in 1998. The cost to fight the Jordan Creek Fire was reported to be in excess of $3 million dollars.

Delineation of Wildland Fire Hazard Area

The location of past fires combined with the fact that there is sufficient open space with fuels throughout the County suggests that wildland fires can occur anywhere. However, some areas within the county are at greater risk than others. Washington State has identified 181 high risk urban interface communities in the state. The Washington State Department of Natural Resources in partnership with federal and local stakeholder's delineated wildland urban interface communities throughout Washington. These geographical areas were evaluated for fire behavior potential, fire protection capability, and risk to social, cultural and community resources. Risk factors included fire history, type and density of vegetative fuels, extreme weather potential, topography, number and density of structures and their distance from fuels, location of municipal watersheds and potential for loss of housing or businesses. The evaluation used the criteria in the wildfire hazard severity analysis of the National Fire Protection Association's NFPA 299 Standard for Protection of Life and Property Wildfire (now NFPA 1144).

Planning and Mitigation

As with floods and landslides, an understanding of the factors which control fire ignition and behavior forms the basis for fire prediction, avoidance, and mitigation. Hazard reduction planning for fires requires:

- identification of the current hazard (characterization of fuel loads, topography, and meteorological patterns);
- modeling of potential future hazards (based on forecasted or planned development or other types of land conversion, vegetation management plans and practices, and long-term meteorological forecasts);
- identification of areas, structures, and people at risk from these hazards and the likelihood and severity of such risk;
- identification of resources available for fire response and recovery and documentation of shortfalls in these resources.

These steps will give the community a sense of the nature of the problem and offer options for how they may address it. Documentation of the current situation, especially in terms of foreseeable future damages, will be helpful in pursuing outside assistance. After this process is complete, goals and implementation strategies may be developed as described in Chapter 5.

Fire hazard mitigation may involve fireproofing, control of ignition, and facilitation of response. Each of these approaches is explored in greater detail below (Table 38). DNR has resources available to help with risk assessment and mitigation planning. Additional details and further ideas for hazard reduction may be obtained from DNR or the *Firewise* website *(vnvw.firewise.org)* sponsored by the National Fire Protection Association, the National Association of State Foresters, and various federal agencies. Also, a model Urban-Wildland Interface Code, prepared by the International Fire Code Institute and available from the International Conference of Building Officials, may help.

Table 38
Fire Hazard Mitigation Approaches

Approach	Techniques
Fireproofing Development	
Building Material and Location Restrictions	• Require Class B or better roofing materials. • Enforce general fire-resistant building design criteria (e.g. limited window surface and fire-resistant materials). • Set back structures on hill and ridge tops at least 30 feet from edge of slope (steep slopes require 100-foot or larger setbacks). • Provide adequate access roads and ensure that gates can be opened by emergency crews and negotiated by fire apparatus if necessary. • Implement fire flow requirement reduction incentives for fireproof development
Landscaping Maintenance * Programs	• Maintain a cleared zone/defensible space (low, irrigated ground covers or inflammable materials only) of 30 feet around structures (steep slopes require 100 feet or larger zone). Prune and carefully space any trees (especially around chimneys). • Maintain a buffer of low, fire-resistant plants gently transitioning into well-spaced trees and the natural landscape beyond the cleared zone. Use selective thinning in the natural zone to maintain an appropriate fuel load. • Avoid ladder fuel situations where a continuous ramp from ground cover to tree crown is provided. • Use fire-resistant design elements such as driveways, walkways, and lawns as fuel breaks. • Maintain the landscape (e.g., remove leaf clutter and mow regularly). • Maintain natural or reduced fuel load through harvest or controlled burns. • Maintain cleared paths in vegetation (fire breaks), generally on ridgetops and in defensible locations. • Properly store and dispose of flammable materials
Property Owner/Occupant Education	• Educate the public about building material and location and landscaping concerns. • Implement a real estate disclosure program to ensure that new property owners are aware of the hazard and the availability of response resources.
Controlling Ignitions	

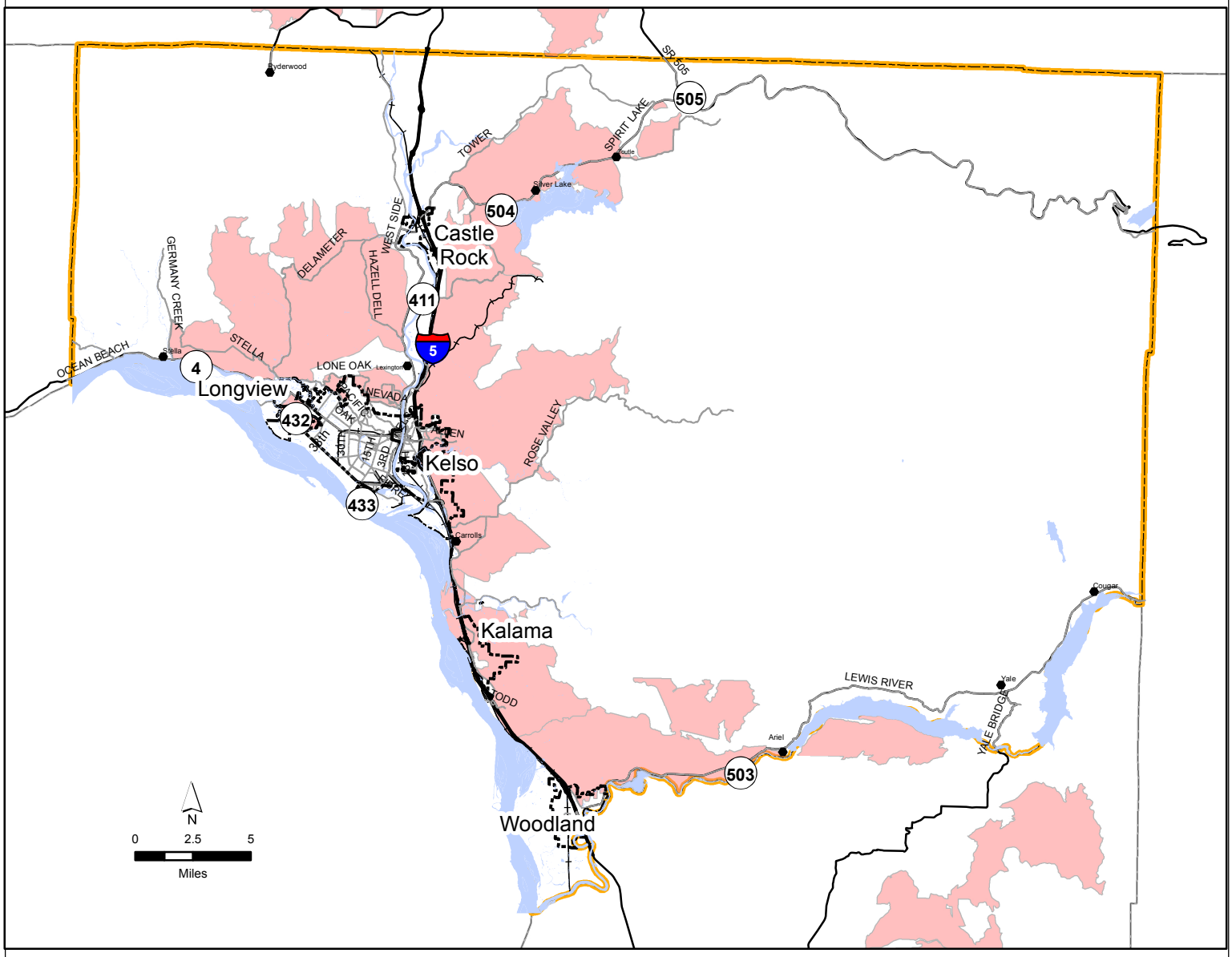
Table 38 Fire Hazard Mitigation Approaches	
Activity Restrictions for High Risk Periods	• Educate the public about fire concerns and the necessities of activity restrictions.
Building Material Restrictions	• Adopt and enforce building codes that implement fire-safe building techniques (e.g., mesh screens on chimneys and fireproof roofing materials to avoid spread from structural fires). • Educate the public about fire concerns and appropriate preventative measures.
Facilitating Response	
Fire Equipment Access/Egress	• Ensure appropriate road width, slope, and surface for fire equipment. Maintain these roads free from obstructions (including parked vehicles). • Provide a pattern of connected streets or turnarounds on deadend streets. • Make sure that all bridges are rated to a sufficient load for responding fire equipment. • Maintain a cleared zone/defensible space (low, irrigated ground covers or inflammable materials only) of 30' around structures (steep slopes require larger zone). Prune any overhanging trees.
Land Use Restrictions for High Risk Areas	• Cluster development where possible to facilitate response and ensure that common open space is accessible and useable by fire apparatus.
Water Supply Requirements	• Develop fire flow requirements that reflect the area and building type characteristics. • Ensure proper water quantity and pressure for anticipated fire flow requirements. Implement these requirements through development restrictions or concurrency provisions in the comprehensive plan. • Consider options for providing sufficient water or decreasing fire flow requirements (e.g., tanker delivery, automatic sprinkler systems, non-combustible roof materials, and increased defensible space).
Coordinated Response	• Develop mutual assistance agreement and coordinated response plans with adjacent communities which address reliable access routes and compatibility of equipment (e.g., hose sizes and manifolds).

Critical Facilities and Infrastructure in Hazard Area

Table 39
Cowlitz County Critical Facilities in Relation To Potential Wildfire Hazard Areas

Building	Building Value ($)	Content Value ($)	Total Value ($)
Carrolls Road Radio Tower	13,758	12,399	26,157
Columbia Heights Radio Tower	85,519	113,214	198,733
Davis Peek Radio Relay Station	126,731	0	126,731
Tower Road Reservoir	208,000	0	208,000
Toutle Sewer Treatment Plant	182,400	475,000	657,400
Toutle Water Reservoir	1,040,000	0	1,040,000
Woodbrook Sewage Treatment	52,000	2,000	54,000
Toutle River Well House	52,000	1,000	53,000

Figure 14
Potential Wildfire Hazard Areas
in Cowlitz County



City Limits
Major Roads
Interstate Five (I-5)
Rail
Potential Fire Hazard Areas

Shared/Planners/Haz_Mit/January/Figures/wildfire

Summary Assessment

The history of wildland fires within Cowlitz County clearly demonstrates a low probability of future occurrence, due to the high amount of precipitation west of the Cascade Mountain Range. Because of the relative large undeveloped land area and population affected, the county is exposed to minor wildland fires periodically during dry summer months.

Adoption of the International Building Code and International Fire Code by Cowlitz County helps to curtail wildland fires from expansive damage by limiting the flammable materials on remote homes and property. This indicates that the vulnerability of major wildland fire events in the region is moderate. The region's overall risk ranking of wildland fires is moderate.

Endnotes

[1] Washington State Enhanced Hazard Mitigation Plan. Washington State Military Department. October 1, 2010. Chapter 5.10 pg. 1 Summary of Wildland Fire Hazard

[2] Originally published in Federal Register, Volume 66, Number 100, pages 43432-43433, August 17, 2001, and updated by the Washington Department of Natural Resources in A Progress Report on The National Fire Plan in Washington, 2002. List Revised, 2004, 2009.

[3] Rocky Mountain Research Station. Prescribed Fire and Fire Effects Research Work Unit. December 1999. www.fs.fed.us/fire/fuelman

[4] Ibid.

Chapter 4.6: Volcanic Hazard Profile

Introduction

There are five major Cascade volcanoes in Washington State: Mount Baker, Glacier Peak, Mount Rainier, Mount St. Helens, and Mount Adams. In the last 4,000 years, 11 Cascade volcanoes have erupted an estimated 100 times; a rate of two events per century.[1] The May 18, 1980 eruption of Mount St. Helens reminds Washington residents that dormant Cascade volcanoes can reawaken with destructive forces and severely impact surrounding communities causing loss of life. The 1980 eruption killed 57 people and caused damage that exceeded one billion dollars.

Two of the most active and hazardous volcanoes in the United States, Mount Rainier, and Mount St. Helens, threaten Cowlitz County, as well as Mount Adams and Mount Hood. The proximity of these mountains to Cowlitz County communities increases the region's risk for disasters initiated from a volcanic event. The region has a low risk for ash fall, but a moderate risk for a large volcanic mudflow known as a lahar.

Hazard Identification

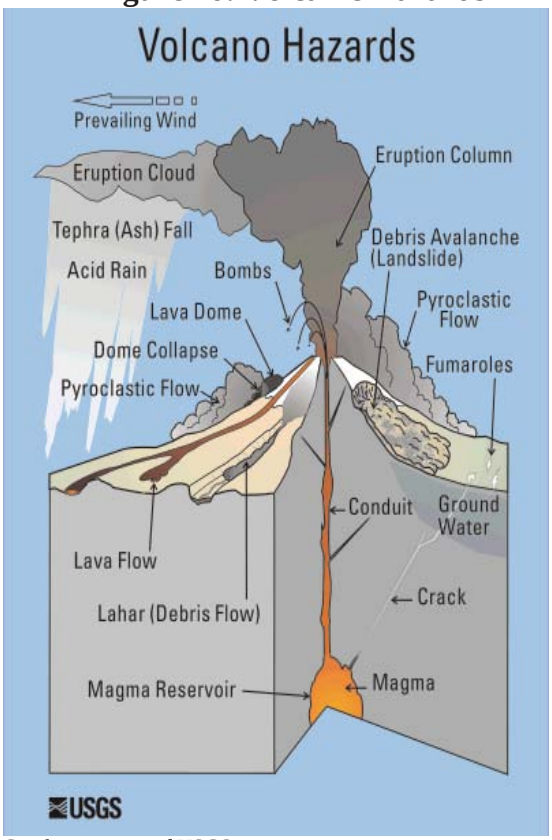
The Cascade Range is approximately 700 miles long and it extends north-south from British Columbia, Canada to northern California. It contains over a dozen active volcanoes.[2] These mountains have been erupting and reshaping over the last 500,000 years. Cascade volcanoes are typically conical shaped mountains surrounding a vent that is connected to a reservoir of molten rock below the surface of the earth. Gas, ash, ballistic projectiles, rock fragments, and magma are forced to the surface through these vents from rising pressures within the earth's interior. The volcanoes were formed through the buildup of their own eruptive materials combined with catastrophic loss events such as landslides, lahars, and gradual erosion from glaciers.

Many volcanic events such as pyroclastic flows, lava flows, landslides, and explosive blasts can devastate an area of ten miles or greater from the source of the eruption. Although these events can destroy flora, fauna, human life, and almost every structure in their path, their geographical range of destruction is limited. Should Mount Rainier or Mount St. Helens erupt, the direct devastation from these types of events would likely be limited to the area within the boundary of Mount Rainier National Park or the Mount St. Helens National Monument.[3]

Mount St. Helens remains a potentially active and dangerous volcano, even though it is now (1995) quiescent. In the last 515 years, it is known to have produced four major explosive eruptions (each with at least 1 km^3 of eruption deposits) and dozens of lesser eruptions. Two of the major eruptions were separated by only 2 years. One of those, in 1480 A.D., was about 5 times larger than the May 18, 1980 eruption, and even larger eruptions are known to have occurred during Mount St. Helens' brief but very active 50,000 year lifetime. Following the most recent major eruption, on May 18, 1980, there were 5 smaller explosive eruptions over a period of 5 months. Thereafter, a series of 16 dome-

building eruptions through October 1986 constructed the new, 270 m (880 ft) high, lava dome in the crater formed by the May 18, 1980 eruption. Volcanoes commonly repeat their past behavior. Thus, it is likely that the types, frequencies and magnitudes of past activity will be repeated in the future. Among the possibilities for renewed eruptive activity at Mount St. Helens are resumption of dome growth, eruption of basaltic or andesitic tephra and lava flows, or explosive eruptions of dacitic tephra and pyroclastic flows in volumes that could be as large as, or even larger than, the volume erupted in 1980. Lahars (sediment-rich floods in volcanic terrain) generated by snowmelt are likely to accompany any eruptive activity. Lahars may also be generated without an eruption by intense storm runoff over erodible sediment, landslides, or by failure of the Castle Lake impoundment as a consequence of an earthquake or heavy rains. Neither a large debris avalanche nor a major lateral blast like May 18, 1980, is likely now that a deep, open crater has formed.

Figure 16: Volcanic Hazards



Graphic courtesy of USGS

1. Tephra Hazard

Definition

Tephra is the term for volcanic dust and rock fragments blasted into the air from an explosive volcanic eruption. It can produce a hazardous plume or column of debris that subsequently falls to the ground in the direction of prevailing winds. Tephra plumes can travel for hundreds of miles and deposit ash along its path. Airborne particle suspension diminishes as tephra columns increase in elevation and distance from the volcano. Both the thickness of the deposition and the size of the particles also decrease with increasing distance from the site of eruption. The following terms are used to describe the various sizes of tephra:

a. Ash: dust particles less than 2mm diameter
b. Lapilli: small rock fragments from 2mm to 64mm
c. Blocks or Bombs: tephra greater than 64 mm

Severity

Mount St Helen's peak is within Skamania County, however a large portion of the mountain resides in Cowlitz County. With the right winds, the entire County could be blanketed with ash. The severity of the hazard would depend on the thickness of the ash deposition. The 1980 eruption of Mount St. Helens blew an ash column 15 miles into the atmosphere above the crater. Over the course of the day of the eruption, nearly 540

million tons of ash was blown by winds to the east.[4] Fallout from the ash created complete darkness in Spokane, nearly 250 miles away; dropping one half inch of ash only a few hours after the start of the eruption.

Impacts

Ash fall of a quarter inch or more will reduce motorists' visibility and disrupt nearly every mode of transportation. Wet ash could create hazardous driving conditions and result in traffic injuries or fatalities. Aircraft is especially vulnerable as ash may disable engines and completely obscure pilots' visibility. Air transportation would be grounded in the affected area as long as conditions pose a hazard. Inhalation of ash particles could cause respiratory irritation and pose more serious problems for people with asthma or other respiratory diseases, but this could be mitigated by simply avoiding exposure. Ash can destroy agricultural crops, contaminate surface water sources, clog drainage and sewer systems, and inhibit or destroy mechanical systems such as outdoor heating, ventilation, and air conditioning systems. Ash fall of just a few inches in depth could exceed the load capacity of some building rooftops and lead to structural failure. Failure could occur with lower depths if ash absorbed subsequent precipitation. Wet ash has been known to cause power lines to short out. Clean up and recovery would likely be the greatest cost to both the public and private sector. The 1980 eruption of Mount St. Helens posed a major nuisance for communities in Eastern Washington. In Yakima, ash removal took ten weeks and cost $2.2 million.[5]

2. Lahar Hazard

Definition

United States Geological Service (USGS) defines a lahar as follows:

> *A lahar is a flowing mixture of water-saturated debris that moves downslope under the force of gravity. Debris flows consist of material varying in size from clay to blocks several tens of meters in maximum dimension. When moving, they resemble masses of wet concrete and tend to flow downslope along channels or stream valleys. Debris flows are formed when loose masses of unconsolidated wet debris become unstable. Water may be supplied by rainfall or by melting of snow or ice. Debris flows may be formed directly if lava or pyroclastic flows are erupted onto snow and ice. Debris flows may be either hot or cold, depending on their manner of origin and temperature of their constituent debris.*[6]

The scientific literature for Cascade lahars identifies several size and origin classifications. Lahars can be both large and small.

Severity [7]

If a large lahar were to occur at Mount St. Helens within the next few decades, the mechanism most likely to be responsible would be rapid melting of snow and ice in the crater or a sudden outbreak of Castle Lake. Either mechanism would produce a lahar only in the North Fork Toutle River (and downstream). Rainfall is seldom intense enough to directly produce lahars in the Cascades, and the flows produced by this mechanism tend to be fairly small. Likewise, any landslides occurring on the flanks of

Mount St. Helens are likely to be relatively small, especially now that the volcano's height has been lowered by the 1980 eruption.

Snow and Ice at Mount St. Helens

A large volume of snow and ice is presently accumulating in the Mount St. Helens crater, protected by the shade of the high, steep crater walls. This accumulation provides a growing potential water source for lahars in the North Fork Toutle River valley. It is already mixed with rock debris eroded from the crater walls and this debris would augment the formation of a lahar. It is possible that a large eruption could melt most or all of this snow and ice in a matter of tens of minutes. A very small eruption in 1982 rapidly melted enough snow and ice in the crater to trigger a 4 million m^3 (5.2 million yd^3) flood that transformed into a lahar and flowed all the way to the Cowlitz River.

Permanent and seasonal snow and ice also blanket the outer flanks of Mount St. Helens. A sufficient volume exists there in winter or spring to produce flank lahars similar in magnitude to those of May 18, 1980, if another large eruption were to occur. Lahars formed on the outer flanks can be expected to be substantially smaller than flows generated in the crater.

Impacts

A number of natural and human-made lakes exist close to the volcano in the North Fork Toutle and Lewis River valleys. The uppermost lake in the Lewis River valley, Swift Reservoir, receives drainage from the volcano via Swift Creek, Pine Creek, and Muddy River. In 1980, lahars descending these streams dumped about 14 million m^3 (18 million yd^3) of sediment and water into the lake, abruptly raising the lake level 0.85 m (2.8 ft). Because the operators of the reservoir, Pacific Power and Light, lowered the lake level about 18 m (23 ft) below normal in anticipation of possible lahars, the small lake-level rise and the 0.4 m (1.3 ft) accompanying wave posed no threat to the dam. It is assumed that (1) future lahars reaching Swift Reservoir would not be appreciably larger than those of May 18, 1980, and (2) dam operators would again take precautionary steps to lower lake level if Mount St. Helens were to show signs of imminent eruption. Therefore, Swift Reservoir and the downstream lakes (Yale Lake and Lake Merwin) are not considered to be at risk from lahars. Three natural lakes in the North Fork Toutle River, formed by natural debris dams during the 1980 eruption, have required modifications to their outlets in order to prevent catastrophic outbreaks.

Effect of the SRS Sediment Dam on Downvalley Lahar Hazard

The U.S. Army Corps of Engineers constructed a sediment dam, called the Sediment Retention Structure (SRS), in the North Fork Toutle River to trap the large volumes of sediment washing down the river from the fresh volcanic deposits near Mount St. Helens. The SRS is located just upstream of the Green River confluence and was completed in 1989. The 56 m (184 ft) high dam has already lost more than half of its original freeboard due to infilling by sediment and is expected to be completely full (to the spillway crest) in the near future. The remaining capacity and the dam's ability to trap a lahar decrease every year. The reinforced spillway was designed to safely pass a flood discharge of 6,460 m^3/s (228,000 cfs).

The numerical modeling by MacArthur and others, indicates that a range of lahar magnitudes is possible, depending on assumptions made about the level of Castle Lake, the mode of breaching of the debris dam, the amount of sediment picked up by the flood to form a lahar (bulking factor), and the level of sediment fill behind the SRS. Given that Castle Lake is now fixed at its "full" level, flow through the SRS spillway could vary from 1,350 m3/s (47,600 cfs) to 6,710 m3/s (237,000 cfs), depending on whether the reservoir was partly full of sediment (1990 existing condition) or completely full and depending on whether lahar volume increased 2.5, 3.3, or 4.5 times due to incorporation of eroded sediment. At the SRS-outflow discharge considered most likely by the Corps of Engineers (2,980 m3/s [105,200 cfs]), the lahar reaching the Cowlitz River would be equivalent to a 100-year flood. Such a lahar would be fully contained within the channel at both Kelso-Longview and Castle Rock. At the high end of the range, flooding would occur all along the Cowlitz River both downstream and slightly upstream of the Toutle River confluence. The modeled lahar chosen to define the Zone 3 hazard boundaries (bulking factor 3.3); SRS "full" would be contained within the channel at Kelso-Longview but not at Castle Rock nor in parts of the Toutle River valley between the SRS and the Cowlitz River.[8]

Probability of Occurrence[9]

Lahars are the effect of volcanic eruption. Since lahars are the result of volcanic eruptions, the probability of occurrence is the same for these two natural hazards. A large eruption of Mount St. Helens can be expected to inject tephra to altitudes of 20–30 km (12–20 mi) and to deposit tephra over an area of 100,000 km^2 (40,000 mi^2) or more. Wind direction and velocity, along with the vigor and duration of the eruption, control the location, size, and shape of the area affected by tephra fall. Wind direction and velocity vary with both time and altitude, making it impossible to predict the velocity and direction of tephra transport more than a few hours in advance. Westerly winds prevail; thus, significant tephra accumulation from a single eruption is more likely east than west of Mount St. Helens. The calculated probability that ten or more centimeters (four or more inches) of tephra from a large eruption will fall as far as 60 km (40 mi) directly east of Mount St. Helens is 20%; the probability that such an eruption would deposit ten or more centimeters (four or more inches) 60 km (40 mi) directly west of Mount St. Helens is less, between 1% and 2%. Mount St. Helens has repeatedly produced voluminous tephra and has erupted much more frequently in recent geologic time than any other volcano in the Cascade Range. Thus, its influence dominates the annual-probability distribution in Washington and Oregon of ten or more centimeters (four or more inches) of tephra accumulation from eruptions throughout the Cascade Range.

Figure 17
Percent Probability Accumulation of Tephra from Mt. St. Helens Eruption

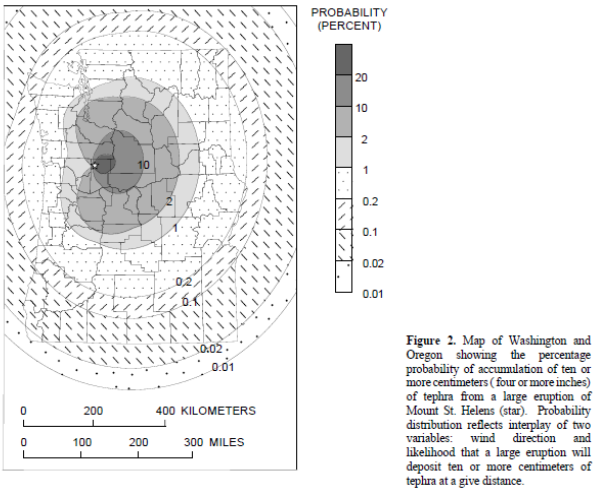


Figure 2. Map of Washington and Oregon showing the percentage probability of accumulation of ten or more centimeters (four or more inches) of tephra from a large eruption of Mount St. Helens (star). Probability distribution reflects interplay of two variables: wind direction and likelihood that a large eruption will deposit ten or more centimeters of tephra at a give distance.

Graphic courtesy of USGS

Population in the Hazard Area

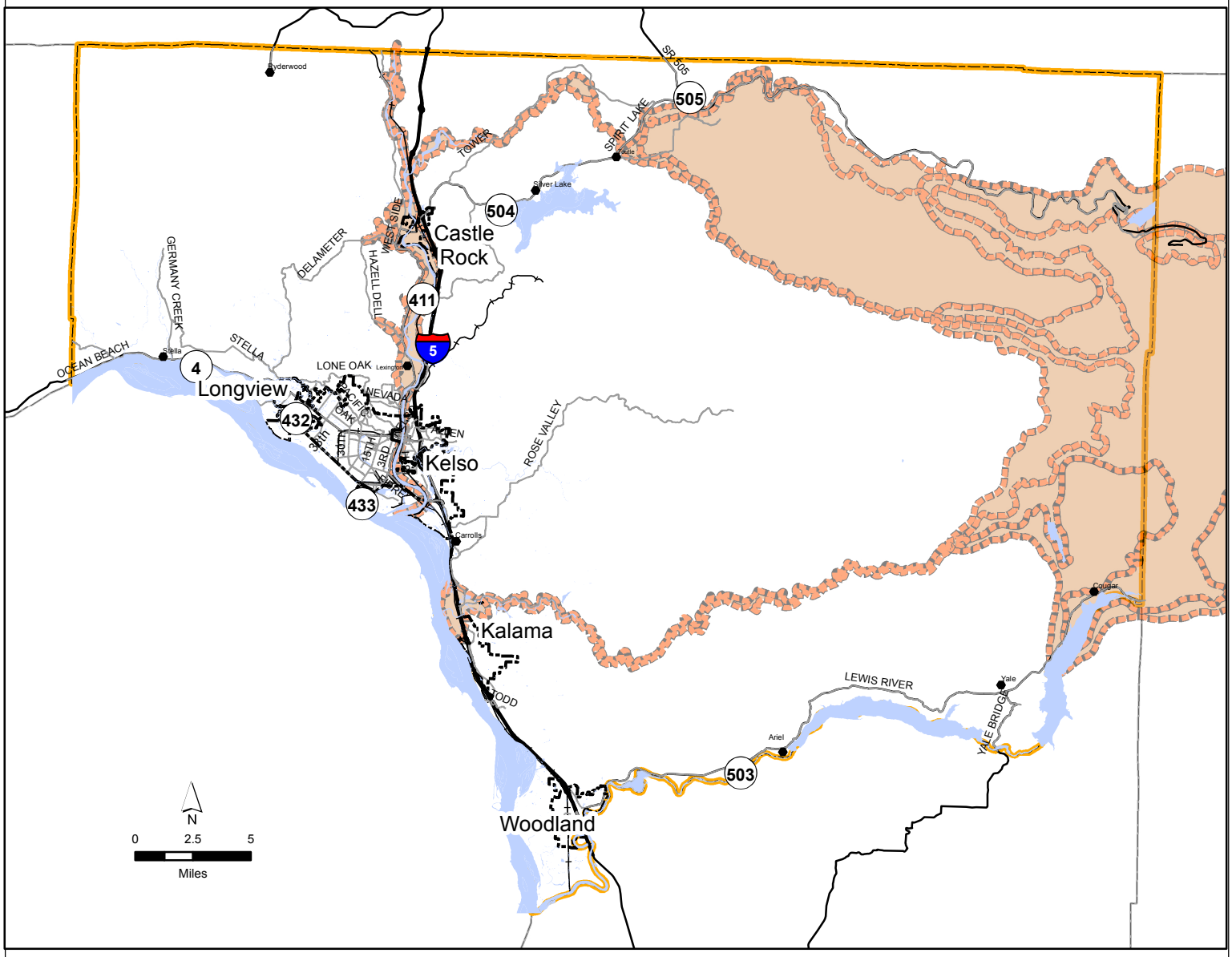
The Potential Lahar Hazard Area is defined as being within the river channel or floodway, which are areas not habitable for people. Those structures built in close proximity to a river bank are potentially susceptible to a lahar event.

Critical Facilities and Infrastructure in Hazard Area

Table 40
Cowlitz County Critical Facilities in Relation To Potential Lahar Hazard Areas

Building	Building Value ($)	Content Value ($)	Total Value ($)
Camelot Drive Reservoir	20,800	1,000	21,800
South Silver Lake Water Reservoir	520,000	0	520,000
Toutle Sewer Treatment Plant	182,400	475,000	657,400
Toutle Water Reservoir	1,040,000	0	1,040,000
Toutle River Well House	52,000	1,000	53,000

Figure 17
Potential Lahar Hazard Areas
in Cowlitz County



City Limits
Major Roads
Interstate Five (I-5)
Rail

Shared/Planners/Haz_Mit/January/Figures/lahar

Summary Assessment

The eruption of Mount St. Helens was catastrophic for the region. While the majority of ash and debris landed east of the mountain, Cowlitz County suffered numerous damages. Economic tolls devastated the county's resource economy in timber losses. The county's waterways continue to be dredged of debris from the eruption, to this day. Since the eruption, our county has been defined by the event in May of 1980 and continues to rebuild from this disaster.

The *Hazard Mitigation Plan for Cowlitz County* aims to compare and contrast the vulnerability our region faces from multiple hazards. This means that storms are evaluated with volcanic eruptions. While storms occur much more frequently than eruptions, eruptions cause a plethora of damages compared to storms. Volcanic eruptions are devastating when they occur. However, they occur very rarely. Mount St. Helens continues to record volcanic activity. That said, Cowlitz County has been assigned a moderate probability of occurrence, yet its vulnerability is high. The overall risk ranking for volcanic activity in Cowlitz County is moderate, due to rarity of a major volcanic eruption.

Volcanic Endnotes

[1] Myers, Bobbie and Driedger, Carolyn, 2008. Eruptions in the Cascade Range during the past 4,000 years: U.S. Geological Survey General Information Product 63, 1 sheet [http://pubs.usgs.gov/gip/63/].
[2] Dzurisin, Dan, et.al. 2008. Living with Volcanic Risk in the Cascades. U.S.Geological Survey Fact Sheet 165-97. [http://pubs.usgs.gov/fs/1997/fs165-97/].
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[4] Tilling,Robert, I. et.al. 1990. Eruptions of Mount St. Helens: Past, Present, and Future, U.S. Geological Survey Special Interest Publication,
[5] Ibid
[6] Miller. 1989. Potential Hazards from Future Volcanic Eruptions in California: USGS Bulletin 1847
[7] Edward W. Wolfe and Thomas C. Pierson, 1995 Volcanic-Hazard Zonation for Mount St.Helens, Washington, Open-File Report 95-497. U.S. Department of Interior. U.S. Geological Survey
[8] MacArthur, Robert C., Hamilton, Douglas L., and Mason, Ronald C., 1990a, Numerical simulation of mudflows from the hypothetical failure of a debris blockage lake below Mount St. Helens, WA, *in* French, R.H., ed., Hydraulics/hydrology of arid lands, Proceedings of the International Symposium at San Diego, CA, July 30-August 2, 1990: American Society of Civil Engineers, New York, p. 416-421.
[9] Edward W. Wolfe and Thomas C. Pierson, 1995 Volcanic-Hazard Zonation for Mount St. Helens, Washington, Open-File Report 95-497. U.S. Department of Interior. U.S. Geological Survey

Chapter 5: Mitigation Goals and Initiatives

Introduction

This chapter describes the framework that comprises the region's mitigation strategy. The mitigation strategy serves as the long-term blueprint for reducing potential losses that are described in the risk assessment. The mitigation strategy consists of goals, objectives, and prioritized mitigation initiatives.

The goals and objectives identify what the region's hazard mitigation planning partners intend to achieve in order to reduce the impacts of natural hazards on people and property and reduce potential losses. The goals and objectives also guide the development of mitigation actions or initiatives. Mitigation initiatives are the action items in the *Hazards Mitigation Plan for Cowlitz County*. The term "mitigation initiative" refers to an action designed to reduce or eliminate losses resulting from natural hazards. Local governments formulate their mitigation strategies by: proposing actions and identifying who will be responsible for implementing them; estimating costs and potential funding sources; projecting timeline for implementation; and selecting a process for monitoring and evaluating the outcomes. It is through the implementation of these initiatives that the communities within Cowlitz County can truly become more disaster resistant.

Although this chapter describes how mitigation initiatives were identified and prepared, it only includes a list of county wide mitigation initiatives that are common and beneficial to all of the region's planning partners. Initiatives that are specific to each jurisdiction are located in their respective annex.

Federal hazard mitigation planning requirements specify that a plan must identify goals that reduce communities' vulnerabilities to the hazards that are identified in the plan's risk assessment.

Goals and Objectives

In 2003, the region's hazard mitigation planning partners identified goals and objectives to guide hazard mitigation planning to the year 2025. Since the plan's adoption, the region has made noteworthy progress towards accomplishing several objectives. Considerable more work is required, by individual jurisdictions and collectively as regional partners, to create more disaster resilient communities.

The original plan's goals remain valid and are unchanged except for very minor modifications (the changes are documented at the end of the next section). Each goal statement has objectives that provide a more specific framework for actions to be taken by the planning partners. The goals and objectives in this plan also serve to build consistency in hazard mitigation planning efforts between the communities of Cowlitz County and the State of Washington.

Cowlitz County Hazards Mitigation Goals and Objectives

The goals and objectives are adopted by all of the region's hazards mitigation planning partners. The objectives define actions or results that can be placed into measurable terms, and translated into

specific assignments for implementation. Each objective fulfills an important role and is integral to the creation of more disaster resilient communities. The goals and objectives listed below are not prioritized in terms of their significance or the order in which they will be fulfilled. Their numbers serve as a reference link between the mitigation initiatives and the goals and objectives they support.

The following are the goals and objectives for mitigating natural disasters in the Region:

1. **All sectors of the community work together to create a disaster resistant community.**
   - A. State, tribal and local governmental entities and community organizations choose to participate in the planning process.
   - B. Promote hazards mitigation planning between local government, the business community, and volunteer organizations.
   - C. Update the natural hazards mitigation plan on a regular basis, and as needed after a disaster event.
   - D. Develop a process to share "lessons learned" after each significant disaster event in the region.
   - E. Alert the community to the next update cycle of the natural hazards mitigation plan, and how they might become involved in that planning process.
2. **Local and state government entities have the capabilities to develop, implement, and maintain effective natural hazards mitigation programs in the region.**
   - A. Maintain existing data as well as gather new data and information needed to define hazards, risk areas, and vulnerabilities in the region.
   - B. Undertake an evaluation by 2015 (during the third plan development cycle) to determine the effectiveness of mitigation initiatives implemented in the region.
   - C. Ensure that employees in the region have the necessary technical skills for mitigation planning and programming.
3. **Collectively the communities in the region have the capacity to initiate and sustain emergency operations during and after a disaster.**
   - A. Ensure that local emergency services have the capability to detect emergency situations and promptly initiate emergency response operations.
   - B. Ensure that local emergency services facilities can withstand the impacts of disasters. Retrofit or relocate these facilities, as needed.
   - C. Ensure that utility and communications systems supporting emergency services operations can withstand the impacts of disasters. Retrofit or relocate these facilities, as needed.
   - D. Designate and modify evacuation routes before, during and after a disaster event.

E. Designate suitable evacuation shelters before, during and after a disaster event.

F. Ensure that structures for vehicles and equipment needed for emergency services operation can withstand disaster impacts. Retrofit or relocate these facilities, as needed.

G. Prioritize the reopening of vehicle access routes to evacuation shelters and key health care facilities after a disaster.

4. Local government operations are not significantly disrupted by disasters from natural hazards.

A. Prepare community specific redevelopment plans to guide recovery after a disaster.

B. Protect important local government records from the impacts of disasters.

C. Retrofit or relocate buildings and facilities used for routine operations of government so they can withstand the impacts of disasters.

D. Have available (e.g. purchase and stockpile) redundant equipment, facilities, and supplies to reestablish local government operations after a disaster.

E. Adopt a plan and identify resources for how local government operations will be reestablished after a disaster.

5. Reduce the vulnerability to natural hazards in order to protect the life, health, safety and welfare of the community's residents and visitors.

A. Provide the highest degree of natural hazards protection at the least cost by working with natural systems and using prevention as a first priority.

B. Ensure there are adequate systems in place to provide emergency instructions during a disaster.

C. Remove or relocate residential structures from 100 year floodplains and identified landslide hazard areas, as state or federal monies are available.

D. Elevate residential structures above the 100 year floodplain as state or federal monies are available, when removal or relocation is not feasible.

E. Rely upon a combination of state, or federal grants and locally generated funds (for the required match) to implement most mitigation initiatives.

6. Local governments will support natural hazards mitigation planning, and implement the mitigation initiatives for their jurisdiction.

A. Integrate the mitigation initiatives from the natural hazards mitigation plan into local government's comprehensive plans, development regulations, and capital facilities plans (CFPs).

B. Adopt Critical Area Ordinance (CAO) regulations which prohibit the location of inappropriate land uses within areas of high risk, and require mitigation measures when structures or facilities are allowed in areas of less risk.

C. Adopt and enforce the most recent version of the

International Building Code (IBC) along with its chapters as a way to address landslide and earthquake hazards.

D. Adopt land use designations, comprehensive plan policies, and development regulations which minimize new development within high hazard areas.

E. Enroll in the Community Rating System (CRS) as a part of the National Flood Insurance Program.

F. Locate new facilities outside of areas vulnerable to the impacts of natural hazards. Where this is not feasible, design these facilities so they can withstand the impacts of a disaster.

G. Minimize the vulnerability of libraries, museums, and other institutions important to the daily lives of the community.

7. The local infrastructure of communities in the region is not significantly affected by a disaster from a natural hazard.

A. Design and retrofit essential transportation facilities and systems to minimize the potential for disruption during a disaster.

B. Design and retrofit essential water and sewer services to minimize the potential for disruption during a disaster.

C. Encourage private sector hazards mitigation planning for the design and retrofit of energy and telecommunication infrastructure to minimize the potential for disruption during a disaster.

D. Support key employers in the community to implement mitigation measures for their facilities and systems.

8. Residents understand the natural hazards of the region and are aware of ways to reduce their personal vulnerability to those hazards.

A. Develop and implement education programs which explain the vulnerabilities and risks of natural hazards in the region, and ways to reduce their personal vulnerability to those hazards.

B. Develop and implement education programs which explain the mitigation initiatives to be undertaken by various communities in the region.

C. Develop and implement education programs for appropriate local government employees that explain the mitigation initiatives to be undertaken in the region.

Revisions to Goals and Objectives

The goals and objectives were reviewed by both the Hazards Mitigation Plan Workgroup and the Emergency Management Council. Despite the issuance of six Federal Disaster Declarations since the first plan's adoption, the region's planning partners consented that the region's goals and objectives remain valid. Only three changes were made:

1. Objective 2B was changed from "Undertake an evaluation by 2008 (during the second planned update cycle)…" to "Undertake an

evaluation by 2015 (during the third plan development cycle) …"

2. For goal number 5, the word "life" was added to emphasize the scope of protection.
3. Objective 6C was changed from "Uniform Building Code" to "International Building Code."

Progress towards Goals and Objectives

The region's planning partners have made steady progress towards fulfilling this plan's goals and objectives. Although the original plan set a goal fulfillment date of the year 2025, most of the plan objectives will require continuous effort and must be maintained in perpetuity to protect life and property throughout the county. The progress made on goals 1 and 2 in the last five years can be successfully measured in the contents of this plan update. However, hazards mitigation planning is a process that requires multiple stakeholders to continuously monitor, evaluate, and revise the plan as appropriate. Planning partnerships must be maintained and communities must continue to invest in their capabilities to perform successful hazards mitigation planning.

The successful outcome of many of the plan objectives will be measured by progress made in the locally adopted mitigation initiatives. Some will take considerable time and resources to complete, but evidence of progress is apparent for several jurisdictions in fulfilling the region's objectives. The following accomplishments have made communities in Cowlitz County more disaster resilient:

- Cowlitz County continues to improve its capabilities to develop, implement, and maintain effective natural hazards mitigation programs in the region. It has played a lead role in the update to the *Hazards Mitigation Plan for Cowlitz County* and it continues to be actively involved in flood mitigation activities. These efforts fully support all of the objectives of Goals 1 and 2.

Relationships with the Washington State Natural Hazards Mitigation Plan

The Washington State Hazard Mitigation Plan provides guidance for hazard mitigation planning in the State of Washington. The mission of the State's plan is to "Reduce the adverse impacts and losses caused by natural hazard events." The region's goals and objectives are specific to the needs of the region's communities, but it is important to establish consistency between state and local plans in order to effectively coordinate mitigation activities. The region's goals and objectives are consistent with the state plan.

Identification and Preparation of Mitigation Initiatives

Federal hazard mitigation planning requirements specify that local governments evaluate the benefits and costs of mitigation initiative alternatives and prioritize initiatives according to their benefits or the needs of the jurisdiction.

Identification

The process to identify mitigation initiatives for the original plan and this plan update were prepared in a similar manner. Each participating jurisdiction represented their entity and was responsible for gathering and coordinating the following information required for their initiatives.

• The original mitigation initiatives from the 2005 plan
• The updated Regional Risk Assessment
• Jurisdiction-specific hazard maps for each of the profiled hazards that affect their jurisdiction
• Hazard exposure tables including jurisdiction-specific critical infrastructure and public owned assets
• Benefit cost review worksheets and instructions
• Local mitigation initiative template with instructions
• FEMA State and Local Mitigation Planning How to Guide Series 386-1 to 386-8
• FEMA "Mitigation Ideas"

The process for evaluating vulnerabilities and identifying a range of alternative mitigation actions to reduce actual and potential hazard exposures varied among jurisdictions depending upon their capabilities and resources. In general, workgroup members collaborated with staff and/or committees within their jurisdictions that were most familiar with their infrastructural systems, facilities, assets, services, or the geographic area being addressed. Local planning partners referenced a variety of materials such as their risk assessment, comprehensive plans, strategic plans, emergency management plans, capital facility plans, after action review debriefings, and other planning documents.

The planning partners' identification processes considered existing initiatives from the original hazards mitigation plan, new and original initiatives identified in this plan update process, and initiatives that have already been identified or documented in a different planning process such as a stormwater utility capital facilities plan.

Benefit Cost Review

FEMA requires local governments to analyze the benefits and costs of range of mitigation actions that can reduce the effects of each hazard within their community. A hazard mitigation plan must demonstrate that a process was employed that emphasized a review of benefits and costs when prioritizing the mitigation actions. The benefit-cost review must be comprehensive to the extent that it can evaluate the monetary as well as the non-monetary benefits and costs associated with each action. The benefit-cost review should at least consider the following questions:

- How many people will benefit from the action?
- How large an area is impacted?
- How critical are the facilities that benefit from the action (which is more beneficial to protect, the fire station or the administrative building)?
- Environmentally, does it make sense to do this project for the overall community?

The severity of hazards and their impacts vary among the region's jurisdictions due to their geography, but more so

because of the varying range of resources and services that they are responsible for providing their customers. For example, the mission of a rural fire district varies greatly from that of a general purpose municipality. As such, their range of mitigation actions for the same hazard will differ substantially. Each plan partner has to consider their jurisdiction's exposure, their capabilities, their resources, and select an appropriate process to evaluate the benefits and costs of various mitigation actions.

In the 2005 planning process, some of the initiatives underwent a benefit to cost analysis using the Mitigation 20/20™ software provided by the State and FEMA. This analysis was only performed for initiatives if the data was available. The method was not utilized by all of the participating jurisdictions and it was not consistently applied by those that did use it. This analysis generated a benefit-to-cost ratio and a priority score, but the effort required to input the variables exceeded the output's reliability as an effective analytical tool. The Mitigation 20/20™ software was not used in the plan update process.

Catalogs of Mitigation Alternatives

Based on information garnered by staff, catalogs of mitigation alternatives were created that list initiatives that could manipulate the hazard, reduce exposure to the hazard, reduce vulnerability to the hazard, and increase the ability to respond to or be prepared for a hazard. These catalogs are separated by responsibility for implementation (in other words, who would most likely implement the initiative: personal property owners, private sector business, or government). The hazards addressed by the catalogs were deemed to be those to which the planning area is most vulnerable based on the risk assessment.

The catalogs are not meant to be exhaustive or site-specific but rather to inspire thought and provide each participating jurisdiction a baseline of initiatives backed by a planning process, consistent with the goals and objectives of the planning area, and within the capabilities of the Partners. The Partners are not bound to these alternatives in preparing their own annexes for this hazard plan. Initiatives from the catalogs that were not selected by the Partners in their jurisdictional annexes were rejected based on the following:

- Initiative is currently outside the scope of capabilities (funding),
- The jurisdiction is not vulnerable to the hazard, or
- Initiative is already being implemented.

Table 41
Catalog of Risk Reduction Measures - Earthquake

	Personal Scale	Corporate Scale	Government Scale
Manipulate Hazard	None	None	None
Reduce Exposure	Locate outside of hazard area (off soft soils)	Locate or relocate mission-critical functions outside hazard area where possible	Locate critical facilities or functions outside hazard area where possible
Reduce Vulnerability	1. Retrofit structure (anchor house structure to foundation 2. Secure household items that can cause injury or damage (such as water heaters, bookcases, and other appliances) 3. Build to higher design	1. Build redundancy for critical functions and facilities 2. Retrofit critical buildings and areas housing mission-critical functions	1. Harden infrastructure 2. Provide redundancy for critical functions 3. Higher regulatory standards 4. Adopt the International Building Code.
Increase Capability	1. Practice “drop, cover, and hold” 2. Develop household mitigation plan, such as creating a retrofit savings account, communication capability with outside, 72-hour self-sufficiency during an event 3. Increase capability by having cash reserves for reconstruction 4. Become informed on the hazard and risk reduction alternatives available. 5. Develop a post-disaster action plan for your household	1. Adopt higher standard for new construction; consider “performance-based design” when building new structures 2. Increase capability by having cash reserves for reconstruction 3. Inform your employees on the possible impacts of earthquake and how to deal with them at your work facility. 4. Develop a COOP	1. Provide better hazard maps 2. Provide technical information and guidance 3. Enact tools to help manage development in hazard areas (e.g., tax incentives, information) 4. Include retrofitting and replacement of critical system elements in capital improvement plan (CIP) 5. Develop strategy to take advantage of postdisaster opportunities 6. Warehouse critical infrastructure components such as pipe, power line, and road repair materials 7. Develop and adopt a Continuity of Operations Plan (COOP) 8. Initiate triggers guiding improvements (such as < 50% substantial damage or improvements) 9. Further enhance seismic risk assessment to target high hazard buildings for mitigation opportunities. 10. Develop a post disaster action plan that includes a grant funding and debris removal components.

Table 42
Catalog of Risk Reduction Measures – Severe Weather

	Personal Scale	Corporate Scale	Government Scale
Manipulate Hazard	None	None	None
Reduce Exposure	None	None	None
Reduce Vulnerability	1. Insulate house 2. Provide redundant heat and power 3. Insulate structure 4. Plant appropriate trees near home and power lines ("Right tree, right place" National Arbor Day Foundation Program)	1. Relocate critical infrastructure (such as power lines) underground 2. Reinforce or relocate critical infrastructure such as power lines to meet performance expectations 3. Install tree wire	1. Harden infrastructure such as locating utilities underground 2. Trim trees back from power lines 3. Designate snow routes and strengthen critical road sections and bridges
Increase Capability	1. Trim or remove trees that could affect power lines 2. Promote 72-hour self-sufficiency 3. Obtain a NOAA weather radio. 4. Obtain an emergency generator.	1. Trim or remove trees that could affect power lines 2. Create redundancy 3. Equip your facilities with a NOAA weather radio 4. Equip vital facilities with emergency power sources.	1. Support programs such as "Tree Watch" that proactively manage problem areas through use of selective removal of hazardous trees, tree replacement, etc. 2. Establish and enforce building codes that require all roofs to withstand snow loads 3. Increase communication alternatives 4. Modify land use and environmental regulations to support vegetation management activities that improve reliability in utility corridors. 5. Modify landscape and other ordinances to encourage appropriate planting near overhead power, cable, and phone lines 6. Provide NOAA weather radios to the public

Table 43
Catalog of Risk Reduction Measures - Flood

	Personal Scale	Corporate Scale	Government Scale
Manipulate Hazard	1. Clear stormwater drains and culverts 2. Institute low-impact development techniques on property	1. Clear stormwater drains and culverts 2. Institute low-impact development techniques on property	1. Drainage system maintenance 2. Institute low-impact development techniques on property 3. Dredging, levee certification, and providing regional retention areas 4. Structural flood control, levees, channelization, or revetments. 5. Stormwater management regulations and master planning 6. Acquire vacant land or promote open space uses in developing watersheds to control increases in runoff
Reduce Exposure	1. Locate outside of hazard area 2. Elevate utilities above base flood elevation (BFE) 3. Institute low-impact development techniques on property	1. Locate business critical facilities or functions outside hazard area 2. Institute low-impact development techniques on property	1. Locate or relocate critical facilities outside of hazard area 2. Acquire or relocate identified repetitive loss properties 3. Promote open space uses in identified high hazard areas via techniques such as: easements, setbacks, greenways, sensitive area tracks. 4. Adopt land development criteria, density transfers, clustering 5. Institute low-impact development techniques on property 6. Acquire vacant land or promote open space uses in developing watersheds to control increases in runoff
Reduce Vulnerability	1. Retrofit structures (elevate structures above BFE) 2. Elevate items within house above BFE 3. Build new homes above BFE 4. Flood-proof existing structures	1. Build redundancy for critical functions or retrofit critical buildings 2. Provide floodproofing measures when new critical infrastructure must be located in floodplains	1. Harden infrastructure,(bridge replacement program) 2. Provide redundancy for critical functions and infrastructure 3 Adopt appropriate regulatory standards, such as: increased freeboard standards, cumulative substantial improvement or damage, lower substantial damage threshold; compensatory storage, non-conversion deed restrictions. 4. Stormwater management regulations and master planning. 5. Adopt “no-adverse impact” floodplain management policies that strive to not increase the flood risk on down-stream communities.
Increase Capability	1. Enforce National Flood Insurance Program (NFIP) 2. Buy flood insurance 3. Develop household mitigation plan, such as retrofit savings, communication capability with outside, 72 hr self sufficiency during and after an event	1. Increase capability by having cash reserves for reconstruction 2. Support and implement hazard disclosure for the sale/re-sale of property in identified risk zones. 3. Solicit ‘costsharing” through partnerships with private sector stake holders on projects with multiple benefits.	1. Produce better hazard maps 2. Provide technical information and guidance 3. Enact tools to help manage development in hazard areas (stronger controls, tax incentives, and information) 4. Incorporate retrofitting or replacement of critical system elements in CIP 5. Develop strategy to take advantage of post-disaster opportunities 6. Warehouse critical infrastructure components 7. Develop and adopt a COOP 8. Participate in the Community Rating System (CRS) Classification 9. Maintain existing data as well as gather new data needed to define risks and vulnerability 10. Train emergency responders 11. Create a building and elevation inventory of structures in the floodplain 12. Develop and implement a public information strategy 13. Charge a hazard mitigation fee 14. Integrate floodplain management policies into other planning mechanisms within the planning area.

Table 44
Catalog of Risk Reduction Measures-Landslide

	Personal Scale	Corporate Scale	Government Scale
Manipulate Hazard	1. Stabilize slope (dewater, armor toe). 2. Reduce weight on top of slope. 3. Minimize vegetation removal and the addition of impervious surfaces.	1. Stabilize slope (dewater, armor toe). 2. Reduce weight on top of slope.	1. Stabilize slope (dewater, armor toe). 2. Reduce weight on top of slope.
Reduce Exposure	Locate structures outside of hazard area (off unstable land and away from slide-run out area).	Locate structures outside of hazard area (off unstable land and away from slide-run out area).	1. Acquire properties located in high risk landslide areas. 2. Adopt land use policies that prohibit the placement of habitable structures in high risk landslide areas.
Reduce Vulnerability	Retrofit home.	Retrofit at-risk facilities.	1. Adopt higher regulatory standards for new development within unstable slope areas. 2. Armor/retrofit critical infrastructure from the impact of landslides.
Increase Capability	1. Institute warning system, and develop evacuation plan. 2. Increase capability by having cash reserves for reconstruction. 3. Educate yourself on risk reduction techniques for landslide hazards.	1. Institute warning system, and develop evacuation plan. 2. Increase capability by having cash reserves for reconstruction. 3. Develop a COOP. 4. Educate your employees on the potential exposure to landslide hazards and your emergency response protocol.	1. Produce better hazard maps. 2. Provide technical information and guidance. 3. Enact tools to help manage development in hazard areas: better land controls, tax incentives, information. 4. Develop strategy to take advantage of postdisaster opportunities. 5. Warehouse critical infrastructure components. 6. Develop and adopt a Continuity of Operations Plan (COOP). 7. Educate the public on the landslide hazard and appropriate risk reduction alternatives.

Table 45
Catalog of Risk Reduction Measures-Wildland Fire

	Personal Scale	Corporate Scale	Government Scale
Manipulate Hazard	Clear potential fuels on property such as dry overgrown underbrush and diseased trees.	Clear potential fuels on property such as dry underbrush and diseased trees	1. Clear potential fuels on property such as dry underbrush and diseased trees. 2. Implement best management practices on public lands.
Reduce Exposure	1. Create and maintain defensible space around structures. 2. Locate outside of hazard area. 3. Mow regularly	1. Create and maintain defensible space around structures and infrastructure. 2. Locate outside of hazard area	1. Create and maintain defensible space around structures and infrastructure. 2. Locate outside of hazard area. 3. Enhance building code to include use of fire resistant materials in high hazard area.
Reduce Vulnerability	1. Create and maintain defensible space around structures and provide water on site. 2. Use fire-retardant building materials. 3. Create defensible spaces around home.	1. Create and maintain defensible space around structures and infrastructure and provide water on site. 2. Use fire-retardant building materials	1. Create and maintain defensible space around structures and infrastructure. 2. Use fire-retardant building materials. 3. Consider higher regulatory standards (such as class A roofing). 4. Biomass Reclamation initiatives
Increase Capability	1. Employ Firewise techniques to safeguard home. 2. Identify alternative water supplies for fire fighting. 3. Install/replace roofing material with noncombustible roofing materials.	1. Support Firewise community initiatives. 2. Create /establish stored water supplies to be utilized for fire fighting.	1. More public outreach and education efforts, including an active Firewise program. 2. Possible weapons of mass destruction funds available to enhance fire capability in high-risk areas. 3. Identify fire response and alternative evacuation routes. 4. Seek alternative water supplies. 5. Become a Firewise community. 6. Utilize academia to study impacts/solutions to wildfire risk. 7. Establish/maintain mutual aid agreements between Fire Service Agencies. 8. Create/implement fire plans

OPERATIONAL AREA-WIDE ACTION PLAN PRIORITIZATION

Table 46 lists the priority of each operational area-wide initiative, using the same parameters used by each of the participating jurisdictions in selecting their initiatives. A qualitative benefit-cost review was performed for each of these initiatives. 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 Hazard Mitigation Grant Program (HMGP) or Pre-Disaster Mitigation Grant Program (PDM). 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 project 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.

POTENTIAL FUNDING SOURCES FOR COMLETING INITIATIVES

Funding for many of the initiatives is contingent upon the ability to procure funds. Included in Table 46 are potential funding sources for completing the initiatives, denoted per the list item enumeration below. Many of the funding sources are competitive processes that are only available after a major disaster declaration and so the funding availability is uncertain. This list is not meant to be exhaustive but is indicative of how programs will be identified to help fund initiatives.

1. **The Hazard Mitigation Grant Program** (HMGP) provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. The HMGP is authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act.

2. **Flood Mitigation Assistance Program (FMA)** program was

created as part of the National Flood Insurance Reform Act (NFIRA) of 1994 (42 U.S.C. 4101) with the goal of reducing or eliminating claims under the National Flood Insurance Program (NFIP). The Federal Emergency Management Agency (FEMA) provides FMA funds to assist States and communities implement measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insured under the National Flood Insurance Program.

3. **Economic Development Administration (EDA) National Disaster Recovery Framework (NDRF)** EDA's role in disaster recovery is to facilitate delivery of Federal economic development assistance to local governments for long-term community economic recovery planning, reconstruction, redevelopment and resiliency.

   Following a disaster, EDA responds by first coordinating with its sister bureaus and other agencies engaged in disaster recovery efforts to share information and data on the ramifications of the disaster. In addition, EDA reaches out to its economic development practitioner network (particularly its network of Economic Development Districts (EDD) District Organizations) to collect on-the-ground information on the economic impacts of the disaster event.

4. **US Dept. of Agriculture (USDA) Community Facilities Loans and Grants Programs** provide loans, grant and loan guarantees for essential community facilities in rural areas. Priority is given to health care, education and public safety projects. Typical projects are hospitals, health clinics, schools, fire houses, community centers and many other community based initiatives.

5. **Nonprofit Grant Fund Opportunities (NPO)** such as the Lower Columbia Fish Recovery Board’s **Salmon Recovery Funding Board (SRFB)** provide funds for salmon protection and restoration that may also minimize potential impact of flooding.

6. **Local Capital Facilities Funds** It is assumed that a combination of local capital facilities funds and in-kind contributions, determined on a case by case basis, will be leveraged when grant funds require a match.

Table 46
Operational Area-Wide Mitigation Initiatives/Action Plan

Mitigation Initiative	Hazards Initiative Addresses	Possible Funding Sources or Resources	Objectives	Responsible Department
		Cowlitz County Initiatives		
CC1. Generator at the Administration and Annex Building. Complete infrastructure work to allow for backup EOC and 9-1-1 in the General Meeting Room.	All	1,2,3,4,6	3B, 3C, 4C	DEM & Maintenance
CC2. Add river gauges to the Coweeman and Kalama Rivers.	Flooding	1,2,5,6	2A, 3A, 3C, 5A, 7B	DEM & Public Works
CC3. Improve a State Hwy #4 detour route.	All	1,2,3,4,6	3D, 7A	DEM & Public Works
CC4. Conduct an engineering analysis to investigate hazard mitigation options identified in the list for the most efficient design and efficient use of taxpayer dollars.	All	1,3,6	1B, 1C, 1D, 4E, 5A, 5B	DEM, Maintenance & Public Works
CC5. Relocate 9-1-1 communications, DEM, Sheriff evidence, District & Superior Court document storage to the 3rd floor of the Hall of Justice.	All	1,2,3,4,6	3B, 3C,4C	DEM & Maintenance
CC6. Relocate Morgue above the floodplain.	Flooding, Severe Winter Storm	1,2,3,4,6	4C, 6G	Maintenance
CC7. Relocate Maintenance Shop above the floodplain.	Flooding, Severe Winter Storm	1,2,3,4,6	4C, 6G	Maintenance
CC8. At the Hall of Justice relocate the primary electrical switch gear, generators and primary HVAC equipment above the floodplain by building a mezzanine below the north end of the 3rd floor.	Flooding, Severe Winter Storm	1,2,3,4,6	4C, 6G	Maintenance
CC9. At the Jail Annex, relocate electrical switch gear, security equipment and emergency generator above the floodplain.	Flooding, Severe Winter Storm	1,2,3,4,6	4C, 6G	Maintenance
CC10. At the Juvenile Center relocate electrical switch gear, security equipment and emergency generator above floodplain.	Flooding, Severe Winter Storm	1,2,3,4,6	4C, 6G	Maintenance
CC11. At Health Department relocate electrical switch gear, and install an emergency generator above floodplain.	Flooding, Severe Winter Storm	1,2,3,4,6	4C, 6G	Maintenance

Table 46
Operational Area-Wide Mitigation Initiatives/Action Plan

Mitigation Initiative	Hazards Initiative Addresses	Possible Funding Sources or Resources	Objectives	Responsible Department
Beacon Hill Water and Sewer District				
BHWSD1: Lexington Reservoir Stabilization	Flooding, Subsidence/Expansive Soils, Landslide	1,2,3,4,6	3C, 4C, 7B	Beacon Hill Water and Sewer District
BHWSD2: Grandview Reservoir Stabilization	Severe Weather Event, Landslide	1,2,3,4,6	3C, 4C, 7B	Beacon Hill Water and Sewer District
BHWSD3: Cowlitz River Crossing Water Line Stabilization	Flooding, Earthquake, Subsidence/Expansive Soils, Landslide, Severe Weather Event	1,2,3,4,6	3C, 4C, 7B	Beacon Hill Water and Sewer District
BHWSD4: Lexington Sewer Pressure Line Stabilization	Flooding, Earthquake, Subsidence/Expansive Soils, Landslide, Severe Weather Event	1,2,3,4,6	3C, 4C, 7B	Beacon Hill Water and Sewer District
City of Castle Rock				
CR1: Three portable generators for potable water wells	Flooding	1,2,3,4,6	3B, 3C, 4C, 4D	Public Works
CR2: Portable pumps for stormwater flooding	Flooding	1,2,3,4,6	4D, 7 B	Public Works
CR3: City Hall Complex Replacement	Earthquake	1,3,4,6	4C	Public Works
CR4: Two portable generators for sewer lift stations	Severe Winter Storm	1,2,3,4,6	3B, 3C, 4C, 4D	Public Works
CR5: Permanent generators	All	1,2,3,4,6	3B, 3C, 4C, 4D	Public Works
CR6: Huntington Avenue South Erosion prevention at Lion's Pride Park	All	1,2,3,4,6	2F, 3B	Public Works
CR7: Raise Riverfront Trail West and PH-10 (SR411)	All	1,2,3,4,6	3B, 6G	Public Works
CR8: Pump Vault installation	All	1,2,3,4,6	3B, 3F, 7B	Public Works
Castle Rock School District				
CRSD1: Replace Middle School	Earthquake	1,2	1B, 4A, 8A, 8B, 8C	Superintendent
CRSD2: Retrofit Computer Room in the Administrative Building, including adding backup generator	Earthquake, Wind Storms	1,2	1B, 4A, 8A, 8B, 8C	Superintendent

Table 46
Operational Area-Wide Mitigation Initiatives/Action Plan

Mitigation Initiative	Hazards Initiative Addresses	Possible Funding Sources or Resources	Objectives	Responsible Department
CRSD3: Conduct seismic assessment of all district owned structures	Earthquake	1,2	1B, 4A, 8A, 8B, 8C	Superintendent
CRSD4: Anchor shelves and equipment in all district owned structures	Earthquake	1,2	1B, 4A, 8A, 8B, 8C	Superintendent
CRSD 5 Provide bus keys in lock box for use by emergency responders when the fleet is needed to evacuate vulnerable populations	All	1,2	1B, 4A, 8A, 8B, 8C	Superintendent
Consolidated Diking Improvement District #1				
CDID1-1: Main Pump Station Generator	All	1,2,3,4,6	3B, 3C, 4C, 4D	District Manager
CDID1-2: Oregon Way Pump Station – Seismic Retrofit	Earthquake, Landslide/Erosion	1,3,4,6	3C, 4C, 7B	District Manager
CDID1-3: Industrial Way Pump Station - Seismic Retrofit	Earthquake, Landslide/Erosion	1,3,4,6	3C, 4C, 7B	District Manager
CDID1-4: Reynolds Pump Station – Seismic Retrofit	Earthquake, Landslide/Erosion	1,3,4,6	3C, 4C, 7B	District Manager
CDID1-5: Main Pump Station – Seismic Retrofit	Earthquake, Landslide/Erosion	1,3,4,6	3C, 4C, 7B	District Manager
CDID1-6: 48th Avenue Booster Pump Station – Seismic Retrofit	Earthquake, Landslide/Erosion	1,3,4,6	3C, 4D, 7B	District Manager
CDID1-7: Various Pump Stations - Portable Generator	All	1,2,3,4,6	3B, 3C, 4C, 4D	District Manager
CDID1-8: Various Pump Stations - Automated Trash Racks	Flooding	1,2,3,4,6	3C, 4C, 4D, 7B	District Manager
CDID1-9: Various Ditches - Culvert Replacements	Flooding	1,2,3,4,6	3C, 4C, 4D, 7A	District Manager
CDID1-10: Cowlitz River Levee Improvements	Flooding	1,2,3,4,6	3B, 3C, 3F, 4C, 4D, 5A, 7A, 7B	District Manager

Table 46
Operational Area-Wide Mitigation Initiatives/Action Plan

Mitigation Initiative	Hazards Initiative Addresses	Possible Funding Sources or Resources	Objectives	Responsible Department
Consolidated Diking Improvement District #2				
CDID2-1: Permanent generator purchase	All	1,2,3,4,6	3B, 3C, 4D, 7B	Public Works Utilities Manager
CDID2-2: Pump Station Rebuild	All	1,2,3,4,6	3B, 3C, 4D, 7B	Public Works Utilities Manager
Consolidated Diking Improvement District #3				
CDID3-1: Permanent Generator	All	1,2,3,4,6	3B, 3C, 4D, 7B	Public Works Utilities Manager
CDID3-2: Raising the South Fork of McCorkle Creek Detention Structure	Flooding, High Winds, Earthquake, Landslide/Erosion	1,2,3,4,6	3B, 3C, 4D, 7B	Public Works Utilities Manager
CDID3-3: Increase pumping capacity at Sparks Drive Pump Station	Flooding, Earthquake, Severe Winter Storm, Infestation / Disease	1,2,3,4,6	3C, 7B	Public Works Utilities Manager
CDID3-4: Install staff gauge adjacent to Lake Dorothy	Flooding	1,2,3,4,6	3C, 4C, 4D, 7A	Public Works Utilities Manager
CDID3-5 Install staff gauge at the South Fork of McCorkle Creek behind detention structure	Flooding	1,2,3,4,6	3C, 4C, 4D, 7A	Public Works Utilities Manager
CDID3-6: Install staff gauge on McCorkle Creek at Ventura Pump Station	Flooding	1,2,3,4,6	3C, 4C, 4D, 7A	Public Works Utilities Manager
CDID3-7: Upgrade Tam O'Shanter Pump Station	Flooding	1,2,3,4,6	3C, 4D, 7B	Public Works Utilities Manager
Cowlitz County Fire District #1				
CCFD1-1: Remodel station 13	All	1,2,3,4,6	3B, 3F, 4C	Fire Chief
CCFD1-2: Relocate station 12 or build a more wildfire resistant station	All	1,2,3,4,6	3B, 3F, 4C	Fire Chief
CCFD1-3: Move station 1 out of floodplain	All	1,2,3,4,6	3B, 3F, 4C	Fire Chief
Cowlitz 2 Fire and Rescue				
C2FR-1: Hazard Vulnerability Study	All	1,2	1A, 1B, 1E, 2B, 3A, 3B, 3C, 3D, 3E, 3F, 4A, 4D, 4E, 5B, 8A, 8B, 8C	Fire Chief

Table 46
Operational Area-Wide Mitigation Initiatives/Action Plan

Mitigation Initiative	Hazards Initiative Addresses	Possible Funding Sources or Resources	Objectives	Responsible Department
C2FR-2: Retrofitting of Emergency Response Technology	All	1,2	1A, 1B, 1E, 2B, 3A, 3B, 3C, 3D, 3E, 3F, 4A, 4D, 4E, 5B, 8A, 8B, 8C	Planning Captain
Cowlitz County Fire District #5				
CCFD5-1: Evaluate water supplies available for Emergency Response	All	4,5,6	3E, 4D	Fire Chief
CCFD5-2: Conduct a critical tasking analysis that establishes minimum operations staffing requirements by incident type	All	1,2,3,4,6	3E, 4D	Fire Chief
Cowlitz Skamania Fire District #7				
CSFD7-1: Relocate Station #2	Volcano	1,3,4,6	3B, 3F, 4C	Fire Chief
CSFD7-2: Seismic Retrofit Station #2	Earthquake	1,3,4,6	3B, 3F, 4C	Fire Chief
Cowlitz Transit Authority				
CTA1: Longview City Shop Emergency Generator	All	1,2,3,4,6	3B, 3C, 4C, 4D	Transit Manager
CTA2: Transit Center Emergency Generator	All	1,2,3,4,6	3B, 3C, 4C, 4D	Transit Manager
Diking Improvement District #1				
DID1-1: Permanent Generator	Flooding, Volcano Activity, Lightning	1,2,3,4,6	3B, 3C, 4C, 4D	District Manager
DID1-2: Replace Redpath Pump Station	Flooding, Volcano Activity, Lightning	1,2,3,4,6	3C, 4D, 7B	District Manager
DID1-3: Install Staff Gauge at North Tunnel Entrance	Flooding, Volcano Activity, Lightning	1,2,3,4,6	2A, 3A, 3C, 5A, 7B	District Manager
Diking Improvement District #15				
DID15-1: Permanent Generator	All	1,2,3,4,6	3B, 3C, 4C, 4D	District Manager
DID15-2: Pump Station Improvements	Flooding	1,2,3,4,6	3C, 4C, 4D, 7A	District Manager
City of Kalama				
KAL1: Install Manhole Vault at Kingwood and W. Frontage Streets	All	1,2,3,4,6	3B, 3C, 4C, 4D	Public Works Director

Table 46
Operational Area-Wide Mitigation Initiatives/Action Plan

Mitigation Initiative	Hazards Initiative Addresses	Possible Funding Sources or Resources	Objectives	Responsible Department
KAL2: Replace Kingwood Reservoir #1	All	1,2,3,4,6	3B, 3C, 4C, 4D	Public Works Director
KAL3: Replace Upper Gore Reservoir	All	1,2,3,4,6	3B, 3C, 4C, 4D	Public Works Director
KAL4: Replace Lower Green Mountain Reservoir	All	1,2,3,4,6	3B, 3C, 4C, 4D	Public Works Director
City of Kelso				
KEL1: Emergency Generator – Ranney Well Pump	All	1,2,3,4,6	3B, 3C, 4D, 7B	Public Works Director
KEL2: Emergency Generator – Water Treatment Plant	Flooding, High Winds, Earthquake, Landslide/Erosion	1,2,3,4,6	3B, 3C, 4D, 7B	Public Works Director
KEL3: Sewer Lines – North Kelso; Phases 1-4 completed. Final Phase 5 to be completed	Flooding, Earthquake, Severe Winter Storm, Infestation / Disease	1,2,3,4,6	3C, 7B	Public Works Director
KEL4: Allen Street flood prevention improvements	Flooding	1,2,3,4,6	3C, 4C, 4D, 7A	Public Works Director
KEL5: Riverside Drive flood prevention improvements	Flooding	1,2,3,4,6	3C, 4C, 4D, 7A	Public Works Director
KEL6: Grade Street bridge replacement	Flooding	1,2,3,4,6	3C, 4C, 4D, 7A	Public Works Director
KEL7: Emergency Generator at each water and sewer pump station	Flooding, Earthquake, Severe Winter Storm, High Winds	1,3,4,6	3B, 3C, 4C, 4D	Public Works Director
Lexington Flood Control Zone District				
LFCZD1: Permanent Generator	Flooding, Volcano Activity, Earthquake, Lightning	1,2,3,4,6	3B, 3C, 4C, 4D	Public Works Utilities Manager
LFCZD2: Raising the South Fork of McCorkle Creek Detention Structure	Flooding, Volcano Activity, Earthquake, Lightning	1,2,3,4,6	3B, 3C, 3F, 4C, 4D, 5A, 7A, 7B	Public Works Utilities Manager
LFCZD3: Increase Pumping capacity at Sparks Drive Pump Station	Flooding, Volcano Activity, Earthquake, Lightning	1,2,3,4,6	3C, 4C, 4D, 7B	Public Works Utilities Manager
LFCZD4: Staff Gauge adjacent to Lake Dorothy	Flooding, Volcano Activity, Earthquake, Lightning	1,2,3,4,5,6	2A, 3A, 3C, 5A, 7B	Public Works Utilities Manager
LFCZD5: Staff Gauge - South Fork of McCorkle Creek behind Detention Structure	Flooding, Volcano Activity, Earthquake, Lightning	1,2,3,4,5,6	2A, 3A, 3C, 5A, 7B	Public Works Utilities Manager
LFCZD6: Staff Gauge on McCorkle Creek at	Flooding, Volcano Activity,	1,2,3,4,5,6	2A, 3A, 3C, 5A, 7B	Public Works Utilities

Table 46
Operational Area-Wide Mitigation Initiatives/Action Plan

Mitigation Initiative	Hazards Initiative Addresses	Possible Funding Sources or Resources	Objectives	Responsible Department
Ventura Pump Station	Earthquake, Lightning			Manager
		City of Longview		
LONG1: Replace Existing Water Treatment Plant with Mint Farm Regional Water Supply and Treatment Plant	Earthquake, Storm, Flood, Volcanic Event	Grants funding; Utility Rates; Beacon Hill Water and Sewer District	3B, 3C, 3F, 4C, 4D	Public Works Director
LONG2: Water Utility Control System Telemetry – SCADA. Phased implementation to complete all sites.	Earthquake, Storm, Flood	Utility Rates	3C, 4C, 4D, 7B	Public Works Director
LONG3: Sewer Utility Control System Telemetry – SCADA. Phased implementation to complete all sites.	Earthquake, Storm, Flood	Utility Rates	3C, 4C, 4D, 7B	Public Works Director
LONG4: Drainage Utility Control System Telemetry – SCADA. Phased implementation to complete all sites.	Earthquake, Storm, Flood	Utility Rates	3C, 4C, 4D, 7B	Public Works Director
LONG5: Fire Station 82 Emergency Generator	Earthquake, Storm, Flood	Capital Facilities Fund	3B, 3C, 4C, 4D	Fire Chief
LONG6: Water System Emergency Generators. Phased implementation to provide fixed or portable generators at all sites.	Earthquake, Storm, Flood	Utility Rates	3B, 3C, 4C, 4D	Public Works Director
LONG7: Sewer System Emergency Generators. Phased implementation to provide fixed or portable generators at all sites.	Earthquake, Storm, Flood	Utility Rates	3B, 3C, 4C, 4D	Public Works Director
LONG8: Replace City Hall Emergency Generator.	Earthquake, Storm, Flood	Capital Facilities Fund	3B, 3C, 4C, 4D	Public Works Director
LONG9: Emergency Generator at City Shop	Earthquake, Storm, Flood	Capital Facilities Fund; CTA	3B, 3C, 4C, 4D	Public Works Director
LONG10: Install Vactor Dumping and Drying Beds Facility	Storm, Flood	Utility Rates	3B, 3C, 3F, 4C, 4D	Public Works Director
		Longview School District		
LSD1: Relocation Procedure	Earthquake, Flooding	1,3,4,6	1A, 1B, 1E, 2B, 3A, 3B, 3C, 3D, 3E, 3F, 4A, 4D, 4E, 5B, 8A, 8B, 8C	Executive Director
LSD2: Replacement of roofs	High Winds	1,3,4,6	3B, 3F, 4C	Executive Director
LSD3: Tree Removal	High Winds, Lightning, Severe Winter Storm	1,3,4,6	4B	Executive Director

Table 46
Operational Area-Wide Mitigation Initiatives/Action Plan

Mitigation Initiative	Hazards Initiative Addresses	Possible Funding Sources or Resources	Objectives	Responsible Department
Port of Longview				
POL1: Install fendering system	Flooding, Landslide/Erosion	Capital Facilities Fund	3B, 3C, 4C, 4D	Director of Facilities
POL2: Berth 4 demolition and lay berth	Severe Winter Storms, Flooding	Local Budget	3B, 3C, 4C, 4D	Director of Planning
POL3: Stormwater alternative	Severe Winter Storms, Flooding	Local Budget	3B, 3C, 4C, 4D	Director of Planning
POL4: Berth 7 Wastewater ponds	Severe Winter Storms, Flooding	Local Budget	3B, 3C, 4C, 4D	Director of Planning
Public Utilities District – Cowlitz County				
PUD1: Substation Transformer containment Barrier	Environmental, Earthquake, Flooding, Lightning, Severe Winter Storm	1,2,3,4,6	3C, 4C, 4D, 7B	Director of Operations
PUD2: Main Office Generator	Power Outage	1,3,4,6	3B, 3C, 4C, 4D	Director of Operations
PUD3: Underground Line Project	Lightning, Severe Winter Storm, Power Outage	1,3,4,6	3C, 4C, 4D, 7B	Director of Operations
PUD4: Outage Management System	Power Outages, Dependence on Communications	1,3,4,6	3A, 3C, 3F, 4C, 7C	Director of Operations
Silver Lake Flood Control District				
SLFCD1: Perform Land Use Buildout Analysis in order to assess overall stormwater and flood control needs	Flooding	1,2,3,4,6	3B, 3C, 4C, 4D	Sustainability Director
SLFCD2: Acquire topography for drainage analysis	Flooding	1,2,3,4,6	3B, 3C, 4C, 4D	Sustainability Director
Toutle Lake School District				
TLSD1: Backup Electrical Power Supply System	All	1,3,4,6	3B, 3C, 4C, 4D	Superintendent
TLSD2: Temporary Emergency Shelter/Supplies for 700 occupants: Water, Food, Cots, Blankets, Pillows, Emergency lighting, storage container	All	1,2,3,4,5	3E, 4D	Superintendent
Woodland School District				
WSD1: Centralized flexible lock down system	Tornado, Earthquake,	1,2,3,4	3E, 4D	Superintendent

Table 46
Operational Area-Wide Mitigation Initiatives/Action Plan

Mitigation Initiative	Hazards Initiative Addresses	Possible Funding Sources or Resources	Objectives	Responsible Department
	Volcano			
WSD2: Creation of a safe room in main office area	Severe Winter Storm, Earthquake	1,3,4,6	3E, 4D	Superintendent
WSD3: Creation of 6 safe rooms for students	Severe Winter Storm, Earthquake	1,3,4,6	3E, 4D	Superintendent
WSD4: Backup Electrical Power Supply and technology System	All	3,4,6	3E, 4D	Superintendent

Table 47
Operational Area-Wide Mitigation Initiatives/Action Plan

Initiative #	# of Objectives Met	Benefits	Costs	Do benefits equal or exceed costs?	Can Project be funded under existing programs/ budgets?	Priority (High, Med., Low)	Integration into other planning mechanism	Plan Adoption Date or inclusion into Scheduled Update
				Cowlitz County				
CC1	3	High	Medium	Yes	Yes	High	Department Strategic Plan and Comprehensive Emergency Plan	Incorporated into 2013 Update, awaiting approval
CC2	2	High	Low	Yes	Yes	High	Department Strategic Plan and Comprehensive Emergency Plan	Incorporated into 2013 Update, awaiting approval
CC3	2	Med	High	No	No	Medium	Department Strategic Plan and Comprehensive Emergency Plan	Incorporated into 2013 Update, awaiting approval
CC4	3	High	Medium	Yes	Yes	High	Department Strategic Plan and Comprehensive Emergency Plan	Incorporated into 2013 Update, awaiting approval
CC5	3	High	High	Yes	No	High	Department Strategic Plan and Comprehensive Emergency Plan	Incorporated into 2013 Update, awaiting approval
CC6	1	High	High	Yes	No	High	Department Strategic Plan and Comprehensive Emergency Plan	Incorporated into 2013 Update, awaiting approval
CC7	1	Medium	High	No	No	Low	Department Strategic Plan and Comprehensive Emergency Plan	Incorporated into 2013 Update, awaiting approval
CC8	1	High	High	Yes	No	High	Department Strategic Plan and Comprehensive Emergency Plan	Incorporated into 2013 Update, awaiting approval

Table 47
Operational Area-Wide Mitigation Initiatives/Action Plan

Initiative #	# of Objectives Met	Benefits	Costs	Do benefits equal or exceed costs?	Can Project be funded under existing programs/ budgets?	Priority (High, Med., Low)	Integration into other planning mechanism	Plan Adoption Date or inclusion into Scheduled Update
CC9	1	Medium	High	No	No	Medium	Department Strategic Plan and Comprehensive Emergency Plan	Incorporated into 2013 Update, awaiting approval
CC10	1	Medium	High	No	No	Medium	Department Strategic Plan and Comprehensive Emergency Plan	Incorporated into 2013 Update, awaiting approval
CC11	1	Medium	High	No	No	Medium	Department Strategic Plan and Comprehensive Emergency Plan	Incorporated into 2013 Update, awaiting approval
Beacon Hill Water and Sewer District								
BHWSD1	3	High	High	Yes	No	Medium	Water Systems Plan	Adopted 2009
BHWSD2	3	High	High	Yes	No	Medium	Water Systems Plan	Adopted 2009
BHWSD3	3	High	High	Yes	No	Medium	Water Systems Plan	Adopted 2009
BHWSD4	3	High	High	Yes	No	High	Capital Facilities Plan	Adopted 2012
City of Castle Rock								
CR1	2	High	Medium	Yes	No	High	Water Systems Plan	Will consider for 2019 update
CR2	1	High	Medium	Yes	No	High	Castle Rock Water and Wastewater Emergency Plan	Adopted 2010
CR3	1	Low	High	No	No	Medium	Capital Improvement Plan	Adopted 2008
CR4	2	High	Medium	Yes	No	High	Castle Rock Water and Wastewater Emergency Plan	Will consider for 2018 update
CR5	2	High	Medium	Yes	No	High	Capital Improvement Plan	Will consider for 2014 update
CR6	2	High	Medium	Yes	No	High	Capital Improvement Plan	Will consider for 2014 update
CR7	1	Low	Medium	No	No	Lo	Capital Improvement Plan	Will consider for 2014 update
CR8	1	High	Medium	Yes	No	High	Capital Improvement Plan	Will consider for 2014 update

Table 47
Operational Area-Wide Mitigation Initiatives/Action Plan

Initiative #	# of Objectives Met	Benefits	Costs	Do benefits equal or exceed costs?	Can Project be funded under existing programs/ budgets?	Priority (High, Med., Low)	Integration into other planning mechanism	Plan Adoption Date or inclusion into Scheduled Update
				Castle Rock School District				
CRSD1	3	High	High	Yes	No	High	Capital Improvement Plan	Will consider for 2015-16 update
CRSD2	3	High	Medium	Yes	No	Medium	Capital Improvement Plan	Will consider for 2015-16 update
CRSD3	3	Medium	Medium	Yes	No	High	Evacuation Plan	Will consider for 2014 update
CRSD4	3	High	Medium	Yes	No	Medium	Capital Improvement Plan	Will consider for 2015-16 update
CRSD5	3	Medium	Low	Yes	Yes	Low	Evacuation Plan	Will consider for 2014 update
				Consolidated Diking Improvement District #1				
CDID1-1:	2	Medium	Medium	Yes	No	High	Capital Improvements Long Term Plan	Will consider for Summer 2014 update
CDID1-2	3	Medium	Medium	Yes	No	High	Capital Improvements Long Term Plan	Will consider for Summer 2014 update
CDID1-3	3	Medium	Medium	Yes	No	High	Capital Improvements Long Term Plan	Will consider for Summer 2014 update
CDID1-4	3	Medium	Medium	Yes	No	High	Capital Improvements Long Term Plan	Will consider for Summer 2014 update
CDID1-5	3	Medium	Medium	Yes	No	High	Capital Improvements Long Term Plan	Will consider for Summer 2014 update
CDID1-6	3	Medium	Medium	Yes	No	High	Capital Improvements Long Term Plan	Will consider for Summer 2014 update
CDID1-7	2	Medium	Medium	Yes	No	High	Capital Improvements Long Term Plan	Will consider for Summer 2014 update
CDID1-8	3	Medium	Medium	Yes	No	High	Capital Improvements Long	Adopted 1995

Table 47
Operational Area-Wide Mitigation Initiatives/Action Plan

Initiative #	# of Objectives Met	Benefits	Costs	Do benefits equal or exceed costs?	Can Project be funded under existing programs/ budgets?	Priority (High, Med., Low)	Integration into other planning mechanism	Plan Adoption Date or inclusion into Scheduled Update
							Term Plan	
CDID1-9	3	Medium	Medium	Yes	No	High	Capital Improvements Long Term Plan	Adopted 1995
CDID1-10	4	Medium	Medium	Yes	No	High	Capital Improvements Long Term Plan	Adopted 1995
Consolidated Diking Improvement District #2								
CDID2-1	3	Medium	Medium	Yes	No	High	Budget Plan Flood Response Plan	Will consider for July 2013 update
CDID2-2	3	Medium	Medium	Yes	Yes	High	Budget Plan	Adopted October 2012
Consolidated Diking Improvement District #3								
CDID3-1	3	Medium	Medium	Yes	No	High	Annual Budget Flood Response Plan	Will consider for July 2015 update
CDID3-2	3	Medium	Medium	Yes	No	High	Annual Budget Flood Response Plan	Will consider for July 2015 update
CDID3-3	2	Low	High	No	No	Low	Annual Budget Flood Response Plan	Will consider for July 2015 update
CDID3-4	3	High	High	Yes	No	High	Annual Budget Flood Response Plan	Will consider for July 2015 update
CDID3-5	3	High	High	Yes	No	High	Annual Budget Flood Response Plan	Will consider for July 2015 update
CDID3-6	3	High	High	Yes	No	High	Annual Budget Flood Response Plan	Will consider for July 2015 update
CDID3-7	3	Medium	Medium	Yes	No	High	Annual Budget Flood Response Plan	Will consider for July 2015 update
Cowlitz County Fire District #1								

Table 47
Operational Area-Wide Mitigation Initiatives/Action Plan

Initiative #	# of Objectives Met	Benefits	Costs	Do benefits equal or exceed costs?	Can Project be funded under existing programs/ budgets?	Priority (High, Med., Low)	Integration into other planning mechanism	Plan Adoption Date or inclusion into Scheduled Update
CCFD1-1	2	High	High	Yes	No	Medium	Strategic Plan	Will consider for 2015 update
CCFD1-2	2	High	High	Yes	No	Medium	Strategic Plan	Will consider for 2015 update
CCFD1-3	2	High	High	Yes	No	Medium	Strategic Plan	Will consider for 2015 update
Cowlitz 2 Fire and Rescue								
C2FR1	6	High	Low	Yes	No	High	Emergency Response Plan	Adopted 2010
C2FR2	6	High	Low	Yes	No	High	Facilities Plan	Adopted 2010
Cowlitz County Fire District #5								
CCFD5-1	2	Medium	Low	Yes	Yes	High	Strategic Plan	Adopted 2007
CCFD5-2	2	Medium	High	No	No	Low	Strategic Plan	Adopted 2007
Cowlitz Transit Authority								
CTA1	3	High	High	Yes	No	Medium	Capital Improvement Plan	Will consider for 2014 Update
CTA2	3	High	High	Yes	No	Low	Transit Development Plan	Will consider for 2013 Update
Diking Improvement District #1								
DID1-1	2	Med.	High	No	No	Low	Annual Budget Flood Response Plan	Will consider for July 2017 update
DID1-2	3	Low	Low	Yes	Yes	Medium	Annual Budget Flood Response Plan	Will consider for July 2017 update
DID1-3	4	High	Low	Yes	Yes	High	Annual Budget Flood Response Plan	Will consider for July 2017 update
Diking Improvement District #15								
DID15-1	2	Med.	High	Yes	No	Medium	Annual Budget Flood Response Plan	Will consider for July 2017 update

Table 47
Operational Area-Wide Mitigation Initiatives/Action Plan

Initiative #	# of Objectives Met	Benefits	Costs	Do benefits equal or exceed costs?	Can Project be funded under existing programs/ budgets?	Priority (High, Med., Low)	Integration into other planning mechanism	Plan Adoption Date or inclusion into Scheduled Update
DID15-2	3	High	Medium	Yes	No	High	Annual Budget Flood Response Plan	Will consider for July 2017 update
City of Kalama								
KAL1	2	High	Medium	Yes	Yes	High	Capital Facilities Plan	Adopted 2012
KAL2	2	Med.	High	No	No	Medium	Water Systems Plan	Will Consider for October 2013 Update
KAL3	2	Med	High	No	No	High	Capital Facilities Plan Water Systems Plan	Adopted 2012
KAL4	2	Med	High	No	No	Medium	Capital Facilities Plan Water Systems Plan	Adopted 2012
City of Kelso								
KEL1	3	Medium	Medium	Yes	No	High	Water Systems Plan Capital Improvement Plan	Adopted March 2013
KEL2	3	Medium	Medium	Yes	No	High	Water Systems Plan Capital Improvement Plan	Adopted March 2013
KEL3	2	Low	High	No	No	Low	General Sewer and Facilities Plan Capital Improvement Plan	Adopted November 2011
KEL4	3	High	High	Yes	No	High	Stormwater Management Plan Capital Improvement Plan	Adopted June 2013
KEL5	3	High	High	Yes	No	High	Stormwater Management Plan Capital Improvement Plan	Adopted June 2013
KEL6	3	High	High	Yes	No	High	Transportation Improvement Program	Will consider for update in 2015
KEL7	3	Medium	Medium	Yes	No	High	General Sewer and Facilities	Will consider for update in

Table 47
Operational Area-Wide Mitigation Initiatives/Action Plan

Initiative #	# of Objectives Met	Benefits	Costs	Do benefits equal or exceed costs?	Can Project be funded under existing programs/ budgets?	Priority (High, Med., Low)	Integration into other planning mechanism	Plan Adoption Date or inclusion into Scheduled Update
							Plan	Fall 2017
Lexington Flood Control Zone District								
LFCZD1	2	Medium	Medium	Yes	No	High	Annual Budget Flood Response Plan	Will consider for July 2017 update
LFCZD2	4	Medium	High	N	N	High	Annual Budget Flood Response Plan	Will consider for July 2017 update
LFCZD3	3	Medium	High	No	No	High	Annual Budget Flood Response Plan	Will consider for July 2017 update
LFCZD4	4	Low	Low	Yes	Yes	Low	Annual Budget Flood Response Plan	Will consider for July 2017 update
LFCZD5	4	Low	Low	Yes	Yes	Low	Annual Budget Flood Response Plan	Will consider for July 2017 update
LFCZD6	4	Low	Low	Yes	Yes	Low	Annual Budget Flood Response Plan	Will consider for July 2017 update
City of Longview								
LONG1	2	High	High	Yes	No	High	Water Comprehensive Plan, Capital Improvement Program, Comprehensive Plan	Adopted September 2012, Adopted December 2012, Will consider for 2025 Comp Plan Update
LONG2	3	Medium	High	No	No	High	Water Comprehensive Plan, Capital Improvement Program, Comprehensive Plan	Adopted September 2012, Adopted December 2012, Will consider for 2025 Comp Plan Update
LONG3	3	Medium	High	No	No	High	Capital Improvement Program,	Adopted December 2012,

Table 47
Operational Area-Wide Mitigation Initiatives/Action Plan

Initiative #	# of Objectives Met	Benefits	Costs	Do benefits equal or exceed costs?	Can Project be funded under existing programs/ budgets?	Priority (High, Med., Low)	Integration into other planning mechanism	Plan Adoption Date or inclusion into Scheduled Update
							General Sewer and Facilities Plan, Comprehensive Plan	Will consider for GSP & FP Fall 2015 update, Will consider for 2025 Comp Plan Update
LONG4	3	Medium	Medium	Yes	No	High	Capital Improvement Program, Comprehensive Plan	Adopted December 2012, Will consider for 2025 Comp Plan Update
LONG5	2	Medium	Medium	Yes	No	Medium	Capital Improvement Program, Comprehensive Plan	Adopted December 2012, Will consider for 2025 Comp Plan Update
LONG6	2	Medium	Medium	Yes	No	Medium	Water Comprehensive Plan, Capital Improvement Program, Comprehensive Plan	Adopted September 2012, Will consider for 2025 Comp Plan Update
LONG7	2	Medium	Medium	Yes	No	Medium	Capital Improvement Program, General Sewer and Facilities Plan, Comprehensive Plan	Adopted December 2012, Will consider for GSP & FP Fall 2015 update, Will consider for 2025 Comp Plan Update
LONG8	2	Medium	Medium	Yes	No	Medium	Capital Improvement Program, Comprehensive Plan	Adopted December 2012, Will consider for 2025 Comp Plan Update
LONG9	2	Medium	Medium	Yes	No	Medium	Capital Improvement Program, Comprehensive Plan	Adopted December 2012, Will consider for 2025 Comp Plan Update
LONG10	2	Medium	Low	Yes	Yes	Medium	Capital Improvement Program, Comprehensive Plan	Adopted December 2012, Will consider for 2025 Comp

Table 47
Operational Area-Wide Mitigation Initiatives/Action Plan

Initiative #	# of Objectives Met	Benefits	Costs	Do benefits equal or exceed costs?	Can Project be funded under existing programs/ budgets?	Priority (High, Med., Low)	Integration into other planning mechanism	Plan Adoption Date or inclusion into Scheduled Update
								Plan Update
Longview School District								
LSD1	6	High	High	Yes	No	High	Emergency Response Plan	Will consider for 2017 update.
LSD2	2	High	High	Yes	No	High	Roof Management Program	Will consider for 2017 update
LSD3	1	High	High	Yes	Yes	High	Capital Facilities Plan	Will consider for 2014 update
Port of Longview								
POL1	2	Medium	Low	Yes	Yes	High	Strategic Plan	Adopted 2012
POL2	2	High	High	Yes	No	High	Wastewater Plan. Strategic Plan	Adopted 2012
POL3	2	High	High	Yes	No	Med	Stormwater Master Plan Capital Improvement Plan	Adopted 2011
POL4	2	High	Low	Yes	Yes	High	Capital Improvement Plan	Adopted December 2012
Public Utilities District – Cowlitz County								
PUD1	3	Medium	Low	Yes	No	High	Spill Response Plan	Will consider for 2014 update
PUD2	2	Medium	Medium	Yes	No	Medium	Completed	Completed, in 2011 Disaster Recovery Plan
PUD3	3	High	High	Yes	No	High	Capital Budget	Will consider for 2015 update
PUD4	3	High	High	Yes	No	High	Capital Budget	Adopted 2013
Silver Lake Flood Control District								
SLFD1	2	Medium	Low	Yes	No	Medium	Annual Budget	Will consider for 2014 update
SLFD2	2	Medium	Low	Yes	No	Medium	Annual Budget	Will consider for 2014 update

Table 47
Operational Area-Wide Mitigation Initiatives/Action Plan

Initiative #	# of Objectives Met	Benefits	Costs	Do benefits equal or exceed costs?	Can Project be funded under existing programs/ budgets?	Priority (High, Med., Low)	Integration into other planning mechanism	Plan Adoption Date or inclusion into Scheduled Update
				Toutle Lake School District				
TLSD1	2	High	High	Yes	No	Low		
TLSD2	2	High	High	Yes	No	Medium		
				Woodland School District				
WSD1	2	Medium	Medium	Yes	No	Low	Emergency Response Plan Infrastructure Improvement Plan	Will consider for updates scheduled
WSD2	2	Medium	Medium	Yes	No	Medium	Emergency Response Plan Infrastructure Improvement Plan	Will consider for updates scheduled
WSD3	2	Medium	Medium	Yes	No	Medium	Emergency Response Plan Infrastructure Improvement Plan	Will consider for updates scheduled
WSD4	2	Medium	Medium	Yes	No	Medium	Emergency Response Plan Infrastructure Improvement Plan	Will consider for updates scheduled

Explanation of Benefits

- **High**: Project will have an immediate impact on the reduction of risk exposure to life and property.
- **Medium**: Project will have a long-term impact on the reduction of risk exposure to life and property, or project will provide an immediate reduction in the risk exposure to property.
- **Low**: Long term benefits of the project are difficult to quantify in the short term.

Explanation of Costs

- **High**: Would require an increase in revenue via an alternative source (i.e. bonds, grants, fee increases) to implement. Existing funding levels are not adequate to cover the costs of the proposed project.
- **Medium**: Could budget for under existing work-plan, but would require a reapportionment of the budget or a budget amendment, or the costs of the project would have to be spread over multiple years.
- **Low**: Possible to fund under existing budget. Project is part of, or can be part of an existing ongoing program.

Explanation of Priorities

- **High Priority**: A project that meets multiple plan objectives, benefits exceeds cost, has funding secured under existing programs or authorizations, or is grant eligible, and can be completed in 1 to 5 years (i.e., short term project) once project is funded.
- **Medium Priority**: A project that meets at least 1 plan objective, benefits exceeds cost, funding has not been secured and would require a special funding authorization under existing programs, grant eligibility is questionable, and can be completed in 1 to 5 years once project is funded.
- **Low Priority**: Any project that will mitigate the risk of a hazard, benefits exceed costs, funding has not been secured, project is not grant eligible, and time line for completion is considered long term (5 to 10 years).

Chapter 6: Adoption, Implementation, Monitoring, and Maintenance

Local Adoption Process and Federal Approval

Once a jurisdiction receives notification from the Federal Emergency Management Agency (FEMA) that their plan is *approvable pending adoption*, it has one year to adopt the plan. As with single jurisdictional plans, in order for FEMA to give approval to a multi-jurisdictional plan, at least one participating jurisdiction **must** formally adopt the plan within one calendar year of FEMA's designation of the plan as *approvable pending adoption*.

Adoption by the Local Governing Body

Each jurisdiction or entity seeking approval of its plan through the multi-jurisdictional planning process must have its governing body adopt the entire plan and their local annex. Each jurisdiction/entity will ensure that proper process is followed according to the laws or rules of their organization including adequate public notice and public hearings.

Adoption by the local governing body demonstrates the jurisdiction's commitment to fulfilling the mitigation goals and objectives outlined in the general plan and in their annex. Adoption legitimizes the plan and authorizes responsible agencies to execute their responsibilities. The plan shall include documentation of plan adoption, usually a resolution. A copy of each participating agency's adoption resolution is located in their respective annex.

Requirement §201.6(c)(5):	[The local hazard mitigation plan **shall** include] documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (*e.g., City Council, County Commissioner, Tribal Council)*.

Requirement §201.6(c)(5):	For multi-jurisdictional plans, each jurisdiction requesting approval of the plan must document that it has been formally adopted

Adoption Requirements

All entities which are part of the *Hazard Mitigation Plan for Cowlitz County*, or an update thereof, must adopt the portions of the natural hazards mitigation plan which apply to all the participating entities. This includes the entire multi-jurisdictional core plan including chapters 1 through 6. In addition, each agency must also adopt their jurisdiction's annex. The core plan plus the jurisdiction's annex represents a complete hazards mitigation plan.

Federal Approval

Once a jurisdiction provides FEMA with a copy of their adoption resolution, FEMA will certify the approval of the plan. FEMA sends each adopting agency a letter that includes the approval date and the expiration date of the plan. The first jurisdiction to formally adopt the plan initiates the five-year approval period and sets the expiration date for the plan for all participating plan partners regardless of when they adopt their plan.

Revisions to Adoption Process

The original plan's adoption process description was only relevant to the original plan. This section was revised

to describe a more general plan adoption and approval process that is consistent with federal requirements and relevant to all local plan participants.

Implementation

Requirement §201.6(c)(4)(ii):	[The plan **shall** include a\ process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvements, when appropriate.

Each governmental entity will be responsible for implementation of their individual mitigation initiatives based on funding availability, availability of resources, and entity priorities. Because the *Hazard Mitigation Plan for Cowlitz County* is a multi-jurisdictional plan, the mechanism for implementation through existing programs will vary between jurisdictions and also between special purpose districts. This section is intended to give an overview of the mechanisms available in Cowlitz County and the municipalities for plan implementation.

In Chapter 5, Goal 6 indicates that local governments will "support natural hazard mitigation, planning, and implement the mitigation initiatives." As noted in Objective 6A, it is expected that many of the mitigation initiatives will be incorporated into existing jurisdictional planning programs such as comprehensive plans, critical areas ordinances, and capital facilities plans. Cowlitz County and the municipalities are required to update their comprehensive plans and review state development regulations, at a minimum, every seven years.

In addition to plans, programs, and regulations, the entities may also incorporate the mitigation measures into their capital facilities plans (CFP's). The CFP's identify major infrastructure developments or facilities which have been identified in a six, ten or twenty year time frame. This identifies those major infrastructure developments or facilities which the entity has identified as needing in a six, ten, or twenty year plan.

Only some of the jurisdictions have comprehensive emergency management plans (CEMP's). When the CEMP's are updated, they should include relevant parts of this plan, if appropriate, or be linked back to this document by reference.

Local jurisdictions often adopt special purpose or "functional plans" separately from their comprehensive plan. These plans deal with a specific function or service such as stormwater, sewage, or in this case, a natural hazards mitigation plan. These plans are officially adopted by the jurisdiction and provide a level of detail that may not be found in the comprehensive plan.

Revisions to Implementation

Many local governments are succeeding in completing or making progress on their mitigation initiatives. No revisions were made to the process for implementing mitigation initiatives.

Plan Stewardship

Requirement §201.6(c)(4)(i):	[The plan maintenance process **shall** include a] section describing the method and schedule of monitoring, evaluating, and updating the hazard mitigation plan within a five-year cycle.

In order to fulfill the goals and objectives outlined in Chapter 5, the plan must be monitored and maintained throughout its five year cycle. A multi-jurisdictional plan requires coordination and collaboration among its partners.

The Department of Emergency Management (DEM) of Cowlitz County is a formally organized intergovernmental board that is familiar with a variety of key community stakeholders involved with disaster preparedness, response, recovery, and hazard mitigation. As such, the DEM has agreed to serve as the steward for the *Hazard Mitigation Plan for Cowlitz County*. As it did in 2005 through 2009, the DEM assumes the lead role for maintaining the plan's viability, and promoting its relevancy among the plan stakeholders.

Cowlitz County is embarking on the first Comprehensive Plan update since May 1981. The *Hazard Mitigation Plan for Cowlitz County* will be incorporated into the Comprehensive Plan.

The remaining sections of this chapter describe how the monitoring and maintenance functions will be fulfilled between 2010 and 2015.

Plan Monitoring

Annual Natural Hazards Mitigation Assessment

The plan will be monitored at least once a year as part of the DEM's regular work program (the schedule may be revised to accommodate exceptional circumstances). The DEM will include a special work session agenda item dedicated to a region wide assessment of the plan. The DEM will invite all plan partners to attend a work meeting. This annual work session will assess the following:

1. Progress towards the plan's goals and objectives
2. Progress towards county wide and jurisdiction specific mitigation initiatives
3. Implementation problems such as technical, legal, or coordination issues among local agencies, the State, or FEMA
4. Financing the multi-jurisdiction plan update
5. Public involvement activities
6. General information sharing (best practices) related to mitigation planning among the plan partners

Additionally, Cowlitz County's Director of Emergency Management will coordinate with other department heads and their adopted plans when performing capital project planning and budgeting, especially the Director of Maintenance and the adopted Facilities Needs Analysis. Because completing many of the initiatives rely on grant fund availability, DEM staff will monitor this plan in relation with various grant programs identified in the previous chapter, notify local jurisdictions, submit for funding when eligible, and report annually on which initiatives are actively being pursued.

Goals and objectives from this plan will be referenced when the county and partnering jurisdictions participate in projects or training required to maintain good standing in specific programs such as FEMA's ongoing update of the Flood Insurance Study and Digital Insurance Rate Map (DFIRM). Maintaining good standing with the National Flood Insurance Program (NFIP) is identified as a priority for the partners and so participating in mapping, trainings, and educational outreach processes to maintain that eligibility is vital.

Assessment after a Significant Disaster Event

It is routine practice for the Department of Emergency Management Council to conduct an after action review within 60 to 80 days following a Federal Disaster Declaration or a significant emergency event that occurred within the County. As part of this meeting, a specific agenda item will be added to the after action review process to capture any lessons learned for the purpose of enhancing the usability of the hazard mitigation plan (see objective 1D). The Emergency Management Council will assess:

1. The characteristics and severity of the hazard to determine if the region's risks have changed
2. Direct and indirect damage as well as any response and recovery costs.
3. The type and extent of the damages to determine any new mitigation initiatives that should be incorporated into the plan to avoid similar losses due to future hazard events. The results of the assessment will be provided to all hazards mitigation planning partners for their review. This information can be used for evaluating (if applicable) modifications to existing initiatives or new initiatives following the disaster event or during the next plan update cycle.

Revisions to Assessment after a Significant Disaster Event

The meeting time period was extended up to 80 days to allow emergency managers more time to effectively recover from disaster events. The new process creates a specific agenda item and provides specific, but simple assessment criteria for the DEM and after action review participants to consider.

Plan Maintenance

Plan maintenance should be an ongoing task. If done properly, it is executed throughout the plan's five year cycle. Plan maintenance ensures that information is current and accurate. Furthermore, by revising the plan on a periodic basis to reflect current conditions, the five year plan update process is simplified for all involved in a routine maintenance cycle.

Changes to the mitigation plan are initiated based on outcomes that are realized as part of annual plan monitoring, events after a major disaster, or on an as needed basis to suit the needs of individual jurisdictions. Changes are also made when new planning partners join the hazard mitigation planning process and adopt their plans. Each individual jurisdiction is responsible for maintaining its annex once they adopt their plan. Cowlitz County Emergency Management assumes responsibility for executing all revisions to the core multi jurisdictional plan (all sections except for local annexes).

Minor Revisions

Corrections regarding spelling and sentence structure that are minor in nature will be handled by the Cowlitz County Emergency Management staff.

Technical Revisions

Requests for changes that would alter the technical content of the general plan such as additions or deletions of data or alterations to the hazard profiles and the risk assessments will be the responsibility of Emergency

Management staff. Any changes of this type would require a review by the DEM and the Workgroup, or if applicable, the affected jurisdiction/entity.

Substantive Revisions

If the State or FEMA request significant changes or analysis to the general plan, it will require a meeting of the Hazards Mitigation Plan Workgroup. Substantive changes to the general plan will require review and approval of the Workgroup. Substantive changes to the jurisdiction/entity specific mitigation initiatives would require review of the changes by the entity's approving body and may possibly require re-adoption of the mitigation initiative depending on the complexity and scope of the change.

Distribution of Revisions

Cowlitz County Department of Emergency Management staff will be responsible for maintaining a master copy of the plan and distributing relevant updates to all adopted plan holders. For any revisions made to the general plan, copies of any correspondence from the State or FEMA, along with supporting analysis and revised plan pages, will be sent to all of the entities and holders of the plans. Conversely, any local agency that makes changes to the contents of its local annex should provide Cowlitz County Emergency Management a copy of its revised annex and documentation of the process that was used to revise its annex.

When at all possible, plan updates will be distributed electronically via email or some other form of electronic media such as a compact disc. Printed copies can be requested by contacting DEM.

Revisions to Plan Maintenance

Minor revisions were made to clarify the role of the DEM, Cowlitz County Department of Emergency Management staff, the Hazard Mitigation Planning Workgroup and the local agencies.

Procedure to Add a Community to the Natural Hazards Mitigation Plan for Cowlitz County

Local governments and special purpose districts are encouraged to develop hazards mitigation plans and may do so through this plan's framework. The plan update process is the best time for an agency, interested in developing a local hazard mitigation plan, to join the multi-jurisdictional plan. However, an entity can choose to develop a plan when it suits their needs. Plans can be developed in between plan update cycles.

The following steps outline the process by which local governments, special purpose districts, tribes, or non-profit entities can develop and adopt their local natural hazard mitigation plan through the region's hazard mitigation planning framework.

1. The community wishing to join the plan contacts the Cowlitz County Department of Emergency Management with a request to become a plan participant.
2. Cowlitz County Emergency Management will provide the new entity with a copy of the Hazard Mitigation Plan for Cowlitz County, local planning requirements, forms and instructions for their annex, and any other pertinent information.
3. The new entity reviews the plan and

the plan requirements. The entity develops a plan that coordinates with the regional plan and meets all of the planning requirements specified in 44 CFR Section 201.6 (201.7 for tribes) of the Disaster Mitigation Act of 2000. Portions of the regional plan that meet the planning requirements for that entity could be referenced in the plan eliminating the need for redundancy.

4. The new entity would then submit their draft plan to The Department of Emergency Management of Cowlitz County for review to ensure conformance with the regional plan.
5. Cowlitz County Emergency Management staff forwards the new plan to the Washington State Hazard Mitigation Program Manager for review (30 days minimum). If the new community plan does not meet the required standards, the State Hazard Mitigation Program Manager will work with the community to resolve issues that require improvement.
6. The State Hazard Mitigation Program Manager forwards the plan to FEMA Region X for review and approval (45 days minimum).
7. Upon approval from FEMA Region X, the new community must adopt their plan. Once adopted, the new entity is considered part of the Hazard Mitigation Plan for Cowlitz County and will comply with the update schedule of the plan and join the Hazard Mitigation Plan Workgroup.

Revisions to Procedure to Add a Community to the Hazard Mitigation Plan for Cowlitz County

The procedures were revised to clarify the roles and responsibilities of the jurisdiction seeking plan approval, the DEM, the State, and FEMA.

Future Plan Updates

If a plan update is deemed necessary, the DEM will be responsible for establishing a work program, budget, and time frame for updating the plan. At that time, the DEM will also announce that the plan is under review and identify and carry out appropriate public process. New planning partners will be encouraged to participate in the plan update process to develop and adopt their own plans. Without any intervening circumstances, the natural hazards mitigation plan is to be updated at a minimum every five years.

Hazard Profiles

During a future update of the natural hazard mitigation plan, consideration will be made to expand the plan to address additional hazard profiles. For example, hazard profiles could be developed for pandemic fu, dam failure, or certain elements of climate change such as sea level rise. As this information is developed, local governments can utilize these profiles to consider additional mitigation initiatives as well as incorporate the newly developed information into their hazard inventory vulnerability assessments (HIVA).

Continued Public Involvement

The Department of Emergency Management, as well as all of the entities that participated in this plan, are committed to continued public involvement and education. It will be important that natural hazards mitigation becomes integrated into

existing programs and becomes part of the way jurisdictions make decisions about land use and facilities planning. As mentioned in the preceding section, in the city and county jurisdictions, comprehensive plan amendment processes as well as capital facilities planning both have elements of public notification and involvement. These local plans require updating every six to seven years but are often amended yearly with an associated public process. These processes will provide a venue that promotes public dialogue regarding the importance of hazard mitigation.

As was the case in the compilation of this plan, when there is a plan update (at least every 5 years) the comprehensive plans and capital facilities plans will need to be reviewed to assure consistency between all planning efforts. It will be important to identify where and how hazard mitigation planning initiatives have been integrated in comprehensive and capital facilities plans.

The Department of Emergency Management will also need to encourage its governmental entities to combine the natural hazards plan elements into existing emergency preparedness activities and information in order to continue to educate the public on the importance of managing the risk for natural hazards. If there are efforts to re-write emergency preparedness public information pieces such as brochures, integration of natural hazards mitigation information will be considered. Jurisdictions that have existing Comprehensive Emergency Management Plans will work to integrate natural hazards mitigation planning into that document and associated public education efforts.

Copies of the Hazard Mitigation Plan will be maintained in the Department of Emergency Management Library.

Appendix A

Samples of documents used in the planning process

Instructions for Completion of the Jurisdictional Assessment

The following are instructions for the completion of the Hazard Mitigation Jurisdictional Assessment template that will need to be completed for each partner in the Hazards Mitigation plan. The purpose of these instructions is to guide each Partner in the preparation of the information required for Disaster Mitigation Act (DMA) compliance. Each Partner should try to complete as much of the information as possible. Technical assistance will be available to each planning partner in the form of a workshop and/or a technical assistance visit with each partner depending on funding availability. Each planning partner should have completed the following prior to completion of this template:

- Reviewed the Summary of Loss matrix for the county plan.
- Reviewed the Results from the Hazard Mitigation Plan Questionnaire.
- Review of the catalog of mitigation alternatives.

Any questions on what is required or how to complete this document should be directed to:

Matt Hermen	**577-3041**	**mhermen@cwcog.org**
T.J. Keiran	**577-3041**	**tkeiran@cwcog.org**

This template has been set up as a word document in a format that will be used in the final plan. Each Partner is asked to use this template with no other derivations or versions so that a uniform product will be completed for each partner. Please provide both a hard copy and digital copy of the completed template to upon completion. If a Partner does not have "Word" capability, prepare the document in whatever format you do have and the planning team will convert it to the Word format.

Instructions:

Title Block:

In the Title box, we have entered in your agency's name to individualize the assessments based on your previous plan's content. If the name needs to be altered, please feel free to make theses changes.

A.) Hazard Mitigation Plan Point of Contact

Please provide the name, telephone number, and e-mail address for the primary point of contact for your district for this plan. Point of contacts would be that person responsible for monitoring, evaluating and updating the plan for your District. This person should also be the principle liaison between your jurisdiction and the Steering Committee overseeing the development of this plan. In addition, designate an alternate point of contact. This would be the person to contact should the primary point of contact is not available, or no longer employed by the District.

B.) District Profile:

Please provide a brief summary to profile your district. Include purpose of the district, date of inception, organization, number of employees, mode of operation (i.e., how operations are funded), who/what is the governing body of the district and who has adoptive authority. Include a geographical description of your service area.

B.1) Land Area served:

In this box enter the total acreage or square miles of all land served by your District.

B.2) Population Served

In this section list the estimated population that your district provides services to. If you do not know this number directly, you can estimate. For most agencies we have provided population and household estimates, provided by the Washington office of Financial Management (OFM). See D.

B.3) Land Area owned:

In this box enter the total acreage or square miles of all land owned by your District. The County Assessor's internet based parcel search may be able to aid this research.

B.4) List of Critical Infrastructure/equipment:

List all infrastructure/equipment that is critical to your Districts operations and/or you have identified to be housed or located in a natural hazard risk zone. Examples are as follows:

- Fire Districts: Apparatus, equipment (note: we do not need a detailed inventory of each engine, truck and there contents. A simple statement like 5 Engines, 2 ladders, and their contents will suffice) that is housed in a facility located in an identified natural hazard risk zone. This is the equipment that is essential for you to deliver services to this area should a natural hazard occur. Do not consider reserve equipment.

- Dike/Flood Control Districts: Miles of levees, pump stations, R/D ponds, tide gates, miles of ditches, etc., within identified natural hazard risk zones.

- Water Districts: Miles of pipe (does not need to be broken down into size and type), pump stations, treatment facilities and most importantly dams and reservoirs, within identified natural hazard risk zones.

- Public Utility Districts: Miles of power line (above ground and under ground), generators, power generating sub-stations, miles of pipeline, etc., within identified natural hazard risk zones.

- School Districts: Include anything (besides school buildings) that is critical for you to operate (i.e., school buses if you own a fleet of school buses) within identified natural hazard risk zones.

B.5) Value of Critical infrastructure/Equipment:

This should be a single dollar amount representing the total "replacement cost" value of the infrastructure/equipment listed in B.4. You may be able to determine the value of your critical infrastructure/equipment by consulting with your insurance coverage.

B.6) List of Critical Facilities (owned by District):

This is a list of buildings and other critical facilities that are critical to your districts operations and/or you have identified to be located in a risk zone.

B.7) Value of Critical Facilities:
This is the replacement cost value of the buildings/facilities listed in B.6.

B.8) Value of Area Served:
What is the approximate County assessed value of your service area? Basically this would be the property value of your constituency. If you do not have this information, the County should be able to provide a number using their assessor's database.

Example:

DISTRICT PROFILE

Humboldt Community Services District is a Special District created in 1952 to provide water, sewer, and street lighting to the unincorporated area surrounding the City of Eureka known as Pine Hill & Cutten. The District s designated service areas expanded throughout the years to include other unincorporated areas of Humboldt County known as Myrtletown, Humboldt Hill, Fields Landing, King Salmon, and Freshwater. A five-member elected Board of Directors governs the District. The Board assumes responsibility for the adoption of this plan while the General Manager will oversee its implementation.
As of April 30, 2007, the District serves 7.305 water connections. 6.108 sewer connections, and street lights with a current staff of 21. Funding comes primarily through rates and revenue bonds. See Attached map for specific District boundaries.

Land Area Served– HCSD's Service area consists of approximately 17.571acres or 27.5 square miles.

Population Served- HSD serves 30,672 households and 102,419 people.

Land Area Owned– HCSD owns approximately 10.91 acres or 475,480 square feet of land.

List of Critical Infrastructure/Equipment– HCSD consists of approximately 87 miles of water main, 3 water wells, 10 water booster stations, 10 steel water storage tanks, 3 metered connections to the City of Eureka,5 un-metered connections to the City of Eureka, 1 metered connection to Humboldt Bay Municipal Water District, approximately 70 miles of sewer collection main, 29

Sewer Lift Stations, 7 Metered sewer connections with the City of Eureka (3 are incorporated as part of the sewer lift stations, 4 are stand-alone), and rolling stock (26 vehicles).

Value of Critical Infrastructure/Equipment— (total '•replacement cost" value of the infrastructure/equipment listed in 3 above) $1,487,500.00

List of Critical Facilities (Owned by District) —
Transmission and distribution pipelines
Wells 1 through 3
Hi. Water Booster Stations 1 through 10
10 Water storage tanks
3 metered connections to the City of Eureka
5 un-metered connections to the City of Eureka
1 metered connection to Humboldt Bay Municipal Water District
Sewer collection system mains
Sewer lift stations 1 through 29
Sewer meter stations, 4, 5, 6 and 7
Office, equipment and parts facilities
Value of Critical Facilities: (replacement cost value of the buildings/facilities listed above)
$10,882,000.00

Value of Area Served— As of April 30, 2007, the County assessed value of the District, net of exemptions, is $1,087,540,799.

C.) Outline of your service area:

The Planning Team will attempt to create maps that will illustrate the service area boundary for all of the special District partners. This most likely will be multiple maps segregated based on district type (i.e., fire districts, water districts, school districts, etc). Please confirm that the boundaries reflected on the maps are current and accurate for your district. In the box for this section, include reference to the map that includes your district's boundaries.

D.) Current and Anticipated Service Trends:

The planning team has provided a table displaying past population, household estimates and Average Annual Growth Rates (AAGR), to most jurisdictions/agencies. This data was provided by the Washington Office of Financial Management (OFM).

A brief description on how your Districts services are projected to expand in the foreseeable future. Also include in this section reference to any identified capital improvement needs identified to meet this projected expansion. Include in the description the probable cause for the expanded services. For example:

- Portions of the district have experienced a 13 percent growth over the last 5 years and land use regulations based on GMA project an increase in light commercial and residential land uses within the district service area.

- (For a Fire District) This increase in density of land uses will represent an increase in population and thus a projected increase in

call volume. Our District is experiencing an average annual increase in call volume of 13 percent.

- (For Dike/Drainage/Flood Control District) This increase in density of land use will result in an increase in impermeable surface within our service area and thus increase the demand on control facilities.

- (For a Water District) This increase in density of land use will represent and increase in the number of housing units within the service area and thus represent an expansion of the districts delivery network.

E.) Natural Hazard Event History:

The planning team has entered in the past three federally declared disasters, since the initial hazard mitigation plans were developed. Please enter any other events that compromised your jurisdiction/agency.

List in chronological order (most recent first) any natural hazard event that has occurred since 2005 that caused damage to your district and/or service area. Include the date of the event and the estimated dollar amount of damage it caused. If repetitive losses occurred, please identify those affected facilities. Finally please list any grants that were received as a result of the event.

F.) Natural Hazard Risk/Vulnerability Risk Ranking:

Under this step, a ranking of risk will be performed as it pertains to your District. The planning staff has entered your Natural Hazard Risk Ranking from the previous plan. Please feel free to revise this ranking, should you feel necessary. A county -wide risk ranking has been performed for the entire planning area and is contained in the risk assessment chapter of the plan. However, each planning partner will have differing degrees of risk exposure and vulnerability aside from the whole, and therefore will need to rank the degree of risk to each hazard as it pertains to them. This will allow for the appropriate selection and prioritization of initiatives that will reduce the highest levels of risk for each planning partner. The exact same methodology that will be applied to the county-wide risk ranking will be applied to each planning partner. This will assure consistency in the overall ranking of risk.

This risk ranking exercise serves two purposes: To describe the probability of occurrence for each hazard and to describe the impact each would have on the people, property and operability of the special purpose districts within the county. Estimates of risk for the county were developed using methodologies promoted by FEMA's hazard mitigation planning guidance and generated by FEMA's HAZUS-MH risk assessment tool.

PROBABILITY OF OCCURRENCE

The probability of occurrence of a hazard event provides an estimation of how often the event occurs. This is generally based on the past hazard events that have occurred in the area and the forecast of the event occurring in the future. This is done by assigning a probability factor, which is based on yearly values of occurrence. The numerical value assigned to each category will be used to determine the risk rating of each hazard. Table 1lists the probability of

occurrence for each hazard as it pertains to your district. This would be the occurrence of an event that caused property damage within your jurisdiction. These values were assigned by high, medium and low occurrence:

• High—Hazard event is likely to occur within 25 years (Numerical value 3)
• Medium—Hazard event is likely to occur within 100 years (Numerical value 2)
• Low—Hazard event is not likely to occur within 100 years (Numerical yalue 1)

For example: If your service area has experienced 2 damaging floods in the last 25 years, the probability of occurrence is high for flooding and scores a 3 under this category. If your service area has experienced no damages from landslides in the last 100 years, your probability of occurrence for landslide is low, and scores a 1 under this category.

G.) Existing Applicable Hazard Mitigation Laws, Ordinances, and Codes

List any federal, state, local or district laws, ordinances, codes and policies that govern your district which include elements addressing hazard mitigation. Describe how these laws may support or conflict with the mitigation strategies oft his plan. None applicable is a possible answer for this section.

G.1) Does your jurisdiction/entity participate in the National Flood Insurance Program (NFIP)? Only applies to cities and county.

Please check “yes” if your jurisdiction is involved in this program.

H.) Existing Natural Hazards Mitigation Associated Plans and/or documents:

Please list plans that are in place to aid in disaster mitigation, preparedness, and/or response. An example may be a school districts evacuation plan.

J.) Hazard Mitigation Action Plan:

Complete the table to include those initiatives your community would like to pursue with this plan. The planning team has entered the initiatives identified in the current plan. Some important points to remember when completing this section:

- Know what is, and is not grant eligible under the Hazard Mitigation Grant Program (HMGP) and Pre-disaster Mitigation Grant Program (PDM). {See attachment "A ")
- Know the overall goals, objectives and guiding principles of the Cowlitz County Hazard Mitigation Plan.
- Identify projects where the benefits will exceed the costs.
- Include any project that your community has committed to pursuing regardless of grant eligibility.

A lot of detail is not needed in the description of the initiative. This will come when you apply for the project grant. Provide enough information to identify the project's scope and impact. For example:

- Address NFIP identified Repetitive Loss properties. Through targeted mitigation, acquire, relocate or retrofit the 5 repetitive loss structures within any town as funding opportunities become available.

- Seismic retrofit of Anytown City Hall.

- Floodplain Property acquisition in Freylands subdivision.

- Assess and enhance the County flood warning capability by joining the NOAA "Storm Ready" program.

Also, if you have projects that are not HMGP or PDM grant eligible, but do mitigate part or the entire hazard and may be eligible for other grant programs sponsored by other agencies, include them in this section. Also, a hazard specific project is not required for each hazard you have ranked in order to be eligible for an HMGP project grant after a "declared" disaster. In other words, if you have not identified an earthquake related project, and an earthquake occurs that causes damage within your community, you are not discounted from HMGP project grant eligibility. The key here is to identify at least 1 initiative for your highest ranked risk.

Goals met: Refer to list of goals below table. Identify those that are supported through the initiative.

Identify the hazard(s) the initiative will mitigate and illustrate who will be the lead in administering the project. This will most likely be your governing board. Identify funding source(s) for project. If it is a grant, include the funding source(s) for the cost share. Refer to your capability assessment to identify possible sources of funding. Indicate the time line as "short term" (1 to 5 years) or "long term" 5 years or greater. Identify by number the Cowlitz County Hazard Mitigation plan goal(s) the project will meet. These have been provided in the Steering Committee meeting minutes that were forwarded to you in the past. Technical assistance will be available to your community in completing this section during a scheduled technical assistance visit.

K.) Prioritization of Mitigation Initiatives

Complete the information in table G. The purpose of this exercise is to prioritize your initiatives in a matter such that meets the requirements of section 201.6 of44CFR. A brief description of each category is as follows:

Initiative#: indicate the number of the initiative from Table J.

Benefits: Enter high, medium or low as described below table.

- High: Project will have an immediate impact on the reduction of risk exposure to life and property.

- Medium: Project will have a long-term impact on the reduction of risk exposure to life and property, or project will provide an immediate reduction in the risk exposure to property.

- Low: Long term benefits of the project are difficult to quantify in the short term.

Costs: Enter high medium or low as described on the following page. If you know the estimated cost of a project because it is part of an existing/on-going program, indicate the amount.

- High: Would require an increase in revenue via an alternative source (i.e., bonds, grants, fee increases) to implement. Existing funding levels are not adequate to cover the costs of the proposed project.

- Medium: Could budget for under existing work-plan, but would require are apportionment of the budget or a budget amendment, or the cost of the project would have to be spread over multiple years.

- Low: Possible to fund under existing budget. Project is part of, or can be part of an existing on going program.

Do benefits exceed the cost: Enter yes or no. This is an anecdotal assessment. For example, a high benefit over a medium cost would =yes. In using this approach, projects that result in positive benefits versus costs categorical ratios (i.e., high over high, high over medium, medium over low, etc.), will be considered cost beneficial and should be prioritized accordingly.

Priority: List the initiative priority as high, medium or low as defined below.

- High Priority: A project that meets multiple plan objectives, benefits exceeds cost, has funding secured under existing programs or authorizations, or is grant eligible, and can be completed in 1 to 5 years (i.e., short term project) once project is funded.

- Medium Priority: A project that meets at least 1 plan objective, benefits exceeds costs, funding has not been secured and would require a special funding authorization under existing programs, grant eligibility is questionable, and can be completed in1to5yearsonceproject is funded.

- Low Priority: Any project that will mitigate the risk of a hazard, benefits exceed costs, funding has not been secured, project is not grant eligible, and time line for completion is considered long term (5 to 10 years).

Is the project grant eligible? Refer to attachment A.

Can Project be funded under existing program budgets? Yes or no. In other words, is this initiative currently budgeted for? Or would it require anew budget authorization or funding from another source such as grants?

This is not intended to be a detailed benefit/cost analysis that is required of HMGP/PDM project grants.
This is a "review" to determine that the initiatives you have identified meet one of the primary objectives of the Disaster Mitigation Act. What this exercise hopes to achieve is to identify projects where the probable benefits will not exceed the probable costs of this project. When performing an anecdotal B/C review, use the following parameters to define the benefits and costs of a proposed project as high, medium or low.

Remember, it is not the intent of this exercise to be overly technical. It is a "review" exercise meant to provide additional information in identifying and prioritizing mitigation initiatives.

L.) Future needs to better understand risk/vulnerability

In this section, identify any future studies, analyses, reports, or surveys your community needs to better understand its vulnerability to identified or currently unidentified risks. These could be needs based on federal or state agency mandates such as EPA's Bio-terrorism assessment requirement for Water District.

M) How will continued public participation be obtained?

Please mark all methods of public participation you plan on utilizing and list others not contained in the choices.

N.) Additional comments:

Use this section to add any additional information pertinent to hazard mitigation and your district not covered in this template.

Hazard Mitigation Jurisdictional Assessment

_____

(Insert District Name)

A.) **Hazard Mitigation Plan Point of Contact**

Primary POC:	**Alternate POC**
Telephone #:	Telephone #:
E-mail Address:	E-mail Address:

Names of other personnel involved in data gathering:

_____

_____

B.) **District Profile**

(Insert text profile of District as describe in instructions)

1) **Land Area Served:**

2) **Population Served:**

3) **Land Area Owned:**

4) **List of Critical Infrastructure/Equipment:**

5) **Value of Critical Infrastructure/Equipment:**

6) **List of Critical Facilities (owned by District):**

7) **Value of Critical Facilities:**

8) **Value of area Served:**

C.) Outline of Area Served:

D.) Current and Anticipated Service Trends

E.) Natural Hazard Event History Specific to the Disaster Service Area

NATURAL HAZARD EVENTS					
Type of Event	**Date**	**Estimated Damages ($)**	**Facilities Impacted**	**Repetitive Loss**	**Grants Received ($)**
Winter Storm, Flooding, Landslide (DR-1671)	Nov. 2-11, 2006				
Winter Storm, Flooding, Landslide (DR-1817)	Jan. 6-16, 2009				
Winter Storm (DR-1825)	Dec. 12, 2008-Jan. 5, 2009				

F.) Natural Hazard Risk Ranking

NATURAL HAZARD RISK RANKING			
Rank #	**Hazard Type**	**Estimate of Potential Dollar Losses to District Owned Facilities Exposed to the Hazard**	****Probability of Occurrence (See table below)**
** High-Hazard event is likely to occur with 25 years Medium-Hazard Event is likely to occur within 100 years Low-Hazard event is not likely to occur within 100 years			

G.) Existing Applicable Hazard Mitigation Codes, Ordinances or Policies

G.1.) Does your jurisdiction/entity participate in the National Flood Insurance Program (NFIP)?

- ☐ **Yes**
- ☐ **No**

H.) Existing Natural Hazards Mitigation Associated Plans and/or documents

J.) Hazard Mitigation Action Plan – If an initiative from the previous plan has been deleted, please explain why deletion occurred.

TABLE F: HAZARD MITIGATION ACTION PLAN MATRIX										
Accomplished?	**Initiative #**	**Mitigation Initiative**	**Included in a Capital Facilities Plan?**	**Applies to New or Existing Assets**	**Hazard(s) Mitigated**	**Goals Met (from list below)**	**Lead Agency**	**Estimated Cost**	**Sources of Funding**	**Time-line**

List of Goals

1) **Protect life:**
2) **Protect property:**
3) **Promote a Sustainable Economy:**
4) **Protect the Environment:**
5) **Increase Public Preparedness for Disasters:**

K.) Prioritization of Mitigation Initiatives:

TABLE G: MITIGATION STRATEGY PRIORITY SCHEDULE									
Initiative #	**Initiative Name**	**Benefits** (High, Medium, or Low)	**Costs** (High, Medium, or Low)	**Do Benefits Equal or Exceed Costs?** (Yes or No)	**Priority** (High, Med., Low)	**Is Project Grant Eligible?** (Yes or No)	**Can Project be Funded Under Existing Programs/Budgets?** (Yes or No)	**Initiative Duplicated in Another Jurisdiction?** (Yes or No)	**Accompanied Form Number**

Explanation of Benefits

- **High**: Project will have an immediate impact on the reduction of risk exposure to life and property.
- **Medium**: Project will have a long-term impact on the reduction of risk exposure to life and property, or project will provide an immediate reduction in the risk exposure to property.
- **Low**: Long term benefits of the project are difficult to quantify in the short term.

Explanation of Costs

- **High**: Would require an increase in revenue via an alternative source (i.e. bonds, grants, fee increases) to implement. Existing funding levels are not adequate to cover the costs of the proposed project.

- **Medium**: Could budget for under existing work-plan, but would require a reapportionment of the budget or a budget amendment, or the costs of the project would have to be spread over multiple years.

- **Low**: Possible to fund under existing budget. Project is part of, or can be part of an existing ongoing program.

Explanation of Priorities

- **High Priority**: A project that meets multiple plan objectives, benefits exceeds cost, has funding secured under existing programs or authorizations, or is grant eligible, and can be completed in 1 to 5 years (i.e., short term project) once project is funded.

- **Medium Priority**: A project that meets at least 1 plan objective, benefits exceeds cost, funding has not been secured and would require a special funding authorization under existing programs, grant eligibility is questionable, and can be completed in 1 to 5 years once project is funded.

- **Low Priority**: Any project that will mitigate the risk of a hazard, benefits exceed costs, funding has not been secured, project is not grant eligible, and time line for completion is considered long term (5 to 10 years).

L.) Future Needs to Better Understand Risk/Vulnerability. Identify any future studies, analyses, reports or surveys your jurisdiction needs to better understand its vulnerability.

M.) How will continued public participation be obtained?

- ☐ **Soliciting Input**
- ☐ **Holding Meetings**
- ☐ **Postings to Internet**
- ☐ **Postings in Newsletters**
- ☐ **Newspaper Advertisements**
- ☐ **Other: _____**

N.) Additional Comments:

Hazard Mitigation Grant Program (HMGP)
Pre-Disaster Mitigation Grant Program (PDM)

What is the Hazard Mitigation Grant Program?

Authorized under Section 404 of the Stafford Act, the Hazard Mitigation Grant Program (HMGP) administered by the Federal Emergency Management Agency (FEMA) provides grants to States and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the program 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.

Who is eligible to apply?

Hazard Mitigation Grant Program funding is only available to applicants that reside within a presidentially declared disaster area. Eligible applicants are:

- Certain non-profit organizations
- State and local governments
- Indian tribes or other tribal organizations

What types of projects can be funded by the HMGP?

HMGP funds may be used to fund projects that will reduce or eliminate the losses from future disasters. Projects must provide a long-term solution to a problem, for example, elevation of a home to reduce the risk of flood damages as opposed to buying sandbags and pumps to fight the flood. In addition, a project's potential savings must be more than the cost of implementing the project. Funds may be used to protect either public or private property or to purchase property that has been subjected to, or is in danger of, repetitive damage. Examples of projects include, but are not limited to:

- Acquisition of real property for willing sellers and demolition or relocation of buildings to convert the property to open space use
- Retrofitting structures and facilities to minimize damages from high winds, earthquake, flood, wildfire, or other natural hazards
- Elevation of flood prone structures
- Development and initial implementation of vegetative management programs
- Minor flood control projects that do not duplicate the flood prevention activities of other Federal agencies
- Localized flood control projects, such as certain ring levees and floodwall systems, that are designed specifically to protect critical facilities
- Post-disaster building code related activities that support building code officials during the reconstruction process

What are the minimum project criteria?

There are five issues you must consider when determining the eligibility of a proposed project.

- Does your project conform to your State's Hazard Mitigation Plan?
- Does your project provide a beneficial impact on the disaster area? i.e. the State
- Does your application meet the environmental requirements?
- Does your project solve a problem independently?
- Is your project cost-effective?

What is the Pre-Disaster Mitigation competitive grant program?

The Pre-Disaster Mitigation (PDM) competitive grant program provides funds to State, Tribal, and local governments for pre-disaster mitigation planning and projects primarily addressing natural hazards. Cost-Effective pre-disaster mitigation activities reduce risk to life and property from natural hazard events before a natural disaster strikes, thus reducing overall risks to the population and structures, while also reducing reliance on funding from actual disaster declarations. Funds will be awarded on a competitive basis to successful Applicants for mitigation planning and project applications intended to make local governments

more resistant to the pacts of future natural disasters.

Who can apply for a PDM competitive grant?

Eligible PDM competitive grant Applicants include State and Territorial emergency management agencies, or a similar office of the State, District of Columbia, U.S. Virgin Islands, Commonwealth of Puerto Rico, Guam, American Samoa, Commonwealth of the Northern Mariana Islands, and Federally-recognized Indian Tribal governments.

Eligible Sub-applicants include State agencies; Federally-recognized Indian Tribal governments; and local governments (including State recognized Indian Tribal governments and Alaska native villages). Applicants can apply for PDM competitive grant funds directly to FEMA, while Sub-applicants must apply for funds through an eligible Applicant. Private non-profit organizations are not eligible to apply for PDM but may ask the appropriate local government to submit an application for the proposed activity on their behalf.

What are eligible PDM projects?

Multi-hazard mitigation projects must primarily focus on natural hazards but also may address hazards caused by non-natural forces. *Funding is restricted to a maximum of $3M Federal share per project*, the following are eligible mitigation projects:

- Acquisition or relocation of hazard-prone property for conversion to open space in perpetuity;
- Structural and non-structural retrofitting of existing buildings and facilities (including designs and feasibility studies when included as part of the construction project) for wildfire, seismic, wind or flood hazards (e.g., elevation, flood proofing, storm shutters, hurricane clips);
- Minor structural hazard control or protection projects that may include vegetation management, Stormwater management (e.g., culverts, floodgates, retention basins), or shoreline/landslide stabilization; and,
- Localized flood control projects, such as certain ring levees and floodwall systems, that are designed specifically to protect critical facilities and that do not constitute a section of a larger flood control system.

Mitigation Project Requirements

Projects should be technically feasible (see Section XII. Engineering Feasibility) and ready to implement. Engineering designs for projects must be included in the application to allow FEMA to assess the effectiveness and feasibility of the proposed project. The project cost estimate should complement the engineering design, including all anticipated costs. FEMA has several formats that it uses in cost estimating for projects. Additionally, other Federal agencies' approaches to project cost estimating can be used as long as the method provides for a complete and accurate estimate. FEMA can provide technical assistance on engineering documentation and cost estimation (see Section XIII.D. Engineering Feasibility).

Mitigation projects also must meet the following criteria:

1. Be cost-effective and substantially reduce the risk of future damage, hardship, loss, or suffering resulting from a major disaster, consistent with 44 CFR 206.434(c)(5) and related guidance, and have a Benefit-Cost Analysis that results in a benefit-cost ratio of 1.0 or greater (see Section X. Benefit-Cost Analysis). *Mitigation projects with* a *benefit-cost ratio* less than 1.0 will *not* be considered for the *PDM* competitive grant program;

2. Be in conformance with the current FEMA-approved State hazard mitigation plan;

3. Solve a problem independently or constitute a functional portion of a solution where there is assurance that the project as a whole will be completed, consistent with 44 CFR 206.434(b)(4);

4. Be in conformance with 44 CFR Part 9, Floodplain Management and Protection of Wetlands, and44 CFRPart10, consistent with44CFR 206.434(c)(3);

5. Not duplicate benefits available from another source for the same purpose, including assistance that another Federal agency or program has the primary authority to provide (see Section VII.C. Duplication of Benefits and Programs);

6. Be located in a community that is participating in the NFIP if they have been identified through the NFIP as having a

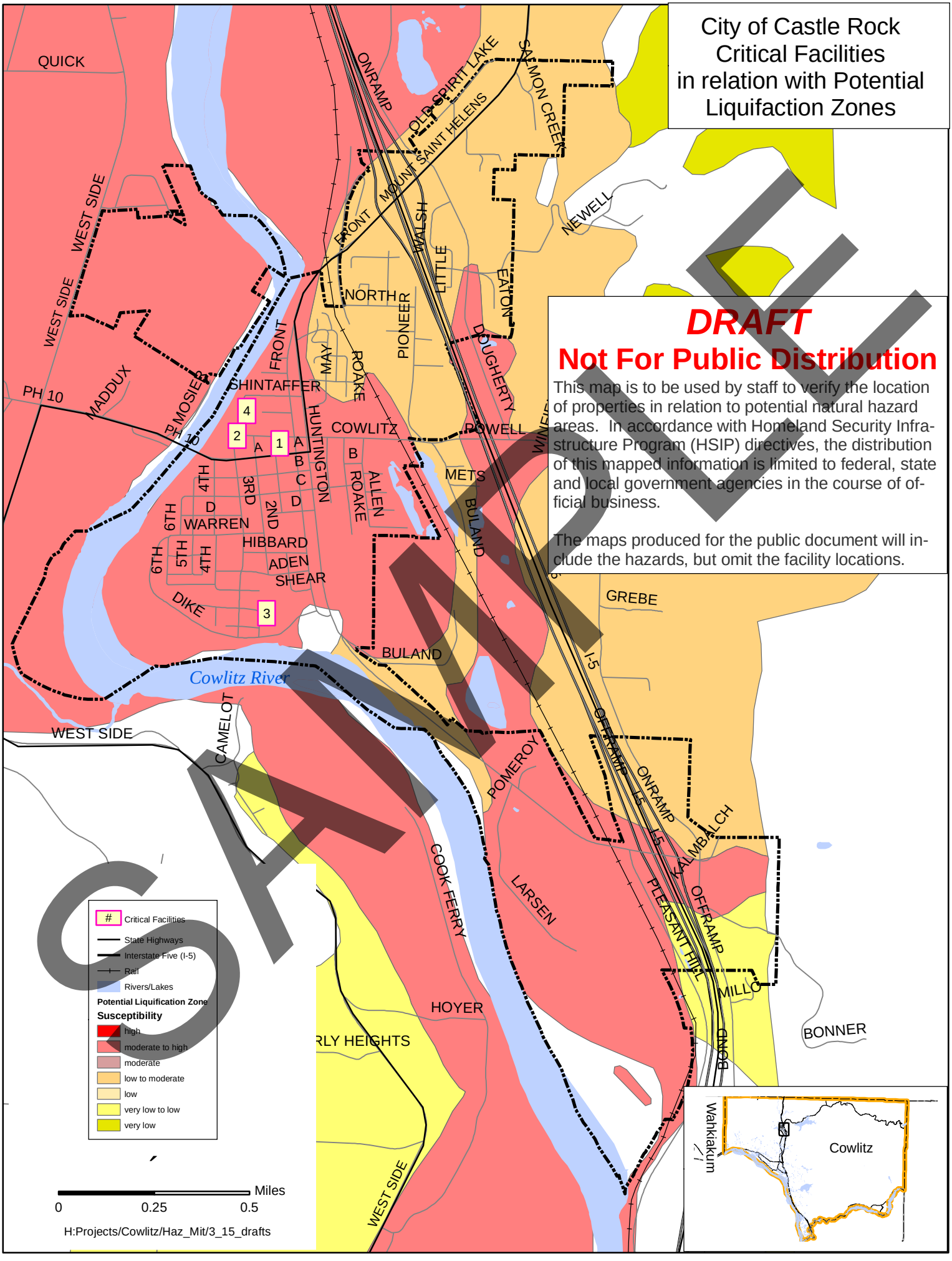
Special Flood Hazard Area (a FHBM or FIRM has been issued). In addition, the community must not be on probation, suspended or withdrawn from the NFIP;

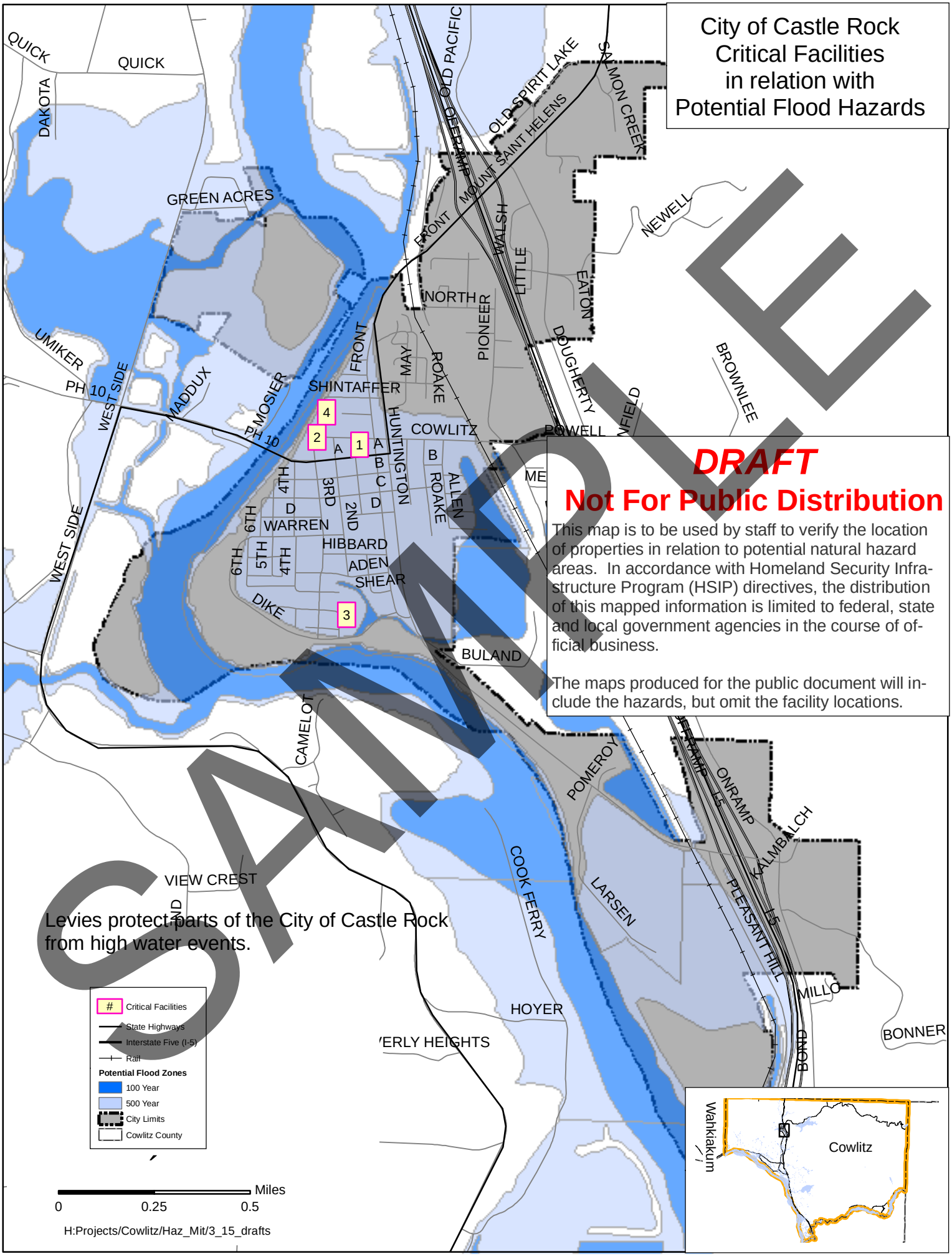
7. Meet the requirements of Federal, State, and local laws.

What are examples of Ineligible PDM Projects?

The following mitigation projects are ***not*** eligible for the PDM program:

• Major flood control projects such as dikes, levees, floodwalls, seawalls, groins, jetties, dams, waterway channelization, beach nourishment or re-nourishment; **S** Warning systems; **S** Engineering designs that are not integral to a proposed project; **S** Feasibility studies that are not integral to a proposed project; **S** Drainage studies that are not integral to a proposed project; **S** Generators that are not integral to a proposed project; **S** Phased or partial projects; **S** Flood studies or flood mapping; and, **S** Response and communication equipment.


City of Castle Rock
Critical Facilities
in relation with Potential
Liquifaction Zones
DRAFT
Not For Public Distribution
This map is to be used by staff to verify the location of properties in relation to potential natural hazard areas. In accordance with Homeland Security Infrastructure Program (HSIP) directives, the distribution of this mapped information is limited to federal, state and local government agencies in the course of official business.
The maps produced for the public document will include the hazards, but omit the facility locations.
SAMPLE
QUICK
WEST SIDE
WEST SIDE
PH 10
MADDUX
PH 10
PH 10
SHINTAFFER
FRONT
HUNTINGTON
MAY
ROAKE
PIONEER
NORTH
LITTLE
MAY
EATON
DOUGHERTY
NEWELL
ONRAMP
OLD SPIRIT LAKE
SAMON CREEK
MOUNT SAINT HELENS
FRONT
COWLITZ
POWELL
METS
BULAND
ALLEN
ROAKE
4TH
3RD
2ND
6TH
WARREN
HIBBARD
ADEN
SHEAR
6TH
5TH
4TH
DIKE
BULAND
GREBE
I-5
Cowlitz River
WEST SIDE
CAMELOT
POMEROY
OFFRAMP I-5
ONRAMP I-5
ALMBALCH
COOK FERRY
LARSEN
PLEASANT HILL
OFFRAMP
MILLO
BONNER
HOYER
RLY HEIGHTS
WEST SIDE
Critical Facilities
State Highways
Interstate Five (I-5)
Rail
Rivers/Lakes
Potential Liquification Zone
Susceptibility
high
moderate to high
moderate
low to moderate
low
very low to low
very low
Miles
0
0.25
0.5
H:Projects/Cowlitz/Haz_Mit/3_15_drafts
Wahkiakum
Cowlitz


City of Castle Rock
Critical Facilities
in relation with
Potential Flood Hazards
DRAFT
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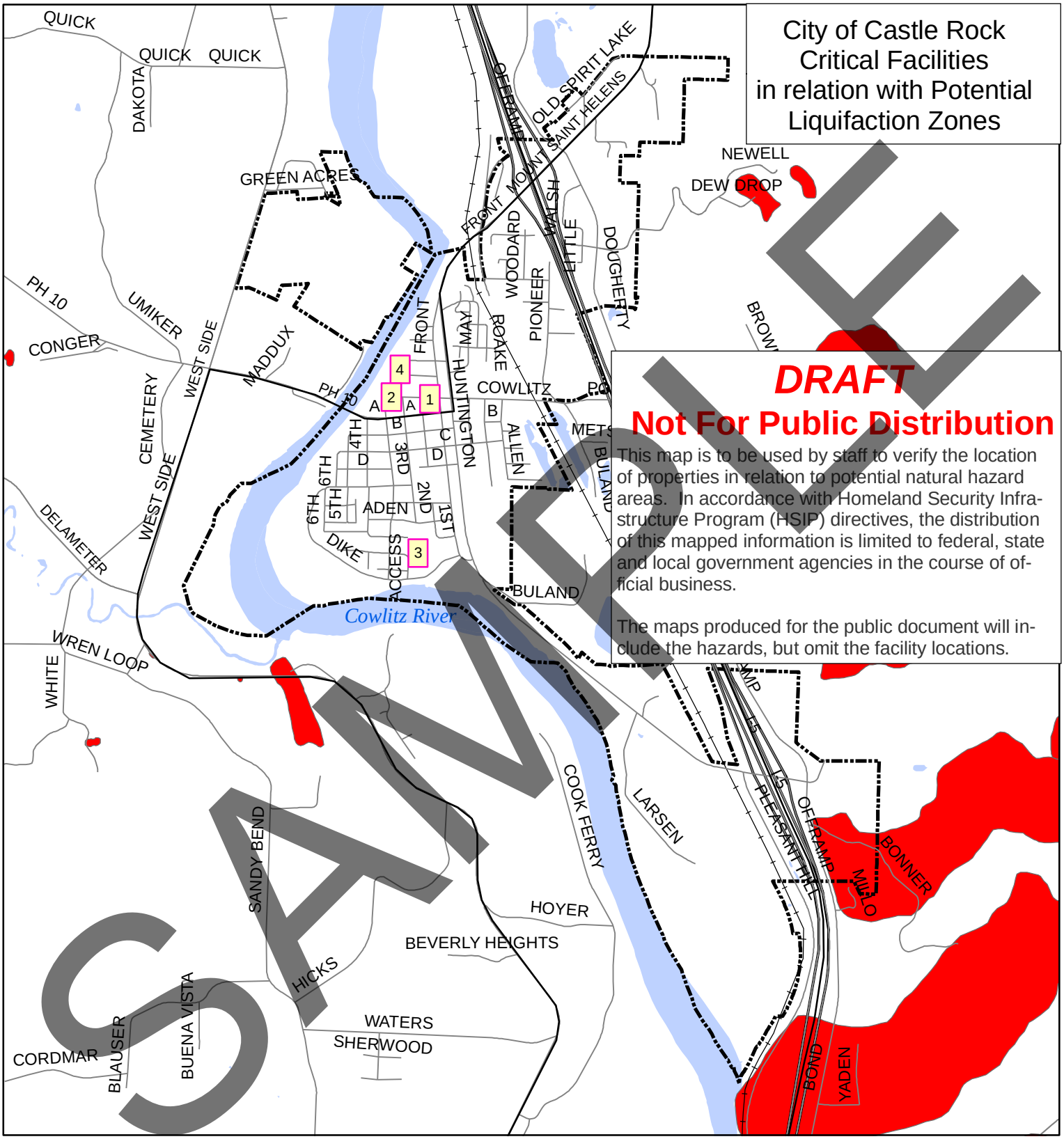
SAMPLE
Levies protect parts of the City of Castle Rock from high water events.
QUICK
DAKOTA
GREEN ACRES
OLD PACIFIC
OLD SPIRIT LAKE
SALMON CREEK
MOUNT SAINT HELENS
FRONT
WALSH
LITTLE
EATON
NEWELL
NORTH
PIONEER
DOUGHERTY
BROWNLEE
UMIKER
PH 10
WEST SIDE
MADDUX
MOSIER
SHINTAFFER
MAY
ROAKE
HUNTINGTON
COWLITZ
POWELL
ALLEN
WARREN
HIBBARD
ADEN
SHEAR
DIKE
4TH
3RD
2ND
6TH
5TH
CAMELOT
BULAND
POMEROY
COOK FERRY
LARSEN
VIEW CREST
HOYER
ONRAMP I-5
KALMBACH
PLEASANT HILL
MILLO
BONNER
BOND
Critical Facilities
State Highways
Interstate Five (I-5)
Rail
Potential Flood Zones
100 Year
500 Year
City Limits
Cowlitz County
Miles
0
0.25
0.5
H:Projects/Cowlitz/Haz_Mit/3_15_drafts
Wahkiakum
Cowlitz


City of Castle Rock
Critical Facilities
in relation with Potential
Liquifaction Zones
DRAFT
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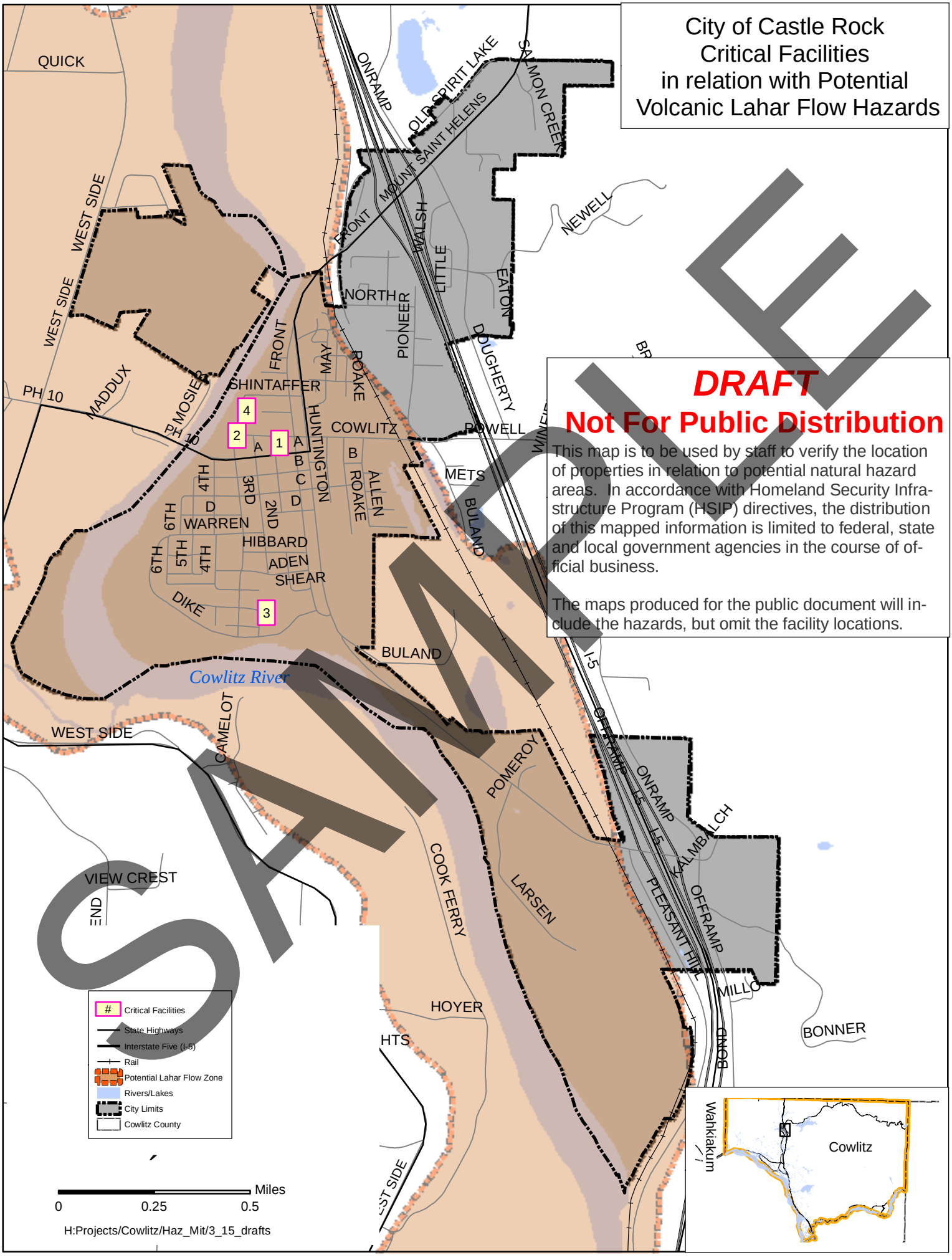
SAMPLE
QUICK
QUICK
QUICK
DAKOTA
GREEN ACRES
OLD SPIRIT LAKE
SAINT HELENS
OFFRAMP
FRONT
MOUNT
WALSH
LITTLE
WOODARD
DOUGHERTY
NEWELL
DEW DROP
PIONEER
ROAKE
MAY
FRONT
HUNTINGTON
COWLITZ
ALLEN
BULAND
PH 10
UMIKER
CONGER
WEST SIDE
MADDUX
CEMETERY
WEST SIDE
DELAMETER
4TH
3RD
2ND
1ST
5TH
6TH
ADEN
DIKE
ACCESS
4
2
A
A
1
B
B
C
D
D
3
Cowlitz River
WREN LOOP
WHITE
SANDY BEND
COOK FERRY
LARSEN
HOYER
BEVERLY HEIGHTS
HICKS
WATERS
SHERWOOD
BUENA VISTA
BLAUSER
CORDMAR
I-5
PLEASANT HILL
OFFRAMP
MUD LO
BONNER
BOND
YADEN
Critical Facilities
State Highways
Interstate Five (I-5)
Rail
Potential Landslide Hazard
Rivers/Lakes
Miles
0
0.25
0.5
H:Projects/Cowlitz/Haz_Mit/3_15_drafts
Wahkiakum
Cowlitz


City of Castle Rock
Critical Facilities
in relation with Potential
Volcanic Lahar Flow Hazards
DRAFT
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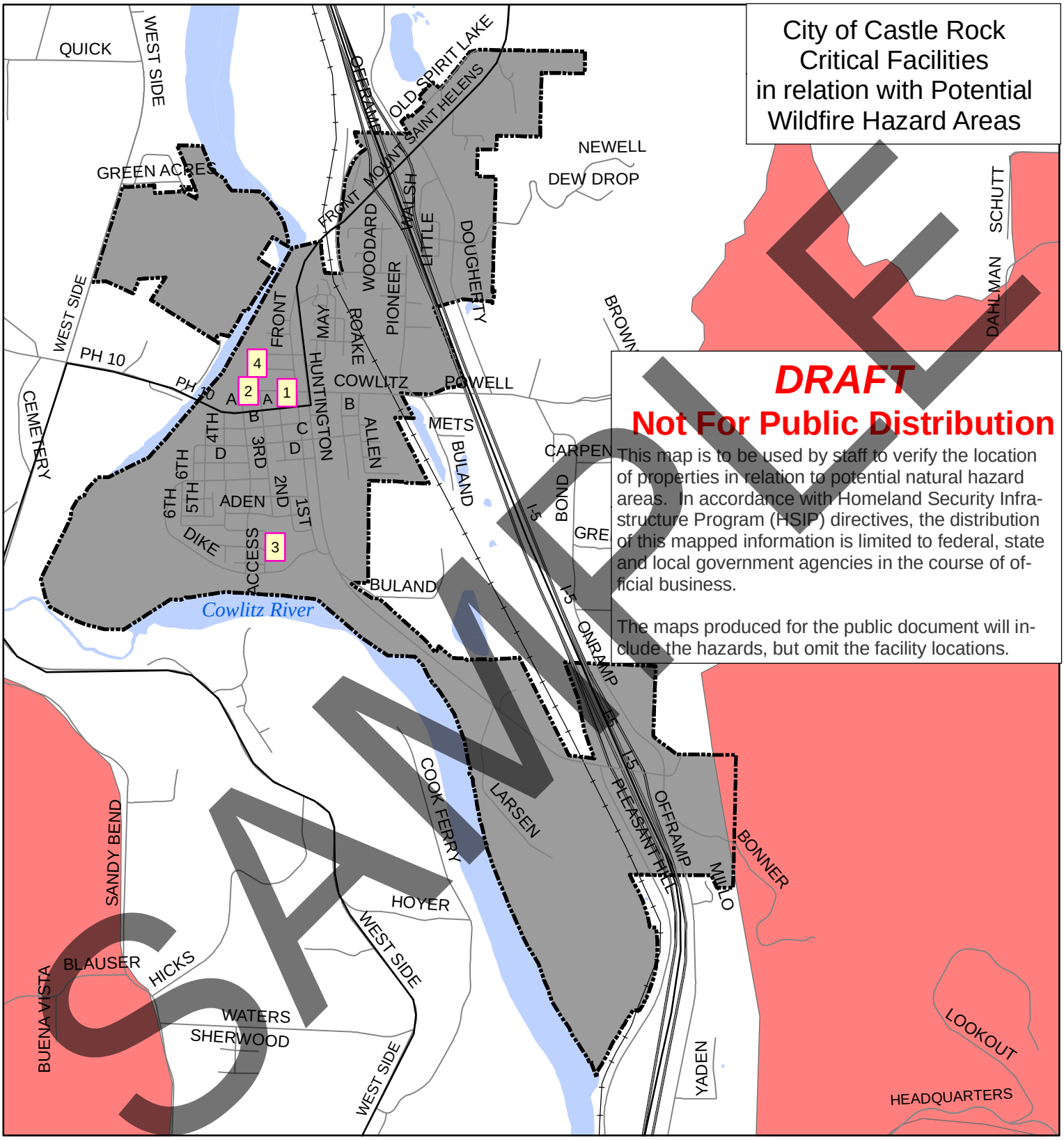
SAMPLE
QUICK
WEST SIDE
WEST SIDE
MADDUX
PH 10
PH 10
MOSIER
SHINTAFFER
FRONT
MAY
ROAKE
HUNTINGTON
COWLITZ
4
2
1
A
A
B
B
C
D
D
4TH
3RD
2ND
6TH
WARREN
HIBBARD
ADEN
SHEAR
6TH
5TH
4TH
DIKE
3
ALLEN
ROAKE
METS
BULAND
BULAND
Cowlitz River
WEST SIDE
CAMELOT
VIEW CREST
END
ONRAMP
OLD SPIRIT LAKE
SALMON CREEK
MOUNT SAINT HELENS
FRONT
WALSH
LITTLE
EATON
NEWELL
NORTH
PIONEER
DOUGHERTY
POWELL
WINER
I-5
OFFRAMP
ONRAMP
I-5
I-5
ALMBLCH
POMEROY
COOK FERRY
LARSEN
PLEASANT HILL
OFFRAMP
MILLO
BONNER
BOND
HOYER
HTS
EST SIDE
Critical Facilities
State Highways
Interstate Five (I-5)
Rail
Potential Lahar Flow Zone
Rivers/Lakes
City Limits
Cowlitz County
0
0.25
0.5
Miles
H:Projects/Cowlitz/Haz_Mit/3_15_drafts
Wahkiakum
Cowlitz


City of Castle Rock
Critical Facilities
in relation with Potential
Wildfire Hazard Areas
DRAFT
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SAMPLE
QUICK
WEST SIDE
GREEN ACRES
OLD SPIRIT LAKE
OFFRAMP
SAINT HELENS
MOUNT
FRONT
WOODARD
PIONEER
LITTLE
DOUGHERTY
NEWELL
DEW DROP
SCHUTT
DAHLMAN
BROWN
PH 10
CEMETERY
FRONT
MAY
ROAKE
HUNTINGTON
COWLITZ
POWELL
METS
BULAND
ALLEN
CARPEN
BOND
GRE
I-5
ONRAMP
ADEN
1ST
2ND
3RD
4TH
5TH
6TH
DIKE
ACCESS
BULAND
Cowlitz River
COOK FERRY
LARSEN
PLEASANT HILL
OFFRAMP
MILLO
BONNER
SANDY BEND
HOYER
WEST SIDE
BLAUSER
HICKS
BUENA VISTA
WATERS
SHERWOOD
YADEN
LOOKOUT
HEADQUARTERS
CWCOG
COWLITZ-WAHKIAKUM COUNCIL OF GOVERNMENTS
Miles
0
0.25
0.5
H:Projects/Cowlitz/Haz_Mit/CR_landslide
Critical Facilities
State Highways
Interstate Five (I-5)
Rail
firehaz_all
City Limits
Rivers/Lakes
Wahkiakum
Cowlitz

City of Longview
Critical Facilities

Label	Facility	Physical Address	Site-Specific Natural Hazards				
			Flood	Lahar	Liquidfaction	WildFire	Steep Slope
1	Bus Transit Center	1135 12th Ave	500	No	Moderate to High	No	No
2	Library	1600 Louisiana St	500	No	Moderate to High	No	No
3	City Hall	1525 Broadway St	500	No	Moderate to High	No	No
4	Fire Station #81	740 Commerce Ave	500	No	Moderate to High	No	No
5	Fire Station #82	2355 38th Ave	500	No	Moderate to High	No	No
6	Mint Valley Golf Course Maintenance Shop	4002 Pennsylvania St	500	No	Moderate to High	No	No
7	Parks & Recreation Office/Shop	706 30th Ave	500	No	Moderate to High	No	No
8	Police Station	1351 Hudson St	500	No	Moderate to High	No	No
9	Senior Center	1109 Commerce Ave	500	No	Moderate to High	No	No
10	Sewer Lift Station	1275 Alabama St	500	No	Moderate to High	No	No
11	Street Department Maintenance Shop	254 Oregon Way	500	No	Moderate to High	No	No
12	Water Treatment Plant	101 Fishers Lane	500	No	Moderate to High	No	No
13	Water Sewer Shop/Pump Station	1460 Industrial Way	500	No	Moderate to High	No	No

The purpose of this list is for site verification only. This list should not be disseminated to the public, per Department of Homeland Security Guidelines.
DRAFT - 3/19/2010

2013 Update

Hello,

The Cowlitz County Department of Emergency Management (Cowlitz DEM) recently received good news from FEMA that the multijurisdictional Natural Hazard Mitigation Plan Update submitted in Fall 2012 is substantially complete and there are only a few steps necessary to finish the plan and remain eligible to compete for funds offered under FEMA's Unified Hazard Mitigation Assistance Grant Programs. The bad news is we have only until **June 26** to submit a revised document.

To help meet that short deadline, Cowlitz DEM and COG staff have prepared a questionnaire that asks for the information needed by FEMA. Basically, FEMA wants to see that the action items identified in this effort can apply to other planning efforts.

Additionally, FEMA considers the plan incomplete because the action items do not meet the criteria of the grant program, which is to identify projects that can be completed prior to a disaster event that will minimize potential damage to persons or property. Response or recovery-related action items are not acceptable.

We suggest reviewing your adopted plans and select capital projects that relate to the natural hazards (flood, winter storm, earthquake, landslide and wildfire). A minimum of two qualifying projects are required. Please let us know if you need assistance identifying an appropriate project.

We ask that you complete the attached questionnaire, save and return it as quickly as possible.

Matt Hermen, Planner
CWCOG
mhermen@cwcog.org
(360) 577-3041 X12594

TJ Keiran, Planner
CWCOG
tkeiran@cwcog.org
(360) 577-3041 X 12585

Ernie Schnabler, CEM, MEP
Director, Cowlitz County
Emergency Management
Phone (360) 577-3130
schnablere@co.cowlitz.wa.us

Sample Questionnaire
June2013

FEMA Guidance:
The plan must describe each participating jurisdiction's individual process for integrating hazard mitigation actions applicable to their community into other planning mechanisms. This can be done by explaining how specific actions will be incorporated into existing mechanisms or can identify existing mechanisms and a process to integrate the hazard mitigation plan into those mechanisms.

Diking Improvement District #1 Return by June 20, 2013 Please

Please review the initiative stated in the 2nd column, and list any other adopted plans where the initiative is included or may be included in the future

Initiative #	Mitigation Initiative	Name of Plan(s)	Initiative Included in Plan?	Hazard(s) Mitigated	Estimated Cost	Sources of Funding
1	Permanent Generator	Budget and/or Emergency Response Pl	No - Will Consider in	Flooding, Volcano Activity, Lightning	$350,000	Federal or State Grants
2	Replace Red Path Pump Station	Budget and/or Emergency Response Pl	No - Will Consider in	Flooding, Volcano Activity, Lightning	$2,000,000	Federal or State Grants
3	Install Staff Gauge at North Tunnel Entrance	Budget and/or Emergency Response Pl	No - Will Consider in	Flooding, Volcano Activity, Lightning	$ 10,000	Federal or State Grants

Plan Name	Adoption Date (Past Date)	Scheduled Plan Update (Future Date)	Is there an opportunity to apply Hazard Mitigation Plan action into this plan? (Yes/No)
Example: Emergency Response Plan	January 2010	Summer 2015	Yes
Budget	September 2012	Adopted Annually	Yes
Emergency Response Plan	September 1998	Updated March 2012	Yes