RESOLUTION NO. 14-20

A RESOLUTION OF THE SCAPPOOSE CITY COUNCIL ADOPTING THE UPDATED COLUMBIA COUNTY MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN FOR THE CITY OF SCAPPOOSE

WHEREAS, the Federal Emergency Management Agency (FEMA) requires municipalities to adopt Hazard Mitigation Plans in order to be eligible for FEMA funding in the event of future disasters; and

WHEREAS, the City of Scappoose adopted a Hazard Mitigation Plan through Resolution No. 14-15; and

WHEREAS, the City of Scappoose, Columbia County, and other county municipalities have since updated the Hazard Mitigation Plan; and

WHEREAS, FEMA has approved the final draft of the Columbia County Multi-Jurisdictional Hazard Mitigation Plan; and

WHEREAS, the Columbia County Multi-Jurisdictional Hazard Mitigation Plan for the City of Scappoose, and attached hereto as Appendix G, has been reviewed by residents, business owners, and federal, state, and local agencies and has been revised to reflect their concerns.

NOW, THEREFORE, THE CITY OF SCAPPOOSE COUNCIL RESOLVES AS FOLLOWS:

Section 1: The Columbia County Multi-Jurisdictional Hazard Mitigation Plan for the City of Scappoose, and attached hereto as Appendix G, is hereby adopted as an official plan of the City of Scappoose.

Section 2: Resolution No. 14-15 is hereby rescinded and replaced.

PASSED AND ADOPTED by the City Council of Scappoose and signed by me, and the City Recorder in authentication of its passage this 15th day of September, 2014.

CITY OF SCAPPOOSE, OREGON

Scott Burge

Scott Burge, Mayor

Attest:

Susan M. Reeves

Susan M. Reeves, MMC, City Recorder

2014

Columbia County

Multi-Jurisdiction Hazard Mitigation Plan

Including the Cities:

Clatskanie

Columbia City

Prescott

Rainier

St. Helens

Scappoose

Vernonia

Columbia County Department of Emergency Management

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List of Acronyms and Abbreviations

ALF	Animal Liberation Front
BPA	Bonneville Power Administration
CCEM	Columbia County Emergency Management
CCEPA	Columbia County Emergency Planning Association
CDBG	Community Development Block Grant
CDC	United States Center for Disease Control
CEPA	Citizen's Emergency Preparedness Association
CFR	Code of Federal Regulations
CR2K	State Fire Marshall's Community Right to Know
CRS	Community Rating System
DHS	United States Department of Homeland Security
DMA 2000	Disaster Mitigation Act of 2000
DOGAMI	Oregon Department of Geology and Mineral Industries
DOT	U.S. Department of Transportation
EHS	Extremely Hazardous Substance
EIR	Environmental Impact Report
ELF	Earth Liberation Front
ENSO	El Niño/Southern Oscillation
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right to Know Act of 1986
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FMA	Flood Mitigation Assistance
FY	Fiscal Year
GIS	Geographic Information System
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
HS	Hazardous Substance
HSIS	Hazardous Substance Information System
MHMP	Multi-Jurisdictional Hazard Mitigation Plan
MM	Modified Mercalli
mph	Miles per Hour
NID	National Inventory of Dams
NFIA	National Flood Insurance Act
NFIP	National Flood Insurance Program

List of Acronyms and Abbreviations (continued)

NFPA	National Fire Protection Association
NGO	Nongovernmental Organizations
NGVD	National Geodetic Vertical Datum
ODF	Oregon Department of Forestry
ODOT	Oregon Department of Transportation
OSFM	Oregon State Fire Marshall
PDM	Pre-Disaster Mitigation
PGA	Peak Ground Acceleration
RFC	Repetitive Flood Claims
RL	Repetitive Loss
SFHA	Special Flood Hazard Area
SRL	Severe Repetitive Loss
Stafford Act	Robert T. Stafford Disaster Relief and Emergency Assistance Act
STAPLEE	Social, Technical, Administrative, Political, Legal, Economic, and Environmental
USC	United States Code
US Census	United States Census Bureau
USGS	United States Geological Survey
WUI	Wildland-Urban Interface

1. INTRODUCTION

This section provides a brief introduction to hazard mitigation planning, local mitigation plan requirements, the grants associated with these requirements, and a description of this Multi-Jurisdictional Hazard Mitigation Plan (MHMP).

1.1 HAZARD MITIGATION PLANNING

Hazard mitigation, as defined in Title 44 of the Code of Federal Regulations (CFR), Part 201.2, is "any action taken to reduce or eliminate the long-term risk to human life and property from natural hazards." Many areas have expanded this definition to include human-caused hazards. As such, hazard mitigation is any work done to minimize the impacts of any type of hazard event before it occurs. It aims to reduce losses from future disasters. Hazard mitigation is a process in which hazards are identified and profiled, people and facilities at risk are analyzed, and mitigation actions are developed. The implementation of the mitigation actions, which include long-term strategies that may include planning, policy changes, programs, projects, and other activities, is the result of this process.

1.2 PLANNING REQUIREMENTS

1.2.1 Local Mitigation Plans

Local hazard mitigation planning is driven by a Federal law. On October 30, 2000, Congress passed the Disaster Mitigation Act of 2000 (DMA 2000) (P.L. 106-390) which amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) (Title 42 of the United States Code [USC] 5121 et seq.) by repealing the act's previous mitigation planning section (409) and replacing it with a new mitigation planning section (322). This new section emphasized the need for State, Tribal, and local entities to closely coordinate mitigation planning and implementation efforts. In addition, it provided the legal basis for the Federal Emergency Management Agency's (FEMA) mitigation plan requirements for mitigation grant assistance.

To implement these planning requirements, FEMA published an Interim Final Rule in the *Federal Register* on February 26, 2002 (FEMA 2002a), 44 CFR Part 201 with subsequent updates. The planning requirements for local entities are described in detail in Section 2 and are identified in their appropriate sections throughout this MHMP.

FEMA's October 31, 2007 changes to 44 CFR Part 201 combined and expanded flood mitigation planning requirements with local mitigation plans (44 CFR §201.6). All hazard mitigation assistance program planning requirements for HMGP, PDM, FMA, SRL and potentially RFC programs were combined eliminating duplicated mitigation plan requirements. It also required participating NFIP communities' risk assessments and mitigation strategies to identify and address repetitively flood-damaged properties.

Under the new 2008 44 CFR update, requirements have changed governing mitigation planning requirements for local mitigation plans published under 44 CFR §201.6. Local mitigation plans now qualify communities for the following federal mitigation grant programs:

Disaster Funded Grants:
- *Hazard Mitigation Grant Program (HMGP)*

Hazard Mitigation Assistance Grants:
- *Pre-Disaster Mitigation (PDM)*
- *Flood Mitigation Assistance (FMA)*

1.3 GRANT PROGRAMS REQUIRING HAZARD MITIGATION PLANS

All five FEMA grant programs provide funding to States, Tribes, and local entities that have a FEMA-approved State or Local Mitigation Plan. Two of the grants are authorized under the Stafford Act and DMA 2000, while the remaining three are authorized under the National Flood Insurance Act and the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act. As of June 19, 2008, the grant programs were segregated. The HMGP is a state competitive grant program, which is directly disaster funded. Whereas the other programs: PDM, and FMA, although competitive, rely on specific pre-disaster grant funding sources, sharing several common elements.

1.3.1 Disaster Funded Mitigation Assistance

Hazard Mitigation Grant Program: is authorized by Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended (the Stafford Act), Title 42, United States Code (U.S.C.) 5170c. The key purpose of HMGP is to ensure that the opportunity to take critical mitigation measures to reduce the risk of loss of life and property from future disasters is not lost during the reconstruction process following a disaster. HMGP is available, when authorized under a Presidential major disaster declaration, in the areas of the State requested by the Governor. The amount of HMGP funding available to the Applicant is based upon the estimated total Federal assistance to be provided by FEMA for disaster recovery under the Presidential major disaster declaration.

1.3.2 Hazard Mitigation Assistance Programs

Pre-Disaster Mitigation Program: program is authorized by Section 203 of the Stafford Act, 42 U.S.C. 5133. The PDM program is designed to assist States, Territories, Indian Tribal governments, and local communities to implement a sustained pre-disaster natural hazard mitigation program to reduce overall risk to the population and structures from future hazard events, while also reducing reliance on Federal funding from future disasters.

Flood Mitigation Assistance Grant Program: is authorized by Section 1366 of the National Flood Insurance Act of 1968, as amended (NFIA), 42 U.S.C. 4104c, with the goal of reducing or eliminating claims under the National Flood Insurance Program (NFIP). Particular emphasis for this program is placed on mitigating repetitive loss (RL) properties *(Repetitive loss properties: A*

property for which two or more NFIP losses of at least $1,000 each have been paid within any 10 year period since 1978). The primary source of funding for this program is the National Flood Insurance Fund. Grant funding is available for three types of grants, including Planning, Project, and Technical Assistance. Project grants, which use the majority of the program's total funding, are awarded to States, Tribes, and local entities to apply mitigation measures to reduce flood losses to properties insured under the NFIP.

1.4 MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN DESCRIPTION

The remainder of this MHMP consists of the following sections and appendices:

Prerequisites - This section addresses the prerequisites of plan adoption, which include adoption by the governing body of each participating jurisdiction, including Columbia County and the cities of Clatskanie, Columbia City, Prescott, Rainier, St. Helens, Scappoose, and Vernonia. Adoption resolutions for each jurisdiction are included in Appendix K.

Community Description - This section provides a general history and background of the communities and unincorporated areas of Columbia County, including historical trends for population and the demographic and economic conditions that have shaped the area.

Planning Process - This section describes the planning process and identifies the Steering Committee members, the meetings held as part of the planning process, and the key stakeholders within the county and surrounding region. In addition, this section documents public outreach activities and the review and incorporation of relevant plans, reports, and other appropriate information.

Hazard Analysis - This section describes the process through which the Steering Committees identified, screened, and selected the 16 hazards to be profiled in this version of the MHMP. The hazard analysis includes the nature, history, location, extent, and probability of future events for each hazard. In addition, historical and location hazard figures are included in Appendix I.

Vulnerability Analysis - This section identifies potentially vulnerable assets—people, residential and nonresidential buildings dwelling units, RL properties, critical facilities, and critical infrastructure—in the incorporated cities and unincorporated areas of the county. These data were compiled by assessing the potential impacts from each hazard using Geographic Information System (GIS) and community provided information. The resulting information identifies the full range of hazards that the incorporated cities and unincorporated areas of the county could face and potential impacts, damages, and (where data was available) economic losses.

Mitigation Strategy - The mitigation strategy provides a plan for reducing the potential losses identified in the vulnerability analysis. The Steering Committees developed a list of mitigation goals and potential actions to address the risks facing Columbia County and the seven incorporated communities. All hazard mitigation actions and strategies include NFIP compliance, preventive actions, property protection techniques, natural resource protection strategies, structural projects, emergency services, and public information and awareness activities. The Steering Committees selected relevant mitigation actions and strategies to implement countywide.

References - This section lists the reference materials used to prepare this MHMP.

Appendices - Appendices A through H provide the vulnerability analyses and mitigation strategies, including the capability assessments, for Columbia County and the cities of St. Helens, Columbia City, Scappoose, Clatskanie, Rainier, Prescott, and Vernonia. Appendix I includes figures and maps for hazards in the county and local jurisdictions. Appendix J provides a copy of the Annual Review Worksheet that will be used by the County and Local steering committees to report on annual reviews of the plan. Appendix K provides copies of the resolutions of formal adoption of the plan by the county and the local jurisdictions.

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2. PREREQUISITES

2.1 ADOPTION BY LOCAL GOVERNING BODIES AND SUPPORTING DOCUMENTATION

The requirements for the adoption of this MHMP by the participating local governing bodies, as stipulated in the DMA 2000 and its implementing regulations, are described below.

DMA 2000 REQUIREMENTS: PREREQUISITES

Multi-Jurisdictional Plan Adoption

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

Element

- Does the new or updated plan indicate the specific jurisdictions represented in the plan?
- For each jurisdiction, has the local governing body adopted the new or updated plan?
- Is supporting documentation, such as a resolution, included for each participating jurisdiction?

Source: FEMA, July 2008.

Columbia County and the cities of Clatskanie, Columbia City, Prescott, Rainier, St. Helens, Scappoose, and Vernonia are the jurisdictions represented in this MHMP and meet the requirements of Section 322 of the Stafford Act.

The local governing body of Columbia County and the cities of Clatskanie, Columbia City, Prescott, Rainier, St. Helens, Scappoose, and Vernonia will adopt the MHMP by resolution upon completion of FEMA and OEM review process. A scanned copy of each resolution will be attached to the plan at that time.

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3. COMMUNITY DESCRIPTION

This section describes the location, geography, and history; demographics; and land use development trends of Columbia County and the cities of Clatskanie, Columbia City, Prescott, Rainier, St. Helens, Scappoose, and Vernonia.

3.1 LOCATION, GEOGRAPHY, AND HISTORY

Columbia County, named for the Columbia River, was created in 1854 from the northern half of Washington County. As shown in Figure I-1, it encompasses 687 square miles and is bounded on the north and east by 62 miles of the Columbia River. It is bordered on the west by Clatsop County and on the south by Washington and Multnomah Counties. Columbia County is Oregon's third smallest county and the sixteenth county to be formed.

Columbia County lies within the marine west coast climate zone. Summers are warm and dry with clear skies, with July averaging 68.4° Fahrenheit (F). Winters can be mild to chilly, and very moist, with January averaging 39°F. The rainfall averages 44.6 inches per year. Columbia County averages 155 days of measurable precipitation a year. Snow occurs infrequently delivering trace amounts however, the County can experience major snow and ice storms as cold air patterns flow from the Columbia River Gorge. The county's winter snowfall totals range from negligible to 60.9 inches in the early 1890s. The County's lowest temperature was −3°F on February 2, 1950; the highest temperature reached 107°F on July 29, 1965, August 8, 1981, and August 10, 1981.

The Lewis and Clark expedition traveled through Columbia County on its way to the Pacific Ocean. Early fur traders settled the County in 1810. Many settlers came to the heavily forested region as immigrants seeking adventure and lush farmland. Other inhabitants left Washington State because of ongoing Indian wars. These emigrants sought safer locations on the other side of the Columbia River arriving in what is now St. Helens and Columbia City.

The primary industries of private sector employment within Columbia County are manufacturing, retail trade, and private educational and health services. The county was covered by old growth timber, which was completely logged over by the 1950s. Second growth timber provides the raw material for local lumber and paper mills.

3.2 DEMOGRAPHICS

3.2.1 Columbia County

According to the 2010 Census report, conducted by the United States Census Bureau, (U.S. Census) Columbia County's population was 49,351. The Portland State University (PSU) Population Research Center has estimated the 2013 population of Columbia County at 49,850. From 2000 to 2013, the percentage of the county's population age 17 and under has decreased from 27.3 percent to 22.6 percent while the percentage of those 65 and over has grown from 11.6 percent to 15.8 percent. The County's labor force (civilian population age 16 and over) has grown from 22,478 in 2000 to 23,792 in 2013, an increase of 5.8 percent. The median

household income is $52,739 and the median family income is $61,861 according to the U.S. Census Bureau's 2010-2012 estimate. According to the U.S. Census Bureau American Community Survey 2008-2012 estimates 15.8 percent of the residents in Columbia County are living below the poverty level, compared to 15.7 percent nationwide. The County's per capita income is $25,617 while the U.S. per capita income is $27,385. At the end of 2012, Columbia County employment was 9,745 with an average weekly wage of $652 (U.S. National weekly average being $1000).

3.2.2 City of Clatskanie

The City of Clatskanie is located along U.S. Highway 30 in Columbia County between Rainier and Astoria, approximately 62 miles northwest of Portland, Oregon, and 53 miles northwest of Vancouver, Washington within the northern portion of Columbia County. Their population in 2000 was 1,528. Per the U.S. Census Bureau, the population was 1,788. According to this survey, 9.3 percent of the population is under 5 years of age, 19.5 percent are between the ages of 5 and 19 years, 51 percent are 20 and 64 years, and 20.1 percent of the population is 65 years or older. Per the U.S. Census in 2010 24.8 percent of the population was under the age of 18, 59 percent were between the ages of 17 and 64 years, and 16.1 percent of the population was 65 years or older. Of the City of Clatskanie's 755 residents eligible for the labor force, 612 are employed with an unemployment rate of 18.9 percent. According to the U.S. Census Bureau, the 2010 median household income was $35,875 and median family income was $58,309 with a per capita income of $22,303. According to the U.S. Census, American Community Survey 2008-2012 estimates, 21.9 percent of Clatskanie residents live below the poverty level.

3.2.3 Columbia City

Columbia City is located in northwestern Oregon on the banks of the Columbia River approximately 32 miles north of the City of Portland on Highway 30 and 2 miles north of the City of St. Helens and 61 miles east of the Pacific Ocean. Their population in 2000 was 1,571. According to the U.S. Census Bureau, their population is 2,147 in 2010. Per to the 2008-2012 American Community Survey 2008-2012 estimates showed 5 percent under 5 years, 22.1 percent were 5-19 years, 55.5 percent were between the ages of 20 and 64 years, and 17.4 percent of the population was 65 years or older. Columbia City's labor force is 952 and the unemployment rate is 8.4 percent. In 2012, the median household income was $66,094 and the median family income was $70,833 per. Their per capita income was $ 25,415 according to the US Census Bureau American Community Survey 2008-2012. In that same timeframe, 7.7 percent of Columbia City's families were living below the poverty level.

3.2.4 City of Prescott

The City of Prescott is located 4 miles from the City of Rainier and 41 miles from Portland. Their population in 2000 was 72. According to the U.S. Census Bureau American Community Survey 2008-2012 estimates a population of 34. Almost three percent of the population is under 5 years of age, 0 percent are 5 to 19 years, 61.8 percent are between the ages of 20 and 64 years, and 35 percent of the population is 65 years or older. The City of Prescott's labor force (16 years and over) is 6 with an unemployment rate of 33.3 percent. The U.S. Census Bureau American Community Survey 2008-2012 estimates the median household income was $23, 750 and the median family income was $43,250. Current per capita income data was unavailable. From the American Community Survey, 14.7 percent were living below the poverty level.

3.2.5 City of Rainier

The City of Rainier is located in northwest Oregon on the Columbia River across the Lewis & Clark Bridge from Longview, Washington. Their population in 2000 was 1,687. The U.S. Census Bureau estimated the 2012 population was 1,807. According to the U.S. Census Bureau American Community Survey 2008-2012, 4.5 percent of the population is under 5 years of age, 17.5 percent are between the ages of 5 and 19 years, 63.5 percent are 20-64 years, and 14.5 percent of the population is 65 years or older. Per the 2008-2-12 American Community Survey estimates, 4.5 percent were under the age of 5, 17.5 percent were between the ages of 5 and 19, 63.5 percent were between the ages of 20 and 64 years, and 14.5 percent of the population was 65 years or older. The City of Rainier's labor force (16 years and over) was 960 with an unemployment rate of 9.7 percent. The current median household income was $58,667 and the median family income was $67,083. The City of Rainier's per capita income was $30,676 and 12.8 percent were living below the poverty level.

3.2.6 City of St. Helens

The City of St Helens is located in southeastern Columbia County, on the Columbia River, approximately 30 miles northwest of Portland, Oregon. Their population in 2000 was 10,019. The American Community Survey 2008-2012 estimated the population was 12,807. According to the same data, 6.1 percent of the population is under 5 years of age, 23 percent are between the ages of 5 and 19 years, 62.8 percent are between 20 and 64 years, and 8 percent of the population is 65 years or older. St. Helens' labor force is 6,742 and their unemployment rate is 17.8 percent. The 2008-2012 estimated median household income was $53,151 and the median family income was $60,722. St Helens' per capita income during the same period was $21,791. The American Community Survey of 2008-2012 showed 18.1 percent of individuals were living below the poverty level.

3.2.7 City of Scappoose

The City of Scappoose lies between the Columbia River and mountainous hillsides, approximately 20 miles North of Portland on State Highway 30. Their population in 2000 was 4,979. The U.S. Census Bureau estimated a population of 6,658 between 2008-2012. According to the American Community Survey 2008-2012, 5.1 percent of the population is under 5 years of age, 23 percent are 5 to 19 years, 57 percent are between the ages of 20 and 64

years, and 14.9 percent of the population is 65 years or older. The City of Scappoose has a labor force of 1,050 with an unemployment rate of 8.2 percent. According to the U.S. Census Bureau American Community Survey 2008-2012 estimated the median household income as $58,004 and the median family income was $71,169. The City of Scappoose's per capita income in that survey was $29,592. Almost 15 percent were living below the poverty level.

3.2.8 City of Vernonia

The City of Vernonia is located in northwest Oregon, located 45 miles from the City of Portland. Their population in 2000 was 2,228. The U.S. Census Bureau American Community Survey 2008-2012 estimated a population of 2,150. During that same time, 9.1 percent of the population were under 5 years of age, 15.1 percent were between 5 and 19 years, 62.1 percent were between the ages of 20 and 64, and 13.6 percent of the population was 65 years or older. The City of Vernonia's eligible labor force (civilian population age 16 and over) was 1,050 with an unemployment rate of 8.2 percent. Using the same data as above, the median household income was $55,150 and the median family income was $59,044. The City of Vernonia's estimated per capita income between 2008-2012 was $25,465. The American Community Survey 2008-2012 estimated 5.6 percent of individuals were living below the poverty level.

3.3 DEVELOPMENT

Since the 2008 nationwide financial crisis, development of residential areas of Columbia County and its incorporated cities has been slowly recovering. However, construction levels have not yet returned to their former pace. The result is that relatively little residential development has occurred in the county since the 2009 plan. In this regard, this updated plan has only made minor changes in its hazard and vulnerability assessments regarding new residential development.

The same is not true for industrial developments in the County. While new physical infrastructure construction (factories, refineries, etc.) has been flat, the commodity flow into these areas has increased. In addition, in March of 2014 the Columbia County Board of County Commissioners approved the rezoning of 737 acres adjacent to the Port Westward industrial park. This ordinance re-zoned the area as Rural Industrial Planned Development, though no new construction has been carried out on the area. Despite this the area remains a focus of mitigation planning for the county and the adjacent local jurisdiction.

4. PLANNING PROCESS

This section provides an overview of the planning process; identifies the Steering Committee members and key stakeholders; documents public outreach efforts; and summarizes the review and incorporation of existing plans, studies, and reports used to develop this MHMP. Additional information regarding the Steering Committees and public outreach efforts are provided in community-specific appendices B – H.

The requirements for the planning process, as stipulated in DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Planning Process

Multi-Jurisdictional Planning Participation

Requirement §201.6(a)(3): Multi-jurisdictional plans (e.g., watershed plans) may be accepted, as appropriate, as long as each jurisdiction has participated in the process … Statewide plans will not be accepted as multi-jurisdictional plans.

Element

- Does the new or updated plan describe how each jurisdiction participated in the plan's development?
- Does the updated plan identify all participating jurisdictions, including new, continuing, and the jurisdictions that no longer participate in the plan?

Planning Process

Requirement §201.6(b): An open public involvement process is essential to the development of an effective plan.

Documentation of the Planning Process

Requirement §201.6(b): In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:

Element

- An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;
- 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 nonprofit interests to be involved in the planning process; and
- Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

Requirement §201.6(c)(1): [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.

Element

- Does the plan provide a narrative description of the process followed to prepare the new or updated plan?
- Does the new or updated plan indicate who was involved in the planning process? (For example, who led the development at the staff level and were there any external contributors such as contractors? Who participated on the plan committee, provided information, reviewed drafts, etc.?)
- Does the new or updated plan indicate how the public was involved? (Was the public provided an opportunity to comment on the plan during the drafting stage and prior to the plan approval?)
- Does the new or updated plan discuss the opportunity for neighboring communities, agencies, businesses, academia, nonprofits, and other interested parties to be involved in the planning process?
- Does the planning process describe the review and incorporation, if appropriate, of existing plans, studies, reports, and technical information?
- Does the updated plan document how the planning team reviewed and analyzed each section of the plan and whether each section was revised as part of the update process?

Source: FEMA, July 2008.

4.1 OVERVIEW OF PLANNING PROCESS

4.1.1 Initial Planning Processes, 1998-2005

In 1997 Columbia County was the first county in Oregon to begin the development of a complete (in 1998) a Hazard Mitigation plan – anticipating the requirement of the Disaster Mitigation Act of 2000 by two years.

In 2005, the Columbia County Director of Emergency Management, under direction from the County Commissioners, expanded the original Steering Committee to include, not only County agencies, but also city agencies, public safety agencies, private organizations, and businesses broadening countywide citizen involvement. The newly expanded Steering Committee collaboratively worked to evaluate and update the 1998 Natural Hazards Mitigation Plan to fulfill newly developed DMA 2000 requirements ultimately adopting it as the 2005 Natural Hazards Mitigation Plan (2005 HMP).

The 2005 HMP Steering Committee consisted of a county level commissioner, emergency management, road department, land development staff, city public works, police, fire and rescue, 911 communications staff, State forestry, fire district personnel and a consultant.

The 2005 HMP formed the basis for the County's All Hazard Mitigation Planning focus -- identifying five far-reaching planning goals with supporting objectives, and corresponding action items. This process refined goal achievement with a matrix to delineate coordinating and partner organizations, timelines, and lists the specific planning goals addressed by each action item.

The plan proceeded to explain Oregon and Columbia County planning initiatives and legislatively mandated land-use policy and supporting initiatives, the development methodology and research process along with a detailed explanation of each chosen hazard potentially threatening the county. Various natural processes were defined for each community and participating jurisdiction along with demographic information to form the basis for a risk assessment. However, only the flood hazard had a well defined critical facility risk assessment and vulnerability analysis. The remaining hazards did not possess a thorough assessment due to limited available information, resources, and funding.

The plan listed several mitigation actions to reduce or prevent damage and losses from natural hazards. However, limited resources prevented developing specific actions or assigning responsible entities to undertake project development and completion.

4.1.2 2009 Plan Update

The 2009 Columbia County Multi-Jurisdictional Hazard Mitigation Plan update was intended to: include newly identified hazards affecting individual jurisdictions; provide a comprehensive risk assessment and vulnerability analysis; provide community based mitigation actions; identify funding sources; and include all incorporated jurisdictions within the county as part of the update.

FEMA provided technical assistance to facilitate developing this MHMP. This includes updating the portions of the existing plan for the unincorporated areas within the County as well as including the incorporated cities (the Cities of Clatskanie, Columbia City, Prescott, Rainier,

Scappoose, and Vernonia). The City of Vernonia's portion of this plan also addresses update requirements as part of bringing all of the cities under one multi-jurisdictional plan.

The following six-step planning process formed the basis for this planning effort.

- **Organize Resources:** Each Steering Committee identified resources, including county staff, city departments and agencies, and local nongovernmental organization (NGOs), which could provide the technical expertise and historical information needed to update the MHMP.
- **Profile Hazards:** Each Steering Committee identified the hazards specific to Columbia County and the cities of Clatskanie, Columbia City, Prescott, Rainier, St. Helens, Scappoose, and Vernonia. A hazard analysis was developed for these 16 hazards.
- **Assess Risks:** A vulnerability analysis was developed for the county and each of the incorporated communities. The county and incorporated communities used the vulnerability analysis results during the mitigation strategy development.
- **Assess Capabilities:** Each Steering Committee reviewed the current administrative and technical, legal and regulatory, and fiscal capabilities to determine whether existing provisions and requirements adequately addressed relevant hazards in each respective jurisdiction.
- **Develop Mitigation Strategy:** Each Steering Committee developed a comprehensive range of potential mitigation goals and actions. Subsequently, Columbia County and the incorporated communities identified, evaluated, and prioritized the actions to be implemented in the county- and city-specific Mitigation Action Plans (Appendices A-H).
- **Monitor Progress:** Each Steering Committee developed an implementation process to ensure the success of an ongoing program to minimize hazard impacts to Columbia County and the incorporated communities.

The 2009 planning effort was a comprehensive and technical substitution of the county's previous HMP. The plan has served successfully to guide previous and ongoing mitigation efforts in the county, and will to provide the basis for subsequent hazard mitigation planning efforts in the future.

4.1.3 2014 Hazard Mitigation Plan Update

Unlike the 2009 effort this update did not rely on the services of an outside contractor – the entire effort was conducted 'in house'. This decision was made based on the quality of the product that the county adopted in 2009. Resultantly, while that plan forms the template for this 2014 effort, significant changes have been made throughout the basic plan and the county and jurisdictional appendices.

The 2014 plan update process is narrated in the following divisions of this section.

4.2 HAZARD MITIGATION STEERING COMMITTEES

4.2.1 Formation of the Committees

This plan update process began in November of 2013 with the creation of the first pre-plan, used to develop timeline and build the planning committees. From this pre-plan three committee types were formed:

1. Basic Plan Steering committee
2. County Appendix Steering committee
3. Jurisdictional Appendix Steering Committees

The first committee to form and begin its work was the Basic Plan committee. This committee formed in order to review, and revise where appropriate, the basic methodology of the plan. When this step had been taken, the additional annex steering committees were formed to conduct the reviews of the county and local jurisdictions plans. Each Committee was formed using staff from relevant local departments, agencies, and NGOs. The Steering Committee members represent community members within Columbia County and each of the county's seven incorporated cities. Table 4-1 Lists the names and Departments of the members of the Basic Plan and County Appendix Steering Committees. The names of the update committee members for the various jurisdictions appear in the jurisdictional appendices. Meetings held throughout the planning process are described below.

Table 4-1. Steering Committees

Name	Agency/Department
Columbia County Basic Plan Committee	
Bill DeJager (Chair)	City of Vernonia
Renate Garrison	Columbia County Emergency Management
Vincent Aarts (Update Coordinator)	Columbia County Emergency Management
Diane Pohl	City of Clatskanie
Anne Parrott	The Public Health Foundation of Columbia County
Lonny Welter	Columbia County Road Department
Columbia County Annex	
Renate Garrison	Columbia County Emergency Management
Vincent Aarts (Update Coordinator)	Columbia County Emergency Management
Lonny Welter	Columbia County Road Department
Todd Dugdale	Columbia County Land Development Services
Todd Cunnignham	Columbia County Land Development Services, Facilities Management
Glen Higgins	Columbia County Land Development Services, Floodplain Manager
Sue Martin	Columbia County Assessor's office
Robin Gallo	Columbia County Assessor's office, GIS

City of Clatskanie	
Diane Pohl (Steering Committee Leader)	Mayor
Ray Pohl	Emergency Committee/Planning Commissioner
Ray DiPasquale	Public Works Director
Marvin Hoover	Police Chief
Renate Garrison	Columbia County Emergency Management
Columbia City	
Leahnette Rivers (Steering Committee Leader)	City Administrator/Recorder
Kelly Niles	Oregon Department of Forestry
Ron Youngberg	Columbia River Fire and Rescue
Lisa Smith	City Planner
Mike Reedy	Chief of Police
Jeff Anderson	Public Works Superintendent
Vincent Aarts (Update Coordinator)	Columbia County Emergency Management
City of Prescott	
Lynette Oswald (Steering Committee Leader)	Mayor
Frank Oliver	Prescott City Council
Bob Ashline	Prescott City Council
Virginia Straka	Prescott City Council
Starr Sanders	City/Finance/Director/Treasurer
James Larson	Prescott City Council/Public Works/
Coy Oliver	Prescott City Recorder
Kevin Miller	Prescott City Treasurer
City of Rainier	
Debra Dudley	City Administrator
Vincent Aarts (Update Coordinator)	Columbia County Emergency Management
City of St. Helens	
John Walsh	City Administrator
Neal Sheppeard	Co-Interim Public Works Director
Sue Nelson	Co-Interim Public Works Director
Dave Elder	Public Works Supervisor
Vincent Aarts (Update Coordinator)	County Emergency Management
City of Scappoose	
Brian Varricchione	City Planner
Norm Miller	Interim Police Chief
Don Sallee	Building Official
Mike Greisen	Fire Chief

City of Vernonia	
Sue Wagner	Planning Commission, City of Vernonia
Maggie Peyton	Upper Nehalem Watershed Council Coordinator
Paul Epler	Fire Chief, City of Vernonia
Sandy Welch	Director, Vernonia Cares Food Bank
Bob Perry	General Manager, West Oregon Electric Coop
Josette Mitchell	Mayor
Josette Mitchell	Interim City Administrator
Vincent Aarts (Update Coordinator)	Columbia County Emergency Management

4.2.2 Planning Team Meetings and Tasks

November 12, 2013

The 2014 update of this HMP began with introduction of the process at the county Homeland Security and Emergency Management Commission meeting on November 12, 2013. During this meeting the plan, its components, and work required to conduct this update were explained to the participants of the commission. The Basic Plan Committee was then formed from volunteers among the county departments, local jurisdictions and industry representatives that make up the membership of this group.

January 21,2014

The initial meeting of the Basic Plan committee occurred on January 21, 2014. This first meeting was arranged to provide some familiarity with the DMA 2000 requirements for the plan and FEMA guidance for producing an update to the plan. Also discussed was the need for each jurisdiction to identify a steering committee to network with Columbia County, their community, other agencies, and other professionals who might have specialized knowledge about the hazards and mitigation activities that could affect the jurisdictions.

January 31, 2014

During the second meeting, the Basic Plan Committee conducted a thorough review of the 2009 MHMP in order to determine which sections of the basic plan required update. During this meeting, tasks were assigned to each committee member requiring thorough review of the material and supporting documents.

February 11, 2014

This workshop brought all the members of the committee back together to reassemble all sections of the 2009 that were tasked for update. Each section was thoroughly discussed; revisions were unanimously adopted and incorporated into the new plan. The draft of the Basic Plan was adopted at the end of this process and the basic methodology was established for all of

the following appendices. At the conclusion of this workshop the committee had completed its work.

Steering Committee Meetings

At this point, the Update Coordinator released the updated basic plan to the county and jurisdictional steering committees. These committees were now free to begin the process of updating their assigned appendices. Each committee in its relevant jurisdiction met several times, and included public involvement in their process. The process for each jurisdiction is located in its appendix.

4.3 PUBLIC INVOLVEMENT

4.3.1 Project Introduction

In early November 2013 the update process was first introduced to the Columbia County Homeland Security and Emergency Management Commission. From the available role of HSEMC participants and the attending public, the Basic Plan Committee was formed and work on the project began forthwith. Throughout the following months of the planning process, multiple efforts were made to encourage and generate public involvement in the process. In addition, each jurisdictional appendix including the county appendix was updated with opportunity for public involvement

4.3.2 Public planning efforts

Table 4-2 contains a summary of the Public Meeting Mechanisms.

Table 4-2. Public Involvement Mechanisms

Mechanism	Description
Columbia County Website	The most recent MHMP has been posted on the Columbia County website to encourage and request public participation in hazard identification for each jurisdiction. Suggestions made against the current plan will be used in the 2014 update
Columbia County Emergency Planning Association (CCEPA)	CCEPA is an association of local businesses, individuals, local and state government agencies and stakeholders. The association includes over 300 members. The following list is a sampling of the attendees for 2013-2014 meetings: American Red Cross, ARES/RACES, Armstrong World Industries, Boise Inc., CERT, Cities Readiness Initiative/Medical Reserve Corps, City of St. Helens, Clatskanie Rural Fire District, Columbia 911 Communications District, Columbia County Board of County Commissioners, Columbia County Emergency Management, Columbia County Rider, Columbia County Sherriff's Department, Columbia Health District, Columbia River Fire & Rescue District, DHS – Chemical Security/Homeland Security, Dyno Nobel, Georgia Pacific, Graymont Western, Guardsmart, Mist-Birkenfeld Fire & Rescue District, Northwest Natural Gas, Oregon Office of Emergency Management, Office of State Fire

Table 4-2. Public Involvement Mechanisms

Mechanism	Description
	Marshal, Oregon DEQ, Oregon Department of Transportation, Oregon –E-Prep Outreach, Oregon Public Health Division, Portland General Electric, Portland Police Bureau, Port of St. Helens, Scappoose Rural Fire District, Scappoose Planning Commission, Scappoose Police Department, St. Helens Police Department and Vernonia Police Department. This organization is Columbia County Local Emergency Planning Commission (LEPC) and a monthly public forum.
Homeland Security and Emergency Management Commission (HSEMC)	This commission performs as an advisory mechanism for the county department of emergency management. Commission meetings are publicized public meetings. Throughout the planning effort the HSEMC commission was informed and encouraged to participate in the process.
Social Media	In an effort to encourage and develop public involvement in the planning process, the Department of Emergency Management's Facebook and twitter accounts were utilized to advertise attendance at public meetings.
The Chronicle, St. Helens, OR	Solicitation for the MHMP Update workshop/public meeting was placed in this newspaper in April 20, 2014.
Public Input Meetings	A public input workshop was held on April 10, 2014. It was held at the Columbia 911 Communications District at 10:00 a.m.
Email to Steering Committee Members	Continuous emails between the update coordinator and Steering Committee members provided constant reminders of the need to encourage public involvement in the planning process. *This generated several public meetings in multiple jurisdictions during the planning process.*

4.4 INCORPORATION OF EXISTING PLANS AND OTHER RELEVANT INFORMATION

During the planning process, the Committees reviewed and incorporated information from existing plans, studies, reports, and technical reports into the MHMP. Section 9 contains a detailed list of references used throughout the document. A synopsis of some of the sources follows.

- *Columbia County General Plan*: The Land Use Element provided information on existing land use and future development trends. The Safety Element provided information for the hazard profiles and development of the mitigation strategy for landslides, fire, and flood hazards. The Seismic Safety Element provided information for the hazard profile section and the mitigation strategy for earthquakes and tsunamis.
- *Columbia County Zoning Ordinance:* These codes regulate development and land use; they were used to develop the capability assessment and the mitigation strategy.
- *The Columbia County Comprehensive Plan:* The plan provided the public's conclusion about development and conservation of the County's resources, public facilities and services.
- *Columbia County Community Wildfire Protection Plan:* The plan provided historical wildland fire information as well as mitigation projects and programs to include in the MHMP mitigation strategy.

- *State of Oregon Natural Hazards Mitigation Plan:* This plan, prepared by the State Interagency Hazard Mitigation Team was consulted to ensure that the MHMP is consistent with the State hazard mitigation plan.
- *Multi-Hazard Mitigation Plan for Columbia County, Oregon:* The 2009 plan was used as a baseline for this planning update. Hazards, critical facilities, and mitigation goals and actions were reviewed as part of the update process.
- *Multi-Hazard Mitigation Plan for Vernonia, Oregon:* The 2005 plan was also used as a baseline for this planning update. Hazards, critical facilities, and mitigation goals and actions were reviewed as part of the update process.

Appendices B through H include the incorporated city-specific existing plans, studies, and reports used during the update.

5. HAZARD PROFILES

This section identifies and profiles the hazards that could affect Columbia County.

5.1 OVERVIEW OF A HAZARD ANALYSIS

A hazard analysis includes the identification, screening, and subsequent profiling of each hazard. Hazard identification is the process of recognizing the natural and human-caused events that threaten an area. Natural hazards result from unexpected or uncontrollable natural events of sufficient magnitude. Human-caused hazards result from human activity and include technological hazards and terrorism. Technological hazards are generally accidental or result from events with unintended consequences (for example, an accidental hazardous materials release). Terrorism is defined as the calculated use of violence (or threat of violence) to attain goals that are political, religious, or ideological in nature. Even though a particular hazard may not have occurred in recent history in the study area, all hazards that may potentially affect the study area are considered; the hazards that are unlikely to occur, or for which the risk of damage is accepted as being very low, are eliminated from consideration.

Hazard profiling is accomplished by describing hazards in terms of their nature, history, magnitude, frequency, location, and probability. Hazards are identified through the collection of historical and anecdotal information, review of existing plans and studies, and preparation of hazard maps of the study area. Hazard maps are used to determine the geographic extent of the hazard and define the approximate boundaries of the areas at risk.

5.2 HAZARD IDENTIFICATION AND SCREENING

The requirements for hazard identification, as stipulated in DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Risk Assessment: Identifying Hazards

Identifying Hazards

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.

Element

- Does the new or updated plan include a description of the types of all natural hazards that affect the jurisdiction?

Source: FEMA, July 2008.

The Steering Committees identified 19 possible hazards that could affect Columbia County and the participating jurisdictions. They evaluated and screened the comprehensive list of potential hazards based on a range of factors, including prior knowledge or perception of the relative risk presented by each hazard, the ability to mitigate the hazard, and the known or expected availability of information on the hazard (Table 5-1). The Steering Committees determined that 16 hazards pose the greatest threat: flood, winter storm, landslide, wildland/urban fire, earthquake, volcano, wind, erosion, ENSO, expansive soils, drought, dam failure, disruption of utility and transportation systems, hazardous materials, terrorism, and epidemic. The remaining hazards excluded through the screening process were considered to pose a lower threat to life

and property in the county due to the low likelihood of occurrence or the low probability that life and property would be significantly affected.

Table 5-1. Identification and Screening of Hazards

Hazard Type	Should It Be Profiled?	Explanation
Natural Hazards		
Avalanche	No	Columbia County is not located in an area prone to frequent or significant snowfall.
Erosion (Riverine & Tributary)	Yes	Columbia County is located inland and is not subject to coastal erosion. Riverine and tributary erosion occurs throughout the county in localized areas.
Drought	Yes	Similar to the entire State of Oregon, Columbia County is subject to impacts associated with drought.
Dust Storm	No	No historic events have occurred in Columbia County or other jurisdictions.
Earthquake	Yes	Columbia County is located within the geographical area bordering the Cascadia Subduction Zone and is subject to impacts associated with earthquakes.
El Niño / La Niña	Yes	Historic El Niño / La Niña patterns have been observed affecting weather patterns throughout the state.
Expansive Soils	Yes	Expansive soils occur in Columbia County.
Flood	Yes	Historic flooding has been identified as occurring throughout Columbia County.
Landslide/Debris Flow	Yes	Columbia County is vulnerable to slope instability, especially after prolonged rainfalls.
Tsunami	No	Columbia County is located inland and is not subject to tsunami impacts, although the Columbia River is subject to tidal influences.
Volcano	Yes	Columbia County is located in the vicinity of active volcanoes.
Wind	Yes	Columbia County is vulnerable to high winds.
Winter Storm	Yes	Winter storms in Columbia County result in several natural hazards – including floods, ice formations, snow, and wind.
Wildland/Urban Fire	Yes	The terrain, vegetation, and weather conditions in the region are favorable for the ignition and rapid spread of wildland fires in Columbia County. Historic downtowns of the cities of Scappoose and Rainier include wood-frame structures that are clustered close together.
Man-Made/Technological Hazards		
Dam Failure	Yes	Several dams are located within Columbia County.
Disruption of Utility and Transportation Systems	Yes	Columbia County is subject to the impacts of disruption of utility and transportation systems.
Hazardous Materials	Yes	Hazardous materials facilities and major transportation routes are located throughout Columbia County and all jurisdictions.
Terrorism	Yes	Terrorism impacts have been identified in several jurisdictions within Columbia County.
Infectious Disease Epidemic	Yes	Epidemic impacts have been identified in several jurisdictions within Columbia County.

Table 5-2 shows the natural and technological hazards for the County and participating jurisdictions and the newly identified hazards (noted with an *) for the County's and the City of Vernonia's update process. Wind, erosion, ENSO, expansive soils, drought, and infectious disease epidemic are the newly identified hazards. Again, where hazards were excluded through the screening process by each jurisdiction, they were considered to pose a lower threat to life and property due to the low likelihood of occurrence or the low probability that life and property would be significantly affected. Should the risk from these hazards increase in the future, the MHMP can be updated to incorporate vulnerability analyses for these and other identified hazards.

Table 5-2. Hazards by Jurisdiction

Hazard	Columbia County	City of Clatskanie	Columbia City	City of Prescott	City of Rainier	City of St. Helens	City of Scappoose	City of Vernonia
Natural Hazards								
Flood	X	X	X	X	X	X	X	X
Winter Storm	X	X	X	X	X	X	X	X
Landslide	X	X	X	X	X	X	X	X
Fire (Wildland/Urban)	X	X	X	X	X	X	X	X
Earthquake	X	X	X	X	X	X	X	X
Volcano	X	X	X	X	X	X	X	X
Wind	X	X	X	X	X	X	X	X
Erosion	X	X	X		X	X	X	X
ENSO (*El Niño / La Niña*)							X	
Expansive Soils	X	X			X		X	X
Drought	X						X	
Manmade and Technological Hazards								
Dam Failure	X		X	X		X	X	X
Disruption of Utility and Transportation Systems	X	X	X	X	X	X	X	X
Hazardous Materials	X	X	X	X	X	X	X	X
Terrorism	X	X	X			X	X	
Infectious Disease Epidemic	X	X	X				X	
**Newly identified hazards (20014 update)*								

Table 5-3 Columbia County Hazard Analysis Matrix

Hazard	Rating Criteria with Weight Factors				Total Score
	History [1] (WF=2)	Vulnerability [2] (WF=5)	Max Threat [3] (WF=10)	Probability [4] (WF=7)	
Score for each rating criteria = Rating Factor (High = 10 points; Moderate = 5 points; Low = 1 point) X Weight Factor (WF)					
Natural Hazards					
Flood	20	50	100	70	**240**
Winter Storm	20	50	100	70	**240**
Landslide	20	25	35	35	**115**
Wildland/Urban Interface Fire	10	50	10	35	**105**
Earthquake	10	50	100	7	**167**
Volcanic Eruption	2	50	50	7	**109**
Wind	20	50	100	35	**205**
Erosion	2	25	10	35	**72**
ENSO (*El Niño / La Niña*)	10	25	10	35	**80**
Expansive Soils	10	25	10	7	**52**
Drought	10	10	50	35	**105**
Manmade and Technological Hazards					
Dam Failure	2	25	50	7	**84**
Disruption of Transportation and Utility Systems	20	50	50	70	**190**
Hazardous Materials	10	50	50	70	**180**
Civil Disorder/Terrorism	2	10	10	7	**29**
Infectious Disease Epidemic	2	5	50	7	**64**

Notes:

1. History addresses the record of previous major emergencies or disasters. Weight Factor is 2. Rating factors: high = 4 or more events in last 100 years; moderate = 3 events in last 100 years; low = 1 or 0 events in last 100 years.
2. Vulnerability addresses the percentage of population or property likely to be affected by a major emergency or disaster. Weight Factor is 5. Rating factors: high = more than 10% affected; moderate = 1%-10% affected; low = less than 1% affected.
3. Maximum Threat addresses the percentage of population or property that could be affected in a worst case incident. Weight Factor is 10. Rating factors: high = more than 25% could be affected; moderate = 5%-25% could be affected; low = less than 5% could be affected.
4. Probability addresses the likelihood of a future major emergency or disaster within a specified period of time. Weight Factor is 7. Rating factors: high = one incident within a 10-year period; moderate = one incident within a 50-year period; low = one incident within a 100-year period.
5. This table sourced from 2014 Columbia County Emergency Operations Plan

5.3 HAZARD PROFILE

The requirements for hazard profiles, as stipulated in DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Risk Assessment – Profiling Hazards

Profiling Hazards

Requirement §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 hazard events.

Element

- Does the risk assessment identify the location (i.e., geographic area affected) of each natural hazard addressed in the new or updated plan?
- Does the risk assessment identify the extent (i.e., magnitude or severity) of each hazard addressed in the new or updated plan?
- Does the plan provide information on previous occurrences of each hazard addressed in the new or updated plan?
- Does the plan include the probability of future events (i.e., chance of occurrence) for each hazard addressed in the new or updated plan?

Source: FEMA, July 2008.

The specific hazards selected by the Steering Committees for profiling, have been examined in a methodical manner based on the following factors:

- Nature
- History
- Location
- Extent
- Probability of future events

The order of presentation does not signify the level of importance or risk.

5.3.1 Flood

5.3.1.1 Nature

A flood is the temporary inundation of water or mud on normally dry land. Heavy or prolonged rain, snowmelt, or dam collapse can cause inundation, as can riverine and flash floods. (NOAA 2008) Urban and riverine flooding primarily affect Columbia County.

Urban flooding occurs in developed areas where the amount of water generated from rainfall and runoff exceeds the storm water systems' capacity. As land is converted from agricultural and forest to urban uses, it often loses its ability to adsorb rainfall. Rain flows over impervious surfaces such as concrete and asphalt and into nearby storm sewers and streams. This runoff can result in the rapid rise of floodwaters. During urban floods, streets can become inundated, and basements can fill with water. Storm drains often back up because of the volume of water and become blocked by vegetative debris like yard waste, which can cause additional flooding.

Development in the floodplain can raise the base flood elevation and cause floodwaters to expand past their historic floodplains. (FEMA 2008c)

Riverine or overbank flooding of rivers and streams is the most common type of flood hazard. Riverine flooding most frequently occurs in winter and late spring. Air rises and cools over the Coast Range and its foothills and heavy rainfall develops over high-elevation streams, as storms move from the Pacific across the Oregon Coast. In this region, as much as four to six inches of rain can fall over a 24-hour period. Severe and prolonged storms can raise rivers and streams to their flood stages for three to four days or longer. (State of Oregon 2008)

Flash floods were identified as occurring in Columbia County by members of the public as part of this planning process. However, the incident events do not fulfill the following scientifically defined flashflood parameters.

> *Flash floods typically originate from slow-moving storms that can generate immense volumes of rainfall and a rapid rise in water levels. The flash floods themselves quickly reach high velocities, and often carry debris. Flash floods can strike a community with little to no warning within 6 hours of heavy rain or rain and snowmelt, dam or levee failure and may bring 10 to 20 feet of water. These events can move boulders the size of small cars, uproot trees, destroy structures and facilities, erode roadways, sweep away vehicles and create new water channels. The County's erodibility index (a soils sensitivity to the effects of wind and water on the soil structure) will greatly determine its water and wind erosion potential and its impact from heavy rains and flash floods. Flash flood intensity is proportionate to rainfall intensity and duration, and is affected by watershed steepness and vegetation, stream gradient, natural and artificial flood storage areas, and streambed and floodplain configurations. Urban areas are more vulnerable to flash flooding because of development, land clearing, drainage system construction, and unobstructed channels such as roads, parking lots and ditches. Wildfires may also contribute to flash floods and landslides by removing vegetation and altering soil conditions. (NOAA 2002, State of Oregon 2008)*

Floods usually are the result of prolonged rainfall over a large area from major weather systems that cause flooding of smaller streams that flow into major rivers. This type of flood and inundation of the natural floodplains of the river system is a part of the natural process. Development in or near the floodplain puts lives and property at risk.

Flood damage can include:

- Structure inundation
- Erosion of stream banks, road embankments, foundations, footings for bridge piers and other features
- Impact damage from high-velocity flow and from debris
- Additional debris damage from accumulation on or blockage of infrastructure
- Cropland destruction
- Sewage and hazardous or toxic materials releases from damaged pipelines, tanks, and facilities
- Economic loss (local facilities, utilities, communications, agriculture)

5.3.1.2 History

Several very destructive floods have been recorded in Columbia County, as well as much of western Oregon, throughout the years. Between 1955 and 1999, Oregon ranked eleventh nationally for flood losses, with more than $197 million in annual damages. The county lies between the Coastal Range and the Cascade Range, in topography rich with rivers and tributaries. Because of this topography, melting snow and heavy winter rains can combine to produce devastating flood events. Floods along the Columbia River itself are in many places limited by the high, steep banks of the river, which contain most floodwaters to a narrow band. However, other waterways exceed their banks more easily. (FEMA 2008b, Goettel 2005)

- 1948. A flood in 1948 covered eight drainage districts, inundated the industrial port of St. Helens, and much of Clatskanie's central business district.
- In 1964, 1972, and 1974, the Nehalem River, Scappoose Creek, North Scappoose Creek, Clatskanie River, Conyers Creek, and McNulty Creek were all subject to winter flooding. (Goettel 2005)
- December 1964. Nearly every river in the state of Oregon exceeded its flood stages as weather stations set new records for precipitation. Known as the *Christmas Flood*, the event triggered debris flows, bridge failures and flooding that caused thousands to evacuate and closed airports, railways and hundreds of miles of roads across the state. Ultimately, the event caused more than $157 million in damages and 20 people were killed. (FEMA 2008b)
- In 1987, a major flood of Scappoose Creek inundated many homes in Scappoose. (Goettel 2005)
- February 1996. Virtually every county in the state received a disaster declaration due to a combination of warm temperatures, heavy snow pack and four days of record-breaking rain. Many areas had already received above-average rainfall, meaning rivers were at or reaching their capacities and flood stages. Recent logging activities contributed to increased runoff, resulting in atypical sediment and debris, which made conditions ripe for flooding and landslides. Hundreds of homes were destroyed, power outages were widespread, thousands were evacuated to public shelters and five people died. Some estimates of flood-related damages exceeded $1 billion. Later that year, in November, a tropical air mass swept across the state, once again bringing record-breaking precipitation. The stormy weather continued into December and early January as 26 major rivers reached flood stage. Snowmelt and intense rain caused extensive flooding that led to widespread landslides, erosion, power outages, damaged homes and businesses, closed roads and eventually resulted in a Presidential Disaster Declaration. (FEMA 2008b, Goettel 2005)

  In Columbia County, there were widespread road closures due to high water and landslides, including the Scappoose-Vernonia Road and highways 30 and 47 in several places. At the peak of the flood, all major highways were closed and those secondary roads that were open were restricted to emergency vehicles. Road closures isolated Vernonia and Clatskanie. Much of these two communities as well as parts of Scappoose, St. Helens and Rainier had to be evacuated. A boil-water alert was in effect for most of the county, and telecommunications, including some emergency communications, were

disrupted. FEMA disbursed repair and response totaling more than $5,000,000 to public entities, and the Oregon Economic Development Department funded nearly $1,000,000 in Disaster Recovery Grants. Damages to private property were estimated at more than $5,000,000. Extensive as the 1996 flood was, much larger floods are possible in Columbia County. (FEMA 2008b, Goettel 2005)

- Other notable flooding events occurred in January 1972, November 1973, January 1974, January 1987, December 1995, November 1996, December 1996 - January 1997, December 2003 - January 2004, March 2006, and December 2006. (FEMA 2008b)
- December 2007. Severe storms, winds, mudslides, landslides, and flooding occurred between December 1 and 17, 2007 shutting down roads and highways including Interstate 5. Public infrastructure, homes, and personal property were damaged. In Oregon, 73,000 residents were without power, and wastewater treatment plants were overwhelmed. A major disaster was declared for the State of Oregon on December 8, 2007 with Columbia County included in the declaration. (FEMA 2008) Coastal river flooding was estimated at or above the 25-year stage and compared to that of the 1964 and 1996 flood events.

The December storm flooded over 750 residences with 340 of those located in the City of Vernonia alone. 220 Vernonia homes were more than 50% damaged, and 34 greater than 70% damaged with an estimated $16.5 million in losses. March 2008 FEMA disaster aid was estimated at approximately $20 million including:

- ❖ $6,051,729 in individual assistance approved
- ❖ $10,957,500 in low-interest disaster loan assistance approved to homeowners, renters and businesses of all sizes
- ❖ $3,157,918 in public assistance obligated
- ❖ 3,569 individuals registered for assistance
- ❖ 3,864 individuals visited Disaster Recovery Centers
- ❖ 2,014 home inspections completed

5.3.1.3 Location

Columbia County is subject to flooding from river overflow (the Columbia River, Multnomah Channel, and smaller rivers such as the Nehalem and Clatskanie rivers) and lesser waterways (including Conyers, McNulty, Milton, Rock, and Scappoose creeks); as well as flooding from local storm water drainage. Between October and April, the county is susceptible to winter rain flooding, while between May and July, snowmelt and runoff can create floods. Typically, the most severe floods are winter rainfall floods in December, January and February.

Flood control storage reservoirs have substantially reduced flood potential along the Columbia River and other major waterways. Upstream of Columbia County, the Columbia River has 22 major reservoirs (representing 40 million acre-feet of flood storage), the Willamette River has 11 major reservoirs (1.7 million acre-feet), and the Cowlitz River, one (360,000 acre-feet). The Lewis River has three reservoirs (12,420 acre-feet). These reservoirs have reduced, but not eliminated flood potential.

Figures I-3 through I-3H identify the location of the 100-year and 500-year floodplains for the county and participating jurisdictions.

5.3.1.4 Extent

Floods are described in terms of their extent (including the horizontal area affected and the vertical depth of floodwaters) and the related probability of occurrence. Flood studies often use historical records, such as stream flow gauges, to determine the probability of occurrence for floods of different magnitudes.

FEMA has mapped most of the flood-prone streams in Oregon for 100- and 500-year flood events. A 100-year flood (one percent probability of occurring within any given year) is used as the standard for floodplain management in the United States and is referred to as a base flood. Flood Insurance Rate Maps (FIRMs) prepared by FEMA provide the most readily available source of information for 100-year floods. These maps are used to support the NFIP. FIRMs delineate 100- and 500-year (two percent probability of occurring in a given year) floodplain boundaries for identified flood hazards; these areas are Special Flood Hazard Areas (SFHAs) and provide the basis for flood insurance and floodplain management requirements.

Columbia County contains a total of 82.2 square miles within the 100-year floodplain, and 103.8 square miles within the 500-year floodplain. The 500-year event floodplain generally encompasses slightly more area than a 100-year event. Each watershed has its own water absorption characteristics. Buildings, roads, and parks replace grass and soil with asphalt or other non-absorbing materials, which limit or prevent water absorption. Therefore, 500-year events contain more water, which spreads further throughout the floodplain until the water can be managed by manmade and natural drainage systems.

The FEMA-mapped floodplains in Columbia County include, for the most part, only areas along the larger rivers and streams, which also have significant population and/or development. Other areas in the county have flood risk, but are not included in the FIRM because of small stream size or low population. Flood hazard evaluation for Columbia County must also take into account these localized areas of high flood risk or repetitive flooding which lie outside mapped floodplains. (Goettel 2005)

For Columbia County, there are several dozen FIRMs for cities as well as for communities in the unincorporated portions of the county. These maps are available at the County Courthouse or online at:
https://msc.fema.gov/webapp/wcs/stores/servlet/info?storeId=10001&catalogId=10001&langId=1&content=productFIRM&title=NFIP%2520Flood%2520Maps&parent=productInfo&parentTitle=Product%2520Information

5.3.1.5 Probability of Future Events

Columbia County and the incorporated Cities of St. Helens, Columbia City, Scappoose, Clatskanie, Rainier, Prescott, and Vernonia, participate in the NFIP and are required to regulate floodplain development. Any structure built in the floodplain after 1974 must meet NFIP requirements for elevation and flood proofing. Columbia County and the incorporated

jurisdictions use FEMA developed floodplain maps as the basis for implementing floodplain regulations. FIRMs delineate flood hazard areas where NFIP regulations apply. FIRMS and flood insurance studies assess the probability of flooding at given locations. These maps represent a snapshot in time, and do not account for changes in the floodplains. Development and other natural and artificial changes in floodplains have caused changes to the rivers and streams in Columbia County. For areas not mapped by FIRMS, flood-susceptible areas can be delineated and flood levels estimated by using historic stream flow records to determine flood frequency and recurrence.

Flood studies use this information to determine the probability of occurrence for floods of different magnitudes. The probability of occurrence is expressed as a percentage indicating the probability of a specific flood event occurring in any given year.

Factors contributing to the frequency and severity of riverine flooding include:

- Rainfall intensity and duration
- Moisture conditions
- Watershed conditions, including steepness of terrain, soil types, amount and type of vegetation, and density of development
- The existence of attenuating features in the watershed, including natural features such as swamps and lakes, and human-built features such as dams
- The existence of flood control features, such as levees and flood control channels
- Velocity of flow
- Tide heights and storm surge
- Availability of sediment for transport, and the likelihood of erosion of the bed and banks of the watercourse

These factors are evaluated using a hydrologic analysis to determine the probability that discharge of a certain size will occur, and to determine the characteristics and depth of the flood resulting from that discharge.

Flooding in western Oregon generally occurs when storms from the Pacific Ocean bring intense or prolonged rainfall to the west coast. Columbia County typically experiences the most severe floods from winter rainfall in December, January, and February. These floods are occasionally exacerbated by frozen snow packs where rain and snow melt combine while the ground is frozen, preventing ground seepage capability. The County is subject to flooding from river overflows; as well as flooding from local storm water drainage. The county is susceptible to winter rain flooding from October through April; while the months between May and July bring snowmelt and runoff floods. Based on previous occurrences, the county is not susceptible to flash floods according to NOAA's National Weather Service – Portland Office, Warning Coordination Meteorologist. However, the county is likely to experience major flood events occurring in and around the county every 2 to 6 years based on recent historic occurrences.

5.3.2 Winter Storm

Winter storms occurring in Columbia County result in several natural hazards – including floods, landslides/debris flows, and wind. Each on its own, or in combination, can completely immobilize emergency response activities, close down transportation corridors, and disrupt transportation and utilities. Each of these natural hazards is individually discussed in detail in their respective sections.

Winter storms in Columbia County can bring snow as well as rain, or can be followed by rising temperatures that melt newly fallen snow in higher elevations. Either scenario often causes flooding; most floods in western Oregon occur as a result of winter storms. The flood hazard is described in detail in the flood section of this document.

As is the case with flood, wind as a hazard in Columbia County most frequently occurs as part of a winter storm. The *nature*, *history*, *location*, *extent,* and *probability of future events* for wind, including winter storm wind, are explored in detail in the wind section of this document.

5.3.2.1 Nature

Ice and snowstorms, which include freezing rain, sleet, and hail, can be the most devastating of winter weather phenomena and are often the cause of automobile accidents, power outages and personal injury. Ice storms result in the accumulation of ice from freezing rain, which coats every surface it falls on with a glaze of ice. Freezing rain is most commonly found in a narrow band on the cold side of a warm front, where surface temperatures are at or just below freezing. Typically, ice crystals high in the atmosphere grow by collecting water vapor molecules, which are sometimes supplied by evaporating cloud droplets. As the ice crystals fall, the air warms and the particles melt and collapse into raindrops. As the raindrops approach the ground, they encounter a layer of cold air and cool to temperatures below freezing. However, since the cold layer is shallow, the drops themselves do not freeze, but rather are supercooled, that is cooled in a liquid state to below-freezing temperatures. These supercooled raindrops freeze on contact when they strike the ground or other cold surfaces.

Snowstorms happen when a mass of very cold air collides with a mass of warm air. The warm air rises quickly and the cold air cuts underneath it, cooling and condensing as it rises, forming a cloud bank in the process. As the moisture droplets in the cloud cool to a point below freezing, they become ice crystals, which then collide within the cloud and snow is formed. The resulting precipitation falls as snow only when the temperature of the air between the bottom of the cloud and the ground is below 40 degrees Fahrenheit. (ONHW 2006) A higher temperature will cause the snowflakes to melt as they fall through the air, turning them into rain or sleet. Similar to those of ice storms, the effects of a snowstorm can disturb a community for weeks or even months. The combination of heavy snowfall, high winds and cold temperatures poses danger from prolonged power outages, automobile accidents and transportation delays, dangerous walkways, and through direct damage to buildings, pipes, crops, other vegetation, and livestock. Buildings and trees can also collapse under the weight of heavy snow.

5.3.2.2 History

Table 5-4 summarizes the NOAA NWS Forecast Office's past storm events website, (http://www.wrh.noaa.gov/pqr/paststorms/index.php) which lists nine significant ice and snowstorms having occurred in Columbia County since 2000[1].

Table 5-4. Winter Storms Events, 2000 – 2014

Date	Snow Type (Ice, Snow, Sleet)	Details
12/3/2001	Heavy Snow	A powerful Pacific storm dumped very heavy snow in the Cascades again. In the Columbia River Gorge 3 to 4 inches of new snow was reported at Hood River, and both Bonneville Dam and Cascade.
12/17/2001	Heavy Snow	In the Columbia River Gorge, Hood River had 4 inches of snow.
12/27/2001	Winter Storm	In the Columbia River Gorge, Hood River reported 2 inches of snow.
12/30/2001	Winter Storm	In the Columbia River Gorge, Hood River reportedly received sleet, freezing rain, and one inch of snow.
11/17/2003	Winter Storm	Over a three-day period of strong Pacific storms, high winds were brought to the North and Central Oregon coast along with heavy rain and/or snow to the area. Locations in the Central and Southern Willamette Valley reported up to an inch.
1/7/2005	Heavy Snow	Snow fell in the NW Oregon Coast Range, with 8 inches in Buxton, 5 inches west of McMinnville, and 4 inches at Sunset Summit and Wilson River Summit. A cold Pacific storm brought heavy snow to the NW Oregon Coast Range, Northern Oregon Cascades, and Columbia River Gorge.
12/3/2005	Winter Storm	A strong moisture-laden Pacific system brought winter conditions to various regions of northwest Oregon.
3/8/2006	Winter Storm	A strong Pacific storm and associated cold front brought relatively late winter conditions to northwest Oregon. This snow event was one of the latest of the year seen in the Portland area, and forced many school closures around the area.
12/14/2006	Winter Storm and Flooding	A strong low-pressure system combined with existing very cold, shallow air over portions of northwest Oregon brought a wintry mix of precipitation resulting in flooding in eight counties including Columbia County.
12/08/07	Winter Storm	Severe storms resulted in flooding, landslides, and mudslides beginning on December 1, 2007 resulted in a major disaster declaration requiring over 20 million in aid. Five counties in Oregon were included in this disaster. Columbia county and participating jurisdictions were severely impacted by this storm.

Table 5-4. Winter Storms Events, 2000 – 2014

Date	Snow Type (Ice, Snow, Sleet)	Details
12/20-26/2008	Snow, Mudslide, Landslide	A severe storm, record and near-record snow, mudslides, and landslides occurred between December 20 and 26, 2008. Said to be the worst snow and ice event to occur in the Willamette Valley in 40 years -- significantly damaged agricultural buildings and equipment. Heavy snow and freezing rain caused ice buildup that resulted in downed trees, limbs and broken branches throughout northwestern Oregon. Roads, infrastructure, and private property were damaged as a result of the storm.
03/01/2012	Winter Storm	An unstable air mass following a Pacific cold front brought widespread snow showers to the North Oregon Cascades and foothills, and the North Oregon Coastal Range. Portions of Columbia County measured 20 inches of new snow and at Wilson River Summit with 15 inches of new snow.
2/6-10/2014	Snow, ice	Columbia County saw 8 inches to 12 inches of snow, followed by about 0.5 inches to 0.75 inches of ice. This storm resulted in considerable disruption of traffic in many portions of Columbia County. Ice storms and freezing rain are fairly common, especially along the Columbia River when cold air near the ground coincides with warm moist air at higher altitudes.

(Data from NOAA2008a and http://www.ncdc.noaa.gov/stormevents/)

5.3.2.3 Location

All areas of Columbia County and the participating jurisdictions are susceptible to winter storms as cold arctic air breaches the Cascade Range and moves westward. Cold air rarely travels west of the Cascade Range, as the mountains provide a natural barrier separating the Willamette Valley from the cold air to the east. However, the Columbia River Gorge can provide a low-level passage funneling cold air westward. Rain, sleet, and/or snow will fall if moisture-saturated warm air from the Pacific moves into the area colliding with the colder air mass.

5.3.2.4 Extent

Columbia County is located in Climate Zone 2, generally consisting of wet winters and dry summers. Winter storm characteristics are determined by the amount and extent of ice and snow, air temperature, wind speed and wind direction. Winter storms can cause power outages, transportation and economic disruptions, injuries and loss of life. Winter storms can also cause traffic-related accidents and death, hypothermia, and heart attacks from snow shoveling. Emergency response times can be slowed because of icy road conditions. The weight of the snow or ice can cause utility disruption and falling trees and limbs. Snowmelt can cause flooding and landslides. (State of Oregon 2006)

5.3.2.5 Probability of Future Events

Historical data shows that the probability for annual winter storm recurrence is high with a one-year recurrence interval. Winter storms combined with other weather events, like El Niño and La

Niña cycle; often result in compounded hazards countywide. Winter storms have caused flooding, landslides, debris flows, utility and transportation systems disruptions.

5.3.3 Landslide

5.3.3.1 Nature

Landslide is a general term for the dislodgment and fall of a mass of soil or rocks along a sloped surface, or for the dislodged mass itself. The term is used for varying phenomena, including mudflows, mudslides, debris flows, rock falls, rockslides, debris avalanches, debris slides and slump-earth flows. The susceptibility of hillside and mountainous areas to landslides depends on variations in geology, topography, vegetation and weather.

Landslides can be triggered by natural events such as seismic tremors and earthquakes, volcanic eruptions, stream erosion, snowmelt, and prolonged or heavy rainfall. Development and other human activities can also provoke landslides. Increased runoff, excavation in hillsides, shocks and vibrations from construction, placement of non-engineered fill, and changes in vegetation from fire, timber harvesting and land clearing have all led to landslide events. Weathering and decomposition of geologic material, and alterations in flow of surface or ground water can further increase the potential for landslides.

The United States Geological Survey (USGS) identifies six types of landslides, distinguished by the type of material and movement mechanism involved:

- **Slides:** The more accurate and restrictive use of the term landslide refers to a mass movement of material, originating from a discrete area of weakness that slides from stable underlying material. A *rotational slide* occurs when there is movement along a concave surface; and a *translational slide* originates from movement along a flat surface.
- **Debris flows:** Flows arise from saturated material that generally moves rapidly down a slope. A debris flow usually mobilizes from other types of landslides on steep slopes, then flows through confined channels, liquefying and gaining speed. Debris flows can travel at speeds of more than 35 miles per hour for several miles. Other types of flows include debris avalanches, mudflows, creeps, earthflows, debris flows, and lahars.
- **Lateral Spreads:** This type of landslide generally occurs on gentle slopes or flat terrain. Lateral spreads are characterized by liquefaction of fine-grained soils. The event is typically triggered by an earthquake or human-caused rapid ground motion.
- **Falls:** Falls are the free-fall movement of rocks and boulders detached from steep slopes or cliffs.
- **Topples:** Topples are rocks and boulders that rotate forward and may become falls.
- **Complex:** Any combination of landslide types.

The likelihood of a landslide in any given slide-prone location is largely dependent on the water content of the soil or rock fill. Landslides may happen at any time of the year, especially during rainy months when soils become saturated with water. Earthquakes can add to slope stress and disrupt ground stability, thereby triggering landslides, usually in already slide-prone locations.

In addition, unconsolidated deposits of alluvial and glacial outwash materials are subject to accelerated stream bank erosion and landslides.

Indicators of a possible landslide include:

- springs, seeps, or wet ground that is not typically wet;
- new cracks or bulges in the ground or pavement;
- soil subsiding from a foundation;
- secondary structures (decks, patios) tilting or moving away from main structures;
- broken water line or other underground utility;
- leaning structures that were previously straight;
- offset fence lines;
- sunken or dropped-down road beds;
- rapid increase in stream levels, sometimes with increased turbidity;
- rapid decrease in stream levels even though it is raining or has recently stopped; and
- sticking doors and windows, visible spaces indicating frames out of plumb.

Landslides often occur in conjunction with other natural hazards, thereby exacerbating conditions, as described below:

- Shaking due to earthquakes can trigger events ranging from rock falls and topples to massive slides.
- Intense or prolonged precipitation that causes flooding can also saturate slopes and cause failures leading to landslides.
- Landslides into a reservoir can indirectly compromise dam safety, and a landslide can even affect the dam itself.
- Wildfires can remove vegetation from hillsides, significantly increasing runoff and landslide potential.

5.3.3.2 History

Landslides and debris flows are common in Columbia County. Much of the terrain is hilly and susceptible to slides; however, many slides take place in undeveloped areas and are unreported or even unnoticed. A statewide survey of winter storm landslides during 1996 and 1997, conducted by the Oregon Department of Geology and Mineral Industries (DOGAMI), reported 9,582 documented slides. The actual number was estimated to be many times the documented number. (Goettel 2005)

Historically, long periods of winter rain and heavy snowfall in the mountains trigger landslides (see Table 5-4 for winter storm history). These landslides affect county roads and key emergency transportation routes.

A February 1996 winter storm triggered numerous slides in Columbia County. Slides interrupted transportation routes in dozens of locations, including two emergency transportation routes, the Scappoose-Vernonia Road (19 locations) and Apiary Road (four locations). (Goettel 2005)

The December 2007 winter storm caused 77 landslides and 41 debris flows in Columbia, Clatsop, and Tillamook counties. In northwestern Columbia County, one or more small landslides occurred triggering a debris flow that traveled approximately 1 mile and blocked a drainage near Woodson on Highway 30. This blockage, combined with additional rainfall resulted in a temporary lake (30-40 feet deep and 200 feet long). Woodson residents were evacuated and Highway 30 was closed on December 11th 2007. A catastrophic debris flow occurred when the embankment failed and engulfed Highway 30 and Woodson. No fatalities occurred.

Since this latest event small incidents continue to require occasional clean up and indicate that landslides remain a constant hazard for county residents in the future.

5.3.3.3 Location

In general, the probability of slope failure increases with an increase in slope inclination. However, this is not always the case. Depending on various factors such as soil type and water content, a slope having a relatively low inclination could be at greater risk of failure than another slope having a relatively high inclination. Other factors that influence susceptibility include: rock type; vegetative cover and type; slope aspect; permeability and rate of infiltration; proximity to seismic sources; and magnitude of seismic events. In addition, unconsolidated deposits of alluvial and glacial outwash materials are subject to accelerated stream bank erosion and landslides. The possibility of failure also increases in sloped areas in which human influences, such as cutbacks, have occurred. Figures I-4 through I-4H show landslide hazard areas.

5.3.3.4 Extent

The Oregon Department of Forestry (ODF) conducted a 3-year study of the impacts of landslides for two 1996 winter storms, entitled, *Storm Impacts and Landslides of 1996: Final Report*. The ODF study included eight study areas, one of which was in Columbia County, but did not provide a detailed inventory of landslide prone areas in Columbia County, outside of the very small study area. This study concluded that the highest hazard for shallow rapid landslides in western Oregon occurs on slopes of over 70% to 80% steepness (depending on landform and geology).

The geographic extent of landslide events is essentially the same as slide location, while the effects depend on what infrastructure is in the way of a slide, as well as the magnitude and force of the slide itself. The extent of effects could be as limited as one building or property, to region-wide effects, as in the case of a major transportation disruption, slide-induced dam failure, or utility outage.

Rapidly moving landslides have the greatest potential to endanger human life or inflict serious injury, especially to those living in or traveling through rapidly moving slide prone areas. Slow moving slides are less likely to inflict serious human injuries, but can cause property damage. (ONHW 2006)

5.3.3.5 Probability of Future Events

Landslides are an annual occurrence in Oregon during the rainy months, October through April. They generally result from intense or prolonged rainfall, particularly during a rain on snow event. Slope alteration and shape can also be a recurrence interval factor. Oregon's Enhanced Natural Hazard Mitigation Plan states that, "Landslide recurrence interval is highly variable" and is terrain dependent. Recurrence intervals for steep terrain can range from 50-5,000 years, with some debris flow recurrence intervals of less than 10 years.

5.3.4 Wildfires

5.3.4.1 Nature

Wildfires can be classified as wildland fires, wildland/urban interface (or intermix) fires, urban fires, and prescribed fires. Due to the large amount of forested land in Columbia County, both wildland fires and wildland/urban interface fires are significant hazards.

Wildland fires spread through the consumption of vegetation. They often begin unnoticed, spread quickly, and are usually signaled by dense smoke that may be visible for miles around. Wildland fires can be caused by human activities such as arson or campfires, or by natural events like lightning. Wildland fires often occur in forests or other areas with ample vegetation. When a wildland fire spreads to developed areas such as suburbs, small communities, or isolated homes, it becomes a wildland/urban interface fire.

The following three factors contribute appreciably to wildland fire behavior and can be used to identify hazards.

- **Topography:** As slope increases, the rate of wildfire spread increases. South-facing slopes are also subject to more solar radiation, making them drier and thereby intensifying wildfire behavior. However, ridge tops can mark the end of a wildfire's spread, since fire spreads more slowly or may even be unable to spread downhill.
- **Fuel:** The type and condition of vegetation plays a significant role in the occurrence and spread of wildfires. Certain types of plants are more susceptible to burning or will burn with greater intensity. Dense or overgrown vegetation increases the amount of combustible material available to fuel the fire (referred to as the "fuel load"). The ratio of living to dead plant matter is also important. The moisture content of both living and dead plant matter decreases during periods of prolonged drought and greatly increases the risk of fire. The fuel's continuity, both horizontally and vertically, is also an important factor. Forests with strong ladder fuels (understory growth between ground fuels and tree crowns) are more likely to have major fires involving tree crowns. Forests with limited ground fuels and little or no ladder fuels are much more likely to experience minor ground fires than a fire involving tree crowns. (ONHW 2006)
- **Weather:** The most variable factor affecting wildfire behavior is weather. Temperature, humidity, wind and lightning can affect chances for ignition and spread of fire. Extreme weather, such as high temperatures coupled with low humidity, can lead to devastating wildfires. Conversely, cool temperatures and higher humidity often signal reduced wildfire occurrence and easier containment of existing fires.

In Columbia County, wildland fires burn primarily vegetative fuels, outside highly urbanized areas. Wildland fires can be categorized as occurring in the following locations:

- **Agricultural:** Agricultural fires burn in areas where the primary fuels are flammable cultivated crops, such as wheat. This type of fire tends to spread very rapidly, but is relatively easy to suppress if adequate resources are available. Structures threatened, if any, are generally those belonging to ranch and farm owners. There can also be significant losses in agricultural products.
- **Forest:** Forest fires are the classic wildland fire. These fires burn fuels composed primarily of timber and associated fuels, such as brush, grass, logging residue and thick stands of replanted trees. Due to variations in fuel and topography, this type of fire may be extremely difficult and costly to suppress.
- **Wildland-Urban Interface:** Fires involving the wildland-urban interface occur in areas where urbanization and the presence of natural vegetation fuels allow a fire to spread rapidly from natural fuels to structures and vice versa. Especially in the early stage of such fires, structural fire suppression resources can be quickly overwhelmed, increasing the number of structures destroyed. Such fires are known for the large number of structures simultaneously exposed to fire. Nationally, wildland interface fires commonly produce widespread losses.
- **Urban:** While fires in urban areas rarely spread out of control, thanks to proximity to fire-fighting resources and less fuel between buildings, urban conflagration is a hazard in densely populated areas. Many of the same factors that influence hazard in wildland and interface areas come into play in urban centers. Drought, high temperatures, and fuel load are joined by factors such as flammable building materials, aging electrical wiring, and closely packed structures to increase fire hazard. When combined with inadequate or faulty firefighting equipment, staff shortages, or poor location data, urban fire risk factors can set the stage for disaster.

Although thought of as a summer occurrence, wildland fires can, and do, occur during any month of the year. The vast majority of wildland fires occur between July and October. Dry spells during the winter months, especially when combined with the factors of winds or dead fuels, result in fires that burn with alarming intensity and rate of spread. Common causes of wildland fire include: lightning; equipment use; railroad activity; debris burning; arson; and improperly extinguished cigarettes.

Wildland fires are part of the natural ecology and natural life cycles of wildlands. Fires create open spaces with different habitats for both plants and animals than existed previously. Fires also reduce fuel loads in areas, which in turn decreases the potential for large catastrophic fires. (ONHW 2006) However, a wildland fire may grow into an emergency or disaster if not promptly controlled. Even a small fire can threaten lives and resources and destroy property, especially in heavily developed interface areas. Wildland fires may also harm livestock and pets. In addition to threatening humans, animals, and infrastructure, wildfires in forested areas have a severe impact on natural resources. Wildland fires strip the land of vegetation and destroy forest resources. Soil exposed to intense heat may lose its capability to absorb moisture and support life. Exposed soils erode quickly and enhance siltation of rivers and streams, thus increasing flood potential, harming aquatic life and degrading water quality. Lands stripped of vegetation are also subject to increased debris flow hazards, as discussed in the landslides hazard profile.

5.3.4.2 History

Wildland fires have burned the Oregon landscape for thousands of years. Many wildfires have resulted from natural lightning strikes and intentional human activities. Historically, indigenous people purposely ignited large portions of the basin valley annually for agriculture, hunting, communication, warfare, visibility, safety, and sanitation. Such systemic burning may have been used for as long as ten thousand years prior to Euro-American settlement. Euro-American settlement in the mid-19th century continued to shape the landscape with fire. Euro-Americans burned land to protect timber and property in the region. They directed more attention to forested areas and coastland. As a result, valley prairies, savannas burned less, and areas not used for fields or pastures began growing into forests. (ONHW 2006)

According to ODF, the following major wildfires have occurred in Oregon in the past 150 years. However, as outlined in Table 5-5 below, none of these major fires occurred in Columbia County.

Table 5-5. Historic Fires in Oregon (1848-2008)

Year	Name of Fire	Counties	Acres burned
1848	Nestucca	Tillamook/Yamhill	290,000
1849	Siletz	Lincoln/Polk	800,000
1853	Yaquina	Lincoln	482,000
1865	Silverton	Marion	988,000
1868	Coos Bay	Coos	296,000
1933	Tillamook	Tillamook/Yamhill	240,000
1936	Bandon	Coos	143,000
1939	Saddle Mountain	Tillamook/Yamhill	190,000
1945	Wilson River/Salmonberry	Tillamook	33,000
1951	North Fork & Elkhorn	Tillamook, Yamhill	33,000
1966	Oxbow	Lane	44,000
1987	Silver	Josephine	97,000
1992	Lone Pine	Klamath	31,000
1996	Skelton	Deschutes	17,700
2002	Biscuit	Josephine/Curry	500,000
2003	B&B Complex	Jefferson/Linn/Deschutes/Marion	80,000
2005	Blossom Complex	Curry	14,772
2006	Shake Table Complex	Grant	14,453
2007	Lovelett Creek	Grant	53,556
2007	Battle Creek Complex	Wallowa	79,299
2007	Irish Springs (Vale BLM)	Baker	45,743
2007	Egley Complex	Harney	140,360

Table 5-5. Historic Fires in Oregon (1848-2008)

Year	Name of Fire	Counties	Acres burned
2008	Royce Butte	Deschutes/Klamath/Lane	390-1,100 acres
2012	Long Draw	Malheur	719,694 acres

Source: *Department of Forestry and Oregon Emergency Management – State Hazard Risk Assessment*

Jim Wolf of ODF provided records for all wildland fires in ODF-responsibility lands in Columbia County from 1970 to 2003 for the 2005 Columbia County HMP. For this 34-year period, a total of 689 wildland fires occurred on ODF-responsibility lands in Columbia County, or an average of 20 fires per year. Most of these fires were less than one acre, 134 fires were between 1 and 9 acres, and 15 fires were 10 acres or more. The largest fire reported consumed 93 acres. It is important to keep in mind that these data are for ODF-responsibility areas, along with ODF joint responses to fires in areas where the primary responsibility is provided by local fire agencies. However, because ODF-responsibility lands include nearly 80% of the entire county, these data probably represent most of the wildland fires in Columbia County in the last 34 years. (Goettel 2005) 2004 through 20013 data was obtained from the ODF fire statistics database. Table 5-6 shows recent fires in the vicinity of Columbia County. Columbia County historic fires are shown on Figure I-5.

Table 5-6. Recent Large Fires in Columbia County and Vicinity

Fire Name	Location	Size (Acres)	Fuel Type	w/i WUI	Year	Cause Category	Vicinity of Homes
Pebble Creek	South of Vernonia	165	Logging Slash/Timber	Yes	1987	Hunter/Smoking	Yes
Keasey Dam	West of Vernonia	117	Logging Slash Reproduction	No	1989	Recreationist/ Campfire	No
Emerald Forest		37	Logging Slash	No	1994	Equipment/ Logging	Yes
Kerry Road	West of Clatskanie	31	Fell/Buck, Slash, Reproduction			Equipment/ Logging	No
Wolden Road		31	Reproduction	Yes	1999	Debris Burning	Yes
Lost Creek Road		20	Reproduction	Yes	1999	Debris Burning	Yes
Lost Creek Road	West of St. Helens	5	Logging Slash	Yes	1999	Burning	Yes
Scappoose Airport	Scappoose Airport	200	Logging Slash/Timber	Yes	2000	Burning	Yes
Pittsburg Road	South of Liberty Hill	5	Scrub Oak/Grass	Yes	2006	Recreationist/ unknown	Yes
Hwy 30/Jones Rd	Hwy 30/Jones Rd	12	Grass/Brush	Yes	2008	Burning vehicle	Yes
North Fork Unit	Elk Creek	7	Slash	No	2008	Hold Over	No
Flora Road	Flora Road	23	Reproduction	No	2009	Vehicle Sparks	Yes
Pittsburg Road	Pittsburg Road	5	Grass	Yes	2012	Burning Building	Yes

5.3.4.3 Location

Columbia County is approximately 90% forested; therefore, there is high risk for wildland fires in the county. (Loy 2001) According to a United States Forest Service report identifying wildland/urban interface communities within the vicinity of Federal lands in Oregon that are at high risk from wildfire, every community in Columbia County is at risk for wildland/urban interface fires. (66 Fed. Reg. 43383-43435)

However, the actual fire hazard in these areas may be lower than expected because a high percentage of forest lands in Columbia County are actively managed for timber. Harvested areas typically have lower fire risk because they are relatively free of dead and downed material that would contribute to the fuel load. In addition, forests within Columbia County are relatively free of major insect and disease problems that often plague other forests in Oregon. Finally, typical rainfall amounts for Columbia County are "moderately high" to "high", averaging 40 to 60 inches per year. (Goettel 2005)

The fire protection service providers in the county identified areas of special concern for wildland/urban interface fires. These areas are identified in Table 5-7. Fire hazard areas are shown on Figures I-6 through I-6H.

Table 5-7. Areas of Special Concern for Wildland/Urban Interface Fires

Community	Areas of Special Concern [1]
Clatskanie	Conyers Creek drainage area, area NE of Clatskanie and populated areas in the interface adjoining natural cover and wildland fuels.
Mist-Birkenfeld	Fishhawk Lake area and other rural areas in the interface adjoining natural cover and wildland fuels.
Rainier	Populated areas of the interface adjoining natural cover and wildland areas.
Scappoose	Chapman, Alder Creek, JP West, Mt. View, Callahan, Bonneville, and Wilkinson Roads. Dutch Canyon, Pamarama Terrace and Raymond Creek subdivisions.[2] Populated areas of the interface adjoining natural cover and wildland areas.
St. Helens	Gray Cliffs and surrounding greater St. Helens area. Areas involving oak, brush, and grass fuel types. Populated areas of the interface adjoining natural cover and wildland areas.
Vernonia	Populated areas of the interface adjoining natural cover and wildland areas.

[1] Michael Simek, ODF, Sept. 21, 2004.
[2] Scappoose RFD, November, 2004
Source: Goettel 2005

5.3.4.4 Extent

ODF records of historical fires show that minor wildland fires occur regularly in Columbia County. Fire protection services have generally been able to contain these fires before they exceeded 10 acres. The county's success in controlling wildland fires is likely due to a combination of well-run fire protection services, "moderately high" to "high" levels of rainfall, and the fact that most of the county's forests are disease-free and actively managed for timber.

Due to successful fire control, the minor wildland fires that have occurred in Columbia County have damaged relatively few residential areas, scattered buildings, and natural resources in the affected forests. However, if a major wildland fire were to occur, it would have the potential to severely impact residential structures, roads, power lines, and other critical infrastructure in all jurisdictions in the county.

5.3.4.5 Probability of Future Events

In Oregon, wildland fire season normally begins in late June, peaks in August, and ends in October. However, a combination of above normal-temperatures and drought can increase the length of the traditional fire season. Wildland fire hazards throughout the county would be highest during prolonged periods of drought, especially after periods of below normal rainfall, which would result in a combination of high fuel loads and unusually dry conditions.

Due to historical fire patterns, the probability of a minor wildland fire occurring in any of the jurisdictions is very high. Although Columbia County has never experienced the major fires that have affected other counties in Oregon, there is a possibility that a major wildland or wildland/urban interface fire could occur in Columbia County in the future.

Urban fires are the most preventable type of fire, and future events depend largely on prevention measures. Although no historical urban conflagrations in have occurred, educating residents, building and maintenance code enforcement, and firefighting equipment, staff, and response systems upkeep are all steps that can ensure that highly likely localized urban fires do not become large-scale conflagrations.

5.3.5 Earthquake

5.3.5.1 Nature

An earthquake is a sudden motion or trembling of the earth produced by the rupture of rocks due to stresses beyond the rocks' elastic limits. The point inside the Earth where the rupture takes place is termed the hypocenter. The point on the planet's surface directly above the hypocenter is the epicenter. The effects of an earthquake can be felt far beyond the site of its occurrence. Earthquakes usually occur without warning and, after just a few seconds, can cause massive damage and extensive casualties. The most common effect of earthquakes is ground motion, usually felt as shaking and vibrations.

The severity of ground motion generally increases with the amount of energy released and decreases with distance from the fault or epicenter of the earthquake. Ground motion causes waves in the earth's interior, also known as seismic waves, and along the earth's surface, known as surface waves. There are two kinds of seismic waves. P (primary) waves are longitudinal or compression waves similar in character to sound waves, that cause back-and-forth oscillation along the direction of travel (vertical motion). S (secondary) waves, also known as shear waves, are slower than P waves and cause structures to vibrate from side to side (horizontal motion). When P and S waves hit the surface of the Earth, they generate surface waves, which are further categorized into Raleigh waves and Love waves. Slower than seismic waves, and therefore later to hit, surface waves are responsible for most of the damage during an earthquake.

Earthquakes are usually measured in terms of magnitude and intensity. Magnitude is related to the amount of energy released during an event, while intensity refers to the effects on people and structures at a particular place. Small to moderate earthquake magnitude is usually reported according to the standard Richter scale. Larger earthquakes are reported according to the moment-magnitude scale because the standard Richter scale does not adequately represent the energy released by these large events.

Intensity is usually reported using the Modified Mercalli Intensity Scale. This scale has 12 categories ranging from "not felt" to "total destruction." Different values can be recorded at different locations for the same event depending on local circumstances such as distance from the epicenter or building construction practices. Peak ground acceleration (PGA) is also used to measure earthquake intensity. It measures the earthquake's intensity by quantifying how hard the earth shakes in a given location. PGA can be measured in g, which is acceleration due to gravity. Table 5-8 identifies corresponding intensity and magnitude ratings as well as effects associated with each rating.

Table 5-8. Effects of Intensity and Magnitude Ratings

Magnitude	MM Intensity	PGA (% *g*)	Perceived Shaking
0 – 4.3	I	<0.17	Not Felt
	II-III	0.17 – 1.4	Weak
4.3 – 4.8	IV	1.4- – 3.9	Light

Table 5-8. Effects of Intensity and Magnitude Ratings

Magnitude	MM Intensity	PGA (% *g*)	Perceived Shaking
	V	3.9 – 9.2	Moderate
4.8 – 6.2	VI	9.2 – 18	Strong
	VII	18 – 34	Very Strong
6.2 – 7.3	VIII	34 – 65	Severe
	IX	65 – 124	Violent
	X	124 +	Extreme

In addition to ground motion, several secondary hazards can occur from earthquakes, such as surface faulting. Surface faulting is the differential movement of two sides of a fault at the earth's surface. Displacement along faults, both in terms of length and width, varies but can be significant (up to 20 feet), as can the length of the surface rupture (up to 200 miles). Surface faulting can cause severe damage to linear structures, such as railways, highways, pipelines, and tunnels.

Earthquake-related ground failure due to liquefaction is another secondary hazard. Liquefaction occurs when seismic waves pass through saturated granular soil, distorting its structure, and causing some of the empty spaces between granules to collapse. Pore-water pressure may also increase sufficiently to cause the soil to briefly become fluid. Liquefaction causes lateral spreads (horizontal movements commonly of 10 to 15 feet, but up to 100 feet), flow failures (massive flows of soil, typically hundreds of feet, but up to 12 miles) and loss of bearing strength (soil deformations causing structures to settle or tip). Liquefaction can cause severe damage to property.

The most common earthquakes that occur in Oregon are crustal, intraplate or great subduction earthquakes. These are described as follows:

Crustal earthquakes: These generally occur along shallow faults near the earth's surface. Crustal earthquakes make up the majority of earthquakes in the Cascadia area (western Washington, Oregon and northwestern California) and are a result of fault movement in the Earth's surface. These shallow earthquakes are usually less than 7.5 magnitude and strong shaking generally lasts 20 to 60 seconds. Aftershocks, as well as tsunamis and landslides, are anticipated after a crustal event.

Intraplate earthquakes: These occur deeper, at 20 to 40 miles beneath the ground surface. These deep earthquakes are usually less than 7.5 magnitude, and damaging events occur every 10 to 30 years in this region. There are few aftershocks, and tsunamis are generally not anticipated, although landslides can trigger localized tsunamis. Due to the deep earth movement, an intraplate earthquake is felt over a larger area with less intensity. Damage from this type of event is generally less than with an equally sized crustal earthquake.

Great subduction earthquakes: occur offshore of the Oregon and Washington Coasts along the Cascadia Subduction Zone. This zone is the result of the Juan de Fuca plate being pushed under the North American plate. Earthquakes centered along this zone can be as great as 9.0 magnitude. Geologic evidence demonstrates approximately 500 years between events with the last significant event on January 26, 1700. Aftershocks up to 7.0 magnitude are anticipated to

cause additional damage. Liquefaction, tsunamis and landslides are expected as a result of a great subduction earthquake.

5.3.5.2 History

Approximately 7,000 earthquakes in the Pacific Northwest have been documented over the past 200 years. This documentation has occurred sporadically, with only the most significant events being recorded until recent history. Currently, the University of Washington seismology laboratory records approximately 1,000 earthquakes of magnitude 1.0 or greater annually in Washington and Oregon. While most of these events are barely felt, anywhere from 12 to 24 earthquakes cause enough ground shaking to be recognized as an actual earthquake by area residents. Historic earthquakes are shown on Figure I-7. Table 5-9 shows magnitude 4.0 or greater earthquakes potentially felt in Columbia County since 1949.

Table 5-9. Magnitude 4.0 or Greater Earthquakes, 1949 - 2006

Date	Magnitude	Location
April 13, 1949	7.1	Olympia, WA
April 18, 1961	4.5	Albany, OR
November 5, 1962	5.5	Vancouver, WA
March 7, 1963	4.6	Salem, OR
March 25, 1993	5.6	Scotts Mills, OR
February 28, 2001	6.8	Anderson Island, WA
June 29, 2002	4.5	Mt. Hood, OR
June 30, 2004	4.4	Lakeview, OR
July 12, 2004	4.9	Newport, OR
July 22, 2004	4.3	Lakeview, OR
August 18, 2004	4.7	Newport, OR
July 14, 2008	4.2	Maupin, OR

5.3.5.3 Location

Columbia County is located within the geographical area bordering the Cascadia Subduction Zone. This zone is comprised of an 800-mile sloping fault and several smaller offshore faults located west of the Pacific Coast, from British Columbia to the north and Northern California to the south. The fault system separates the Juan de Fuca and North American plates. Inland, there are nine faults located within the USGS Quaternary Fault and Fold Database for the Salem 1° x 2° Sheet (44°- 45° by 124° -122°), including the Portland Hills Fault, East Bank Fault, and Mount Angel Fault. (Evarts 2005) Statewide, regional, and local earthquake fault and hazard areas are shown on Figures I-8 through I-10.

5.3.5.4 Extent

The extent of earthquake effects depends on the nature, magnitude, and location of the quake. An earthquake can range from a tiny tremor affecting only a small, localized area, to a major shake affecting an entire region. For hazard mitigation purposes, it should be considered that the extent of a major event would be greater than countywide.

During the rainy winter season, an earthquake may trigger a landslide. Areas with steep slopes and loose rock are most susceptible. The Cities of St. Helens, Columbia City, and Scappoose, may be subject to earthquake-induced landslides. To date, these "high" landslide potential areas of have received little development; although some residential areas are present.

Overall, an earthquake may affect water and sewer systems, natural gas lines, and power/electrical systems.

5.3.5.5 Probability of Future Events

Geological evidence indicates that damaging earthquakes (M 8.0 to M 9.0) may have occurred at least seven times in the last 3,500 years, suggesting a return interval of 300 to 600 years. While it is impossible to predict when an earthquake may occur, it is highly probable (1 event in 35 years) that a moderate earthquake (M 4.0 and greater) will occur along the Cascadia Subduction Zone, thereby affecting the jurisdictions in Columbia County.

Shaking hazard maps produced by the USGS consider two alternative scenarios for damaging earthquakes (M 8.3 or M 9.0) along the subduction zone. The shaking hazard maps show the level of ground motion that has 1 chance in 475 of being exceeded each year, which is equal to a 10 percent probability of being exceeded in 50 years. Any place within the planning area may be subject to earthquake. However, the jurisdictions in the western portion of Columbia County are more likely to be impacted by a major quake, because of their closer proximity to the Cascadia Subduction Zone. (Weldon 2003)

5.3.6 Volcano

5.3.6.1 Nature

A volcano is a vent or opening in the earth's crust from which molten lava (magma), pyroclastic materials, and volcanic gases are expelled onto the surface. Volcanoes and other volcanic phenomena can unleash cataclysmic destructive power greater than nuclear bombs, and can pose serious hazards if they occur in populated and/or cultivated regions. Ashfall and tephra, an eruptive hazard, are of the greatest concern in Columbia County.

There are four general types of volcanoes found within a short distance of Columbia County:

- **Lava domes** are domes that are formed when lava erupts and accumulates near the vent.
- **Cinder cones** are cone-shaped and formed by accumulation of cinders, ash, and other fragmented materials originating from an eruption.
- **Shield volcanoes** are broad, gently sloping volcanic cones of flat domical shape, usually several tens or hundreds of square miles in extent, built chiefly of overlapping and interfingering basaltic lava flows.
- **Composite or stratovolcanoes** are typically steep-sided, symmetrical cones of large dimensions built of alternating layers of lava flows, volcanic ash, cinders, and blocks. Most composite volcanoes have a crater at the summit containing a central vent or clustered group of vents.

Along with the different kinds of volcanoes there are different types of eruptions. The type of eruption is a major determinant of what physical results an event will create, and what hazards it poses. Six main types of volcano hazards exist:

- **Volcanic gases** are made up of water vapor (steam), carbon dioxide, ammonia, as well as sulfur, chlorine, fluorine, boron, and several other compounds. Wind is the primary source of dispersion for volcanic gases. Life, health, and property can be endangered from volcanic gases within about six miles of a volcano. Acids, ammonia, and other compounds present in volcanic gases can damage eyes and respiratory systems, and heavier-than-air gases, such as carbon dioxide, can accumulate in closed depressions and suffocate humans or animals.
- **Lahars** are formed when loose masses of unconsolidated, wet debris become mobilized, and are usually created by shield volcanoes and stratovolcanoes. Eruptions may trigger one or more lahar directly by quickly melting snow and ice on a volcano or ejecting water from a crater lake. More often, lahars are formed by intense rainfall during or after an eruption. Rainwater can easily erode loose volcanic rock and soil on hillsides and in river valleys. As a lahar moves farther away from a volcano, it will eventually begin to lose its heavy load of sediment and decrease in size.
- **Landslides** are common on stratovolcanoes because their massive cones typically rise thousands of feet above the surrounding terrain, and are often weakened by the very process that created the mountain – the rise and eruption of molten rock (magma). If the moving rock debris is large enough and contains a large content of water and soil material, the landslide may transform into a lahar and flow more than 50 miles from the volcano.
- **Lava flows** are streams of molten rock that erupt from a vent and move down slope. Lava flows destroy everything in their path. However, deaths caused directly by lava flows are uncommon because most move slowly, and flows usually do not travel far from the source vent. Lava flows can bury homes and agricultural land under hardened rock, obscuring landmarks and property lines.
- **Pyroclastic flows** are dense mixtures of hot, dry rock fragments and gases that can reach 50 mph. Most pyroclastic flows include a ground flow composed of coarse fragments and an ash cloud that can travel by wind. Escape from a pyroclastic flow is unlikely because of the speed at which they move.
- **Tephra** is a term describing any size of volcanic rock or lava that is expelled from a volcano during an eruption. Large fragments generally fall back close to the erupting vent, while particles of ash can be carried hundreds to thousands of miles away from the source by wind. Ash clouds are common adaptations of tephra.

5.3.6.2 History

Mount St. Helens has been the most active volcano in the Cascade Range during the past 10,000 years. In Oregon, awareness of the potential for volcanic eruptions was greatly increased by the May 18, 1980 eruption which killed 57 people. The upper portion of the summit collapsed in a massive landslide triggered by volcanic tremors. That portion of the mountain is now a

horseshoe-shaped crater partially filled by a lava dome. Early 19th Century settlers in the region witnessed eruptions occurring along the north flank area of the mountain.

As a result of the 1980 eruption and the far-reaching extent of the lateral blast, damage and reconstruction exceeded $1 billion. The coverage area was 230 square miles and reached 17 miles northwest of the crater. Impacts from pyroclastic flows covered six square miles and reached 5 miles north of the crater, and landslides covered 23 square miles. Lahars (mudflows) affected the North and South Forks of the Toutle River, the Green River, and ultimately the Columbia River as far as 70 miles from the volcano.

Mount St Helens' most recent eruption began in October of 2004, with initial steam and ash eruptions giving away to slow-moving lava flows which ceased in January of 2008.

Mount Hood erupted in approximately 1805. Two other minor eruption periods occurred during the last 500 years with some lava flow near the summit. The eruptions created pyroclastic flows and lahars with little ash fall. (State Interagency Hazard Mitigation Team 2006) The other volcanoes in the Pacific Northwest have undergone similar formation and eruption cycles.

5.3.6.3 Location

The extensive north-south oriented chain of volcanoes known as the Cascadia volcanic arc, or Cascade Range were formed by the Cascadia subduction zone. As the seafloor plate sinks beneath the North American Plate, it heats up and begins to melt, providing a vast reservoir of the heat and molten rock that create the magma chambers that become volcanoes.

Volcanoes near Columbia County include Mount St. Helens, Mt. Hood, Mt. Rainier, and Mt. Adams. The first three are active, and Mt. Adams is potentially active. Columbia County is approximately 40 miles from Mount St. Helens, and further away from the other volcanoes.

Historic volcanic eruptions are shown on Figure I-11.

5.3.6.4 Extent

The volcanoes nearest to Columbia County are far enough away that none of the more devastating near source hazards are likely to be experienced. Heavier tephra particles will generally not reach Columbia County.

The major hazard for Columbia County is ashfall – either minor ash falls from an eruption of Mount St. Helens or lesser ash falls from more distant volcanoes. Ashfall deposition is controlled by prevailing wind direction, which in the Cascades is predominately from the west. During previous eruptions, ashfall has drifted to the east of the volcanoes. (State Interagency Hazard Mitigation Team 2006) Volcanic eruptions may impact water bodies, such as the Columbia River at Longview and further downstream. River valleys are susceptible to debris flows, landslides, and lahars; rivers may require dredging to maintain channel depths for navigation.

Mount St. Helens, a stratovolcano, is located in southwestern Washington and is believed to be the volcano with the greatest potential to have a near-term impact on the region because of it's ongoing activity since the cataclysmic event in 1980. A large eruption of Mount St. Helens is expected to eject tephra to altitudes of 12 to 20 miles, with a deposition area of 40,000 square miles or more. Wind direction and velocity, along with the vigor and duration of the eruption, will control the location, size, and shape of the area affected by tephra fall.

Mount St. Helens most recently erupted in October of 2004, pushing ash more than 10,000 ft into the air, and lava flows continued until January 2008, after which activity ceased. The volcano has been recently downgraded from "Advisory" to "Normal", although another eruption in the near future is highly likely.

5.3.6.5 Probability of Future Events

By careful analysis of past activity, geologists can make general forecasts of long-term activity associated with individual volcanoes, but these are on the order of trends and likelihood, rather than specific events or timeline. Short-range forecasts are often possible with greater accuracy. Several signs of increasing activity can indicate that an eruption will follow within weeks or months. Magma moving upward into a volcano often causes a significant increase in small, localized earthquakes, and increased emissions of carbon dioxide and compounds of sulfur and chlorine that can be measured. Shifts in magma depth and location can cause changes in ground level elevation that can be detected through ground instrumentation or remote sensing.

The USGS has identified several other potentially active volcanoes in Washington, Oregon, and California. The effects of volcanic activity from these volcanoes could include landslide avalanches, lahars, tephra, lava, and pyroclastic flows or surges. Activity from one of these volcanoes is highly likely in the near future.

5.3.7 Wind

5.3.7.1 Nature

Wind is air flow that travels horizontally with respect to the Earth's surface. High winds are defined as those that last longer than one hour at greater than 39 miles per hour (mph) or for any length of time at greater than 57 mph. Wind speeds vary with individual storms.

In general, the damaging effects of windstorms may extend for distances of 100 to 300 miles from the center of storm activity. Many buildings, utility and transportation systems in open areas, natural grasslands, agricultural, or timberlands are especially vulnerable to wind damage.

Columbia County's most devastating windstorms typically occur from the south.

5.3.7.2 History

Columbia County has a two-year recurrence interval of sustained winds speed that ranges from 37 to 43 mph. Winds of this velocity may cause significant damage at sites where local wind speeds are higher than this average. Damage is more prevalent in clear-cut areas. The 50-year recurrence interval winds speed range from 56 to 62 mph, which can cause widespread wind damage.

Numerous damaging windstorms have occurred within Columbia County. Table 5-10 includes some of the most noteworthy windstorms that brought extensive damage to the region. (NOAA 2008b)

Table 5-10. Windstorm Events, 1950 – 2008

Date	Sustained Wind Speeds	Details
November 10–11, 1951	40 mph	Extensive timber, building, and utility losses and disruption. Damage experienced statewide. Statewide winds 40-80 mph
December 1951	42 mph	Serious damage to buildings and utility system disruption. Statewide winds 40-100 mph
December 21, 1955	60 mph	Extensive damage to buildings, power and telephone lines throughout the state. Statewide winds 55-70 mph
November 1958	51 mph	Extensive timber, building, and utility losses and disruption. At one point, all highways closed at one or more points from fallen trees. Statewide winds 50-75 mph
October 1962	62 mph (90 mph wind gusts)	Downed trees and power lines, utility disruption. The Columbus Day storm was the equivalent of a Category IV hurricane in terms of central pressures and wind speeds. The storm, which started east of the Philippines as Typhoon Freda, measured 1,000 miles long as it hit the West Coast. 38 fatalities, $200M damages statewide. Statewide winds 29-138 mph. Portland wind-116 mph
March 1963	39-68 mph	Widespread destruction. Statewide wind 39-100 mph
October 1967	70 mph	Extensive agricultural, timber, power and telephone utilities, and home losses Statewide 70 - 115 mph, one fatality and 15 injuries
March 1971	58 mph	Extensive roof damage, trees toppled, power line breakage, extensive utility disruption. Statewide wind 40-71 mph
November 1981	57 mph	Strongest windstorm since the 1962 Columbus Day storm. 57 mph winds. 75-92 mph wind along coast, gusts, 11 fatalities, $50M damages statewide
November 1997	52 mph	Trees uprooted
December 2007	52 mph	Heavy snowfall, rains, rapid temperature warming created widespread flooding, tree blockages, landslides, transportation and utility disruptions, and 5 deaths in Oregon. Statewide wind 50-100 mph $180M damages
November 2009	58 mph	**Strong winds were estimated based reports of power outages in communities along the Columbia River in northwest Oregon**
November 2011	81 mph	**A strong Pacific cold front brought strong southerly winds to the north and central Oregon Coastal range. Strong winds were reported with a gust to 81 mph, and then the sensor stopped reporting.**

Table 5-10. Windstorm Events, 1950 – 2008

Date	Sustained Wind Speeds	Details

Sources: *NOAA 2008b*
(Data from Western Region Headquarters NWS Historical Archives)
Tornadoes have occasionally occurred in Oregon and two tornadoes have been documented in Columbia County (NOAA 2008); one in August of 1978 near Scappoose, and the other in November of 1965 at Rainier. The nearby counties of Clatsop and Multnomah have experienced several tornado events. (Goettel 2005)

5.3.7.3 Location

Several Pacific low-pressure centers make landfall on the Northwest each winter. Winds blowing along a north to south axis (parallel to the major mountain ranges) can prove extremely destructive. The windstorm pattern in this area is typically southwesterly, flowing directly into the Pacific Northwest. Severe windstorms have historically impacted all jurisdictions in Columbia County.

The National Weather Service's extensive ENSO website delineates information explaining these weather patterns as they affect various US locations. They describe the Pacific Northwest's late fall and early winter El Niño effects as warmer than normal temperatures with decreased precipitation, while La Niña patterns exhibit increased storminess, precipitation, and cold. These patterns and trends appear in Oregon's historical weather events listing.

5.3.7.4 Extent

The low-pressure centers bring sustained winds (40-60 mph) strong enough to topple power lines and trees. These prolonged windstorms are likely to last an average of three to six hours before moving on.

5.3.7.5 Probability of Future Events

Windstorms producing winds gusting up to 70 mph or greater occur 1- 2 times every 10 years. High winds usually occur during October through April. Destructive windstorms are less frequent.

The preliminary research shows that El Niño events tend to shear weather systems apart as they approach the Northwest and La Niña events tend to have periods with enhanced high pressure, thereby producing enhanced cool, northerly flows. The wind-producing intervening neutral years tend to occur every 3-7 years.

Tornadoes have been documented in Columbia County and nearby counties; however, climate and weather conditions in Columbia County make the occurrence of major tornadoes unlikely. (Goettel 2005)

5.3.8 Erosion

5.3.8.1 Nature

Erosion is a process that involves the gradual wearing away, transport, and movement of land. However, not all erosion is gradual. It can occur quite quickly as the result of a flash flood,

coastal storm, or other event. Most of the geomorphic change that occurs in a river system is in response to a peak flow event. It is a natural process but its effects can be exacerbated by human activity.

Erosion is a problem in developed areas where the disappearing land threatens development and infrastructure. There are three main types of erosion that affect human activity in Oregon.

- **Coastal erosion** is the wearing away of land and loss of beach, shoreline, or dune material because of natural activity or man-made influences. It can occur gradually or suddenly. Usually erosion is a long-term process, but it can also happen quickly during storm events.

- **Wind erosion** occurs when wind removes, moves, and redeposits soil. It can cause a loss of topsoil, hindering agricultural production. Blowing dust can also reduce visibility and have a negative effect on air quality.

- **Riverine erosion** results from the force of flowing water in, and adjacent to, river, creek, and tributary channels. This erosion affects the bed and banks of the channel and can alter or preclude any channel navigation or embankment development. In less stable braided channel reaches, erosion and material deposition are a constant issue. In more stable meandering channels, episodes of erosion may only occur occasionally.

Riverine and wind erosion threaten various communities along the rivers, creeks, and tributaries in Columbia County. Erosion of any type rarely causes death or injury. However, erosion can cause significant destruction to property and infrastructure. The Columbia River is subject to tidal influences in the far distant lower river. Additionally, a major river reclamation project has taken away part of the natural floodplain north of Clatskanie. This combination of a high tide and reduced floodplain exacerbates flooding damages as these two conditions limit where excess Clatskanie River water can flow during a high-flow flood event. Flooding and erosion scour result from these two conditions.

Generally, erosion within the Columbia River occurs when the flow of the river changes and is directed towards the banks or mid-channel islands. These changes can be caused by surface wind stress and gravity waves during storm events (primarily severe winter storms), transporting sediment by bottom currents. (Sternberg 1986)

The reduction in peak river-flows due to the construction of dams and reservoirs have reduced the amount of sand reaching the lower river as well as reducing nearshore sediment movement in many areas of the Columbia River. (Mitchell 2008, O'Conner, 2003)

Rivers constantly alter their courses, changing shape and depth, trying to find a balance between the sediment transport capacity of the water and the sediment supply. This process is usually seen as the wearing away of the water course's banks and beds over a long time period.

Riverine erosion is often initiated by failure of an embankment causing high sediment loads, or by heavy rainfall. This generates high volume and velocity run-off, which will concentrate in the lower drainages within a river's catchment area. When the stress applied by these flows exceeds the resistance of the embankment material, erosion will occur. As the sediment load increases, fast-flowing waters will erode their banks downstream. Eventually, the river, creek, or tributary becomes overloaded or velocity is reduced, leading to the deposition of sediment further

downstream or in dams and reservoirs. The deposition may eventually lead to the watercourse developing a new channel.

While all rivers change in the long-term, short-term rates of change vary significantly. All rivers can be categorized based on their ability to adjust their shape and gradient as either bedrock or alluvial channels. Within Columbia County, the Columbia River is an alluvial channel. (Tetra Tech 1992)

5.3.8.2 History

Erosion loss has historically occurred in Columbia County from landslides, stream bank failures, and agricultural activities. All rivers and creeks are subject to erosion. Columbia County has over 200 rivers and creeks.

A series of dams were constructed along the Columbia River and its major tributaries from 1912 through the 1970s; the US Army Corps of Engineers dredged the Clatskanie River to accommodate navigational concerns in 1924 and lowered the channel depth to -7.5 feet National Geodetic Vertical Datum (NGVD) (referring to the elevation above or below mean sea level). Periodic dredging occurred until 1968 to maintain the channel depth, and again in 1998 by the City of Clatskanie.

The combination of dam construction, dredging, flow training device construction, and bank stabilization projects has affected river velocities and sediment transport. Only limited major alterations have occurred since 1970 to the lower river system. (Tetra Tech 1992)

The following descriptions provide a brief overview of historic erosion events in Columbia County.

- Sand Island, located east of the City of St. Helens in the Columbia River has experienced annual erosion loss.
- The shoreline at the Nehalem Street Bridge on the Clatskanie River lost 1.25 feet of depth between 1981 and 1996.
- A small side drainage coming into Conyer's Creek from the west caused road culvert damage. (City of Clatskanie, 1999)

5.3.8.3 Location

Columbia County has experienced erosion loss in several localized areas. Rivers, creeks, and tributaries within the county are subject to the effects of erosion include the Columbia, Clatskanie, and Nehalem Rivers, Beaver Creek, Conyer's Creek, Fox Creek, Nice Creek, Owl Creek, Rock Creek, and Bear Creek and several unidentified tributaries. The County experiences annual rain and wind events which assail river shorelines combined with landslides and debris flows within the watersheds, loss of plant cover in riparian areas, and river traffic induced erosion, particularly during severe storm events.

Historic erosion hazard areas and community identified areas of potential erosion hazards are identified in Figures I-12 through I-12G and in Table 5-11.

Table 5-11. Historic Erosion Hazard Areas within Columbia County

Community	Description of Location
City of Clatskanie[2]	A number of locations within the Clatskanie River Basin (City of Clatskanie and upstream) occur where portions of the stream bank are unstable Nehalem Street Bridge Dirt road along Conyer's Creek 25-75% of the Beaver Creek shoreline, which enters northeast of the City is subject to stream bank erosion.
Columbia City[1]	North of Columbia City at McBride Creek and Columbia River.
City of Rainier[3]	Nice Creek and Fox Creek as well as 25-75% of the Beaver Creek shoreline.
City of St. Helens[1]	Sand Island and Columbia River shoreline along city boundary
City of Scappoose[1]	Scappoose Creek (main and North and South areas as well as forks of Alder Creek and Coal Creek)
City of Vernonia[4]	Nehalem River, Rock Creek, Knickerson Creek, Sheely Creek, and Bear Creek

[1] Steering Committee Meetings, 2008.
[2] & [3] - Entranco, 1999
[4] – City of Vernonia, 1996

5.3.8.4 Extent

A variety of natural and human-induced factors influence the erosion process. For example, embankment orientation and exposure to prevailing winds (which can be altered by human development) all influence erosion rates. Other factors that may influence riverine erosion include:

- Geomorphology (composition)
- Structure types along the river embankments
- Development density
- Amount of encroachment in the high hazard zone
- Proximity of erosion-inducing structures
- Nature of the shoreline topography
- Embankment elevation
- Embankment wind exposure

The erosion rate depends on the sediment supply and amount of run-off reaching the watercourse. These variables are affected by many factors including earthquakes, floods,

climatic changes, loss of bank vegetation, urbanization, and the construction of civil works in the waterway.

Erosion along the banks of the rivers and streams in Columbia County is generally caused by a combination of factors:

- The natural process of a watercourse to find the path of least resistance.
- Debris flows within the watershed.
- Loss of plant cover in of riparian areas.
- Logging.
- Increased boat traffic close to river embankments.
- Runoff from rainfall.

While erosion has been identified as occurring within the county, only one event was reported to result in damage (City of Clatskanie culvert at Conyer's Creek). Additionally, the Clatskanie River is reported to have lost 1.25 feet of depth over a 15-year period. Based on past events and the lack of development in proximity to erosion hazard areas, the magnitude and severity of erosion impacts in Columbia County are considered negligible.

5.3.8.5 Probability of Future Events

Based on historic events it is possible that structures located near the shoreline of the Columbia, Clatskanie, and Nehalem Rivers, and numerous creeks and tributaries are vulnerable to erosion. Erosion data is limited to localized geographic areas within the County.

5.3.9 El Niño/Southern Oscillation

ENSO comprise two weather phenomenon known as El Niño and La Niña. While ENSO activities are not a hazard itself, it can lead to severe weather events and large-scale damage throughout the jurisdictions in Columbia County. Direct correlations have been found linking ENSO events to severe weather across the Pacific Northwest, particularly drought, flooding, and severe winter storms. (State of Oregon 2004) Therefore, increased awareness and understanding of the impacts of ENSO events on regional weather are important.

For more detailed discussions on drought, flood, and winter storms, please refer to their respective sections in this chapter.

5.3.9.1 Nature

ENSO weather patterns portray periodic warming and cooling of the central Pacific Ocean. This warming and cooling cycle has global implications as normal weather patterns are altered over vast areas of the world, causing changes in temperature and precipitation from Chile to Indonesia to the Pacific Northwest.

During El Niño periods, alterations in atmospheric pressure in equatorial regions yield an increase in the surface temperature off the west coast of South America. This gradual warming sets off a chain reaction affecting major air and water currents throughout the Pacific Ocean. In

the North Pacific, the Jet Stream is pushed north, carrying moisture laden air up and away from its normal landfall along the Pacific Northwest coast. In Oregon, this shift results in reduced precipitation and warmer temperatures, normally experienced several months after the initial onset of the El Niño. (Taylor 2008a) These periods tend to last nine to twelve months, after which surface temperatures begin to trend back towards the long-term average.

La Niña periods ensue when surface temperatures increase past the long-term average. Typical weather patterns throughout the Pacific Ocean are strengthened, yielding stormier than normal weather throughout the Pacific Northwest. Above average precipitation and colder temperatures are experienced across Oregon during these periods, with the potential for severe snow storms increasing. (Taylor 2008a) These periods generally last longer than El Niño events, taking anywhere from one to three years to dissipate.

Both El Niño and La Niña periods tend to develop between March and June, and peak from December to April. (NOAA 2005)

5.3.9.2 History

An examination of past ENSO patterns show El Niño and La Niña events are regularly observed in Oregon. Direct correlations have been found linking precipitation, temperature, and snowfall with ENSO across Oregon, including Columbia County (Taylor 2008a). In general, El Niño periods result in warmer temperatures and lower precipitation, while La Niña periods are colder and wetter. (Lubomudrov 2008)

Strong El Niños of 1982 and 1997 were observed throughout the state, and the El Niño in 1994 resulted in widespread drought conditions. Alternatively, severe flooding caused by the heavy snow and intense rain in the winters of 1995-1996 and 1998-1999 were due to La Niñas. (State of Oregon 2004)

5.3.9.3 Location

ENSO weather pattern effects are experienced on a global scale. Any local climate changes experienced in Columbia County will be reflective of a much broader trend impacting the entire Pacific Northwest. Hazards resulting from one of these periods will most likely be spread across large regions of the state, with adjoining counties experiencing similar conditions.

5.3.9.4 Extent

Columbia County has a climate generally consisting of wet winters and dry summers. (Taylor 2008b) During El Niño years, decreased precipitation and increased temperatures throughout the winter can lead to drought. Alternatively, increased precipitation and decreased temperatures associated with La Niña periods can result in widespread flooding and severe winter storms.

5.3.9.5 Probability of Future Events

As climate scientists continue to unravel the oceanic and atmospheric relationships governing ENSO, predictive powers are growing. 1997 marked the first time an El Niño was accurately forecasted, and as more studies detail how ENSO impacts the Pacific Northwest, and Oregon in particular, hazard mitigation agencies will benefit from increased warning time. ENSO generally

follows a two to seven year cycle, with El Niño or La Niña periods occurring every three to five years. However, the cycle is highly irregular, and no set pattern exists. (Taylor 2008a) Furthermore, variations are likely to continue, and not all droughts and floods are related to El Niño or La Niña events. (State of Oregon 2004)

5.3.10 Expansive Soils

5.3.10.1 Nature

The addition of moisture to any soil will cause a change in volume, which is referred to as a shrink-swell characteristic. (USDA NRCS 2008) Expansive soils are typically comprised of clay minerals that, under some conditions, are capable of increasing in volume when moisture is added. Clay soils consist of mineral particles that are less than 0.002 millimeters in diameter.

Linear extensibility is used to determine the shrink-swell potential of soils. Linear extensibility refers to the change in soil volume as the moisture content is decreased from a moist to a dry state. The amount and type of clay minerals in the soil influence volume change. The volume change is described as a percentage value change for the soil being tested. A low shrink-swell potential is considered less than a 3% change in soil volume (Table 5-12); whereas a high shrink-swell potential is greater than 6% change in soil volume. (USDA NRCS 2008)

Table 5-12. Expansive Soil Criteria Based on Shrink-Swell Potential

Shrink-Swell Potential	Linear Extensibility (%)
Low	< 3
Moderate	3 - 6
High	6 - 9
Very High	> 9

Source: NRCS National Cooperative Soil Survey

Soil expansion may be caused by changes in soil moisture, variations in thickness and composition of the expansive foundation soil, non-uniform structural loads, and the geometry of the structure. (US Army 1983) Potential sources of moisture changes are variation in precipitation, poor gutter or water drainage, vegetation changes over time (such as root growth of nearby trees), and plumbing leaks. By affecting the relative moisture of soils underlying foundations, uneven movement such as localized heave can occur, causing shifting and non-uniform foundation movements, thus impacting the structures above.

However, many sources of soil moisture change can be avoided, minimized, or mitigated through planning and structure maintenance. Some signs of possible soil expansion include: separation of joints and trim; cracks in walls, floors, or concrete; and bowed or non-vertical walls. Some possible mitigation measures are maintaining separation between structures and runoff, using compact fill to shed water, not absorb it, and planting trees a distance equal to their mature height away from buildings to reduce root interference.

Several different types of soil expansion related to structures and infrastructure exist, which can include but are not limited to:

- Doming heave - upward, long-term, dome-shaped foundation movement that develops over many years,
- Cyclic heave - shrink and swell associated with seasonal or water leak events,
- Edge heave - damaging edge or dish-shaped heaving, and
- Lateral movement – lateral thrust of expansive soils.

5.3.10.2 History

In 1982, expansive soils were documented as the most costly natural hazard in the US, causing more damage than all other natural hazards combined, including earthquakes, floods, tornadoes and hurricanes. (FEMA 1982) Annual losses nationwide have been estimated between $2 billion and $9 billion. (Jones and Jones 1987) While expansive soils occur in Columbia County, there have been no historic damages reported.

5.3.10.3 Location

In Columbia County, approximately 18,925 acres contain soils with "moderate" to "high" rated shrink-swell potential, concentrated mainly in the northern portion of the county and along the Columbia River.

Potential damages to structures from expansive soils in Columbia County include: cracks in grade beams, walls, and drilled shafts; distortion and cracking of pavements and on-grade floor slabs; failure of steel or concrete blocks supporting grade beams; jammed or misaligned doors and windows; and buckling of basement and retaining walls due to lateral forces. Extensive damage can potentially result in the condemnation of structures. (US Army 1983)

Expansive soil locations are shown on Figures I-13 through I-13D.

5.3.10.4 Extent

The geographic extent of expansive soil events are directly dependant on the extent of clay-based expansive soil types and the size and type of moisture event that triggers the soil expansion. Another dependant factor for the extent is the amount and type of infrastructure that exists at the expansive soil location and near proximity, as well as the percentage volume change of the swelling or shrinking soil. The extent of expansive soil effects could be very local and limited to a single structure (i.e. resulting from a plumbing leak), or more landscape in nature due to a large area of soil moisture change (i.e. resulting from a large flood or storm event).

5.3.10.5 Probability of Future Events

Expansive soil events are difficult to predict because the location and time when water is available to the soil could happen at various periods in the life of a structure. Most soil expansion and associated structural damage has been shown to occur within five to eight years following construction. However, the effects of heave may also not be observed for many years until some change occurs in the foundation conditions to disrupt the moisture regime. (PCCDD 2006) The probability of damages increases for structures on expansive soils if the climate,

effects of construction, and effects of occupancy promote moisture changes in the soil. (US Army 1983)

5.3.11 Drought

5.3.11.1 Nature

Drought is variously defined as a period of abnormally dry weather creating hydrologic imbalance, shortage of precipitation adversely affecting crops, or a period of below-average water in streams and lakes, reservoirs, aquifers, and soils. (USGS 2008) There is no universal measure of precipitation or dryness that signifies drought. Historically, droughts have been seen as unpredictable and unavoidable events. Climate fluctuations occur everywhere, and periods of low precipitation are a normal, recurrent feature of climate.

Drought is commonly referenced in terms of its effects on agriculture, with crop damage or failure used to measure its effects. Other direct environmental effects of drought include livestock death or decreased production, wildland fire, impaired productivity of forest land, damage to fish habitat, loss of wetlands, and air quality effects. Indirect effects to society are measured by the economic and physical hardships brought on by drought and by the increased stress on residents of a drought-stricken area. (ONHW 2004) The economic impact of drought is estimated between $6 and $8 billion annually in the United States. These costs primarily affect agricultural, forestry, fisheries, recreation and tourism, transportation and energy sectors. Drought is also associated with insect infestation, disease, and wind erosion. (ONHW 2006)

Drought is usually thought of as a meteorological phenomenon, resulting from abnormally low precipitation. It can also be an institutional phenomenon, resulting from poor management of water supply and reserves – an imbalance in supply and demand – and is often due to a combination of these factors. Understanding drought as a recurring climate cycle is a first step toward creating management practices that effectively mitigate its effects.

Drought is difficult to measure, due to its diverse geographical and temporal nature, and its operation on many scales. Despite that difficulty, various indices for measuring and characterizing drought can be useful. The Palmer Drought Indices and the Standardized Precipitation Index are most commonly used. Palmer's indices describe water balance—looking at water supply (precipitation), demand (evapotranspiration), and loss (runoff)—on three scales; weekly during growing season, long-term cumulative measured by month, and another long-term scale that takes into account hydrological factors such as reservoir and groundwater levels. These are the Crop Moisture Index, the Palmer Drought Severity Index, and the Palmer Hydrological Drought Index, respectively. The Standardized Precipitation Index considers precipitation alone, comparing the probability of a region's receiving a given amount of precipitation (based on historical levels) in a given time period with precipitation actually recorded. (NOAA 2008d)

There are four types of drought: meteorological, agricultural, hydrological and socioeconomic. Meteorological drought is based on the degree of dryness. Agricultural drought focuses the amount of soil moisture versus the needs of the crops. Hydrological drought is associated with shortfalls of surface and subsurface water supply. Socioeconomic drought refers to physical water shortages and its human effect, and occurs when the need for water exceeds the supply resulting in a shortfall. (ONHW 2006)

5.3.11.2 History

Drought occurs in all parts of Oregon, and has had profound effects in the past on the state's economy, particularly the agricultural and hydro-power sectors. Environmental consequences have included insect infestations in forests, insufficient stream flows to support endangered fish species, and increased susceptibility to fire.

The following past drought events were recorded for Columbia County:

- 1928-1941 – Statewide prolonged drought caused major agricultural problems
- 1976-1981 – Stream flows were low for western Oregon; 1976 and 1977 were the driest years of the century.
- 1985- 1994 – Ten consecutive years of drought cause problems statewide; fires were common and insects attacked trees; a drought emergency was declared in 1992.
- 1999 – Drought reduced spring and summer agriculture yields and delayed planting of winter wheat. (NOAA 2008d)
- 2000-2001 – Severe drought conditions; October 2000 to February 2001 was the second driest period of record in Washington and Oregon.
- 2005 – February 2005 was the driest since 1977. (ONHW 2006)

5.3.11.3 Location

Droughts occur in every climate zone, and can vary from region to region. Drought occurs in all parts of Oregon, and has had profound effects on the state's economy, particularly the agricultural and hydro-power sectors. All jurisdictions in Columbia County are susceptible to drought.

5.3.11.4 Extent

Drought is often associated with El Niño events affecting the polar and subtropical jet streams. The polar jet stream dips southward causing the northwest to be drier than average. The severity of drought depends on the degree of moisture deficiency, duration, and size of the affected area. The agricultural sector is usually the first to feel the impacts of drought because of its dependence on soil moisture. Those reliant on surface and groundwater sources are usually the last to feel the effects of drought. (ONHW 2006)

5.3.11.5 Probability of Future Events

As part of a statewide HMP process, county emergency management program managers conducted risk analyses to determine probability of, and vulnerability to, severe drought occurrence in each county. Oregon's Partnership for Disaster Resilience assesses Columbia County as having an "average risk" for drought; a future drought affecting the planning area is likely. (*Partnership* 2008)

Drought appears to be a cyclic part of the climate of Oregon, occurring in both summer and winter, with an average recurrence interval between 8 and 12 years. Short-term, seasonal events

are more frequent, while the less frequent, long-term events have ranged from 3 to 12 years in length.

Estimating drought probability and frequency is difficult, but understanding cyclic climate variations and other variables that contribute to weather behavior is advancing. (State Interagency Hazard Mitigation Team 2006) Understanding ENSO weather systems are helping scientists to better predict weather changes in the Pacific Northwest.

5.3.12 Dam/Levee Failure

5.3.12.1 Nature

Dams are impervious artificial barriers typically constructed of earth, rock, concrete, or mine tailings. The purpose of a dam is to divert water or impound (store) water, wastewater, or liquid-borne materials for any one or a combination of several reasons including: flood control, human water supply, irrigation, livestock water supply, energy generation, and containment of mine tailings, recreation, and pollution control.

Dams can be embankment dams constructed with excavated natural materials or masonry dams constructed with stone, brick or concrete blocks painted with mortar. Most dams are built at the narrowest part of a river on a stable foundation made of concrete, rock, or compacted soil. The abutments of a dam can be the natural valley walls or constructed of artificial materials when a natural abutment is not suitable. There are several types of dams named for the primary material used in construction, the primary purpose of the dam, and/or the way they are engineered to function. Common types of dams include:

- **Diversion Dam:** diverts water from one waterway to another waterway
- **Arch Dam:** a concrete dam that is convex on the upstream side and concave on the downstream side, taking advantage of the water load itself to compress the concrete, and allowing the majority of water load to shift to the abutments
- **Overflow Dam:** designed to be overtopped
- **Regulating Dam:** designed to regulate water flow downstream
- **Gravity Dam:** constructed of masonry materials wherein the weight and internal strength provides stability

Levees are man-made structures, usually an earthen embankment, designed and constructed with sound engineering practices to contain, control or divert the flow of water in order to provide protection from temporary flooding. A levee is built parallel to a body of water (most often a river) to protect the lives and properties behind it.

Dam inundation is the flooding that occurs resulting from the structural failure of a dam (breach) or mis-operation (unscheduled release). Outlet works and spillways allow dam managers to make scheduled releases when necessary, e.g., to prevent damaging flooding. Dam failures can result from any one or a combination of the following causes:

- Prolonged periods of rainfall and flooding
- Seismic activity/Earthquake

- Landslides into reservoir or onto dam itself
- Inadequate spillway capacity, resulting in excess overtopping flows
- Internal erosion caused by embankment or foundation leakage or piping
- Improper design or construction
- Improper maintenance or operation
- Failure of upstream dams on the same waterway
- Vegetation growth
- Structural integrity loss from burrowing small animals

Dam failures can create flash floods that are catastrophic to life and property. Seismic activity can directly cause dam failure, and can also generate a wave capable of overtopping a dam, which may inundate the surrounding area but not cause dam failure. Two factors that influence the potential severity of a full or partial dam failure include: (1) the amount of water impounded, and (2) the density, type, and value of development and infrastructure located downstream.

The hazard potential for dams is determined by the downstream damage that could result from improper operation or dam failure. It is important to note that neither the integrity of a dam nor the probability of failure are considerations when determining the hazard potential. The hazard potential rating for dams describes only the extent of expected losses if the dam were to fail. Hazard potential categories are organized into three tiers:

High hazard: dam failure or improper operation would probably cause loss of life. Economic, environmental, and lifeline losses are also likely but not necessary for this rating, which is based solely on probable loss of life.

Significant hazard: dam failure or improper operation would cause property damage or temporary loss of roads or utilities, with a remote chance of loss of life.

Low hazard: dams would have little or no effect to life and property downstream in the event of failure or improper operation.

5.3.12.2 History

The National Performance of Dams Program records no dam failures for dams located in Columbia County.

5.3.12.3 Location

Dams and reservoirs have been built throughout Columbia County primarily for the purposes of irrigation and water diversion. The National Inventory of Dams (NID), maintained by the US Army Corps of Engineers, is a database of all dams in the United States that either pose a significant or high hazard, or that meet inclusion criteria for dam height and storage (exceed 25 feet in height and 15 acre-feet of storage, or exceed 6 feet in height and 50 acre-feet of storage). There are many dams too small to be listed in the NID, but these small dams are not expected to have significant impacts if they fail. The storage capacities of reservoirs and impoundments in the planning area range from a few acre-feet to several thousand acre-feet. The water from most

of these reservoirs eventually makes its way to the Pacific Ocean by way of several river systems. NID listed dams in Columbia County are summarized in Table 5-13.

Table 5-13. National Inventory of Dams Listed Dams in Columbia County

Dam Name	Waterway	Downstream City	Owner	Year	Storage (acre-feet)	Hazard	EAP
Vernonia Log Pond	Nehalem R	Vernonia	ODFW	1924	170	Significant	No
Fisher, James O Reservoir	Sly Creek (tributary)	None	Betsy Johnson	1971	36	Low	No
Petes Slough Reservoir	Petes Slough	None	State Hwy Division	1980	2,000	Low	No
Rainier City Reservoir	Fox Creek	Rainier	City of Rainier	1952	14.5	Significant	No
Floeter Pond Reservoir	E Fork Nehalem River		ODFW	1962	9	Low	No
Salmonberry Reservoir	Salmon Creek	Trenholm	City of St. Helens	1960	61	Significant	No
Sherman Stock Reservoir#1	Sly Creek (tributary)	Warren	Jeff & Beverly Heller	1962	36	Significant	No
Sherman Stock Reservoir#2	Trib of N Scappoose Creek	Warren	Clark W Sherman	1950	13.7	Low	No
Bauder Reservoir	West Fork Clatskanie River		Rudolph Bauder	1996	15.0	Low	No
Deep Lake Reservoir	Cunningham Slough		ODFW	2002	102	Low	No
Ruby Reservoir	Cunningham Slough		ODFW	2002	240	Low	No
Millionaire Lake Reservoir2002	Cunningham Slough		ODFW	2002	120	Low	No
Fishhawk Lake*	Fishhawk Creek	Birkenfeld	Fishhawk Lake Rec. Club	1969	1,650	Significant	No

Source: NID, *available at*: http://crunch.tec.army.mil/nidpublic/webpages/nid.cfm
* Fishhawk Lake Dam is in Clatsop County, but is upstream of Birkenfeld in Columbia County, and therefore is included.
Oregon Water Resources Dept Dam Inventory available at:: http://apps2.wrd.state.or.us/apps/misc/dam_inventory/Default.aspx
EAP refers to whether or not the dam has an emergency action plan, which is not required for dams in the size range of those listed here. All dams in this table are RE (rockfill/earthfill) dams (primarily rockfill), with the exception of Vernonia Log Pond, which is a combination RE and earthfill/rockfill (ER) dam.

In addition to dams within or proximate to Columbia County, there is dam failure risk from numerous large dams upstream on the Columbia River and its tributaries, most notably the Willamette, Snake, and Lewis rivers. For instance, 22 major dams on the Columbia River represent over 40 million acre-feet of flood control storage, 11 dams on the Willamette River provide about 1.7 million acre-feet of flood control storage, (Goettel 2005) and three dams on the Lewis River provide approximately 12,420 acre-feet of flood control storage. (CCEM 2008) Inundation hazard areas are shown on Figures I-14 through I-14E.

5.3.12.4 Extent

The extent of dam failure effects in the planning area can be assessed region-wide or by each body of impounded water. Effects depend a great deal on the nature of the failure—for instance, whether a dam fails when retaining a normal level of water, or whether water influx is involved in the dam failure, which then involves a greater-than-usual volume of impounded water. Likewise, whether a dam is overtopped, damaged, or fails completely will make a great difference in volume of water released, and therefore in effects. An isolated dam failure, even a significant release, may have less significant impact than a series of dam failures caused by region-wide flooding.

Of the twelve dams within Columbia County, five of them would have a significant impact if breached. The volume of water held by each of these strategically located dams is large enough to create a chain reaction of flooding, property damage, and/or impairment of the local water supplies. Oregon's Water Resources Department advocates for a continued dialogue among dam owners and municipalities to practice emergency planning procedures to ensure public safety should such an event occur.

5.3.12.5 Probability of Future Events

Given that there are no recorded dam failure events in the county, it is impossible to predict the probability of future events of dam failure with significant effects on the jurisdictions along the waterways. The risk to the jurisdictions in Columbia County from upstream dams, and the history of dam failures in those areas, has yet to be evaluated. Also, it is important to note that global and regional climate change could alter the likelihood of dam failure in the planning area, if increasing storms and rainfall were to significantly change water inflow.

5.3.13 Disruption of Utility and Transportation Systems

The 2009 *Multi-Jurisdiction Hazard Mitigation Plan for Columbia County* treated disruption of utility and transportation systems as a separate hazard because, while such disruption is a potential impact of each of the natural and human-caused hazards reviewed, its ramifications are far-reaching and much broader than direct damage and direct loss of service. For continuity and ease of comparison, this revised plan will do the same.

It is important to remember, in considering any of the other hazards profiled in this plan, that disruption of utility and transportation systems should be viewed in addition to other impacts. The probability, duration, extent, and risk associated with disruption of systems is described below, and in some cases quantified. Electric power outages are dealt with in more detail than other disruptions because loss of electric power has the most widespread effects on other utilities.

5.3.13.1 Nature

The major transportation modes of significance to Columbia County are roads and railways. Both are subject to disruption from the hazards already profiled in this plan: flood, dam failure, landslide, earthquake, volcano, wind, fire, winter storm, infectious disease epidemic (quarantine, public transit restrictions), hazardous materials incidents, and terrorism.

The ramifications of transportation system disruption range from effects on life, health, and safety (emergency vehicle mobility, access to hospitals, access to evacuation routes, access to vital supplies if transport is seriously disrupted for an extended period of time) to the economic effects of delays, lost commerce, and lost time.

Similarly, disruption of utility systems can affect the county at the level of commerce and recreation as well as at the level of fundamental health and safety. Analysis of potential utilities disruptions is complicated because utilities like electric power, potable water, wastewater, natural gas, and telecommunications are all networks, consisting of nodes (centers where something happens) and links (connections between nodes). Networks typically have some level of redundancy built in, and the amount and nature of alternate pathways determines the robustness of the system to any particular disturbance. (Goettel 2005)

Many water treatment plants in Columbia County are located in flood-prone areas. Floodwater inundation can cause raw water to circumvent and contaminate source wells and filtration and treatment systems. Earthquakes can damage water storage, treatment, and transport systems. Water systems are also extremely vulnerable to power outages. Storage tanks are usually located 60 to 200 feet above the water customer network, and water is pumped into these tanks using electricity. Storage tanks typically contain one to two days' supply of water. Power outages of longer duration can result in a shortage of clean water for drinking and cooking—a basic requirement for public health. (Goettel 2005)

Wastewater management is also crucial for public health, and wastewater systems are similarly vulnerable to floods, earthquake damages, and power outages. Floods may cause collection pipes to overflow, and can cause inflow that exceeds treatment plant capacity, resulting in release of untreated or partially treated wastewater. Treatment plants are often located in low-lying areas, which facilitates gravity flow of collected wastewater to the plant. However, this means that treatment plants are often found in flood zones. Wastewater pipes and plants are subject to earthquake damage, and loss of power can result in plant shutdown and releases of untreated or partially treated water. (Goettel 2005) Public health hazards can be posed by backed up wastewater and sewage, as well as by releases of untreated or incompletely treated wastewater.

Natural gas systems (compression stations and distribution pipes) are vulnerable to seismic events, and compression stations are vulnerable to flood damage and power loss. Landslides, too, can affect natural gas systems. (Goettel 2005) Where it is used for cooking or heating, disruption of natural gas distribution will create difficulties. Leaks in enclosed areas present a health hazard, and it is both flammable and explosive, attributes which are addressed in the Hazardous Materials section.

Telecommunications systems (including telephone, broadcast radio and television, as well as cable networks) are generally somewhat less vulnerable to hazards than other services, given that few nodes (stations) are located in flood zones or landslide areas. Buried lines have more ability to stretch than do gas and water lines, and can usually accommodate several feet of ground movement before failing. Above-ground lines are vulnerable to falling trees or the failure of poles, but disruptions are about 10 times less common than electrical line failures—partly because electrical lines are the highest on utility poles and therefore the first to be hit by falling trees and branches, and partly because the much lower voltage of communications lines makes them much less vulnerable to arcing or shorting out if lines come very close to one another. (Goettel 2005) Telecommunications failures can have devastating impacts on a community.

Emergency response systems at the individual level (fire, police, ambulance) as well as at the disaster-response level rely on immediate, accurate communications.

Electrical power plants and transmission lines are vulnerable to most of the hazards covered in this Plan. Flood, fire, earthquake, volcano, intentional sabotage and/or terrorism are all threats to power sources and transmission and distribution lines. Columbia County has only one small (530 megawatt) generating plant (near Clatskanie). The bulk of the County's electrical power is produced outside the county and transmitted via high-voltage transmission lines—most of which are operated by the Bonneville Power Administration (BPA). BPA electricity comes from Corps of Engineers and Bureau of Reclamation operated hydroelectric power plants, and from the Pacific Interties, a high-voltage transmission system that moves electric power between California, the Pacific Northwest, and western Canada. Electric power is pivotal to modern life. Residential, commercial, and public facilities all rely heavily on electricity. Emergency facilities such as hospitals and emergency response centers typically are equipped with backup generators for critical life-support and communications functions. Nonetheless, the consequences of long-term and widespread electrical power outages are significant. Other utility systems, discussed above, are also dependent on electricity for normal operations, so loss of electric power can have serious secondary effects. In addition, power outages longer than a few hours can greatly increase the impact of riverine floods, as all of the drainage districts and drainage improvement companies within Columbia County rely on pumping to keep diked areas dry, even during non-flood conditions. (Goettel 2005)

5.3.13.2 History

System disruptions are deemed a secondary hazard or a result from a primary hazard event and receive discussion in the natural hazards sections throughout this document.

5.3.13.3 Location

Columbia County has and relies upon modern infrastructure. Transportation and utility systems are the basis of everyday life in both urban and rural areas of the county.

The County has worked with each community to identify critical system networks and links which may experience critical failure from these technological hazards. To that end, all jurisdictions communities have expressed that they have or are working to acquire emergency generators, bury utility lines, and ensure fuel availability for their critical infrastructure's sustainability. Many of the communities have also identified the need to work with their utility suppliers to encourage them to consider mitigating power line failure projects, developing plans for fuel distribution, and water-waste treatment alternatives.

The most common countywide relied upon critical components are summarized below in Table 5-14.

Table 5-14. Countywide Infrastructure Affected by Utility and Transportation System Disruptions

(Key: C – County, **CC** – Columbia City, **CL** – Clatskanie, **P** – Prescott, **R** – Rainier, **S** – Scappoose, **ST** – St Helens**, V** – Vernonia)

	Central Governance And EOC	Electrical Power Distribution	Emergency Medical Response And Care	Emergency Response Access/ Transportation Route	Emergency Response And Equipment Maintenance	Coordinate Emergency Infrastructure Repairs	Emergency Transportation	Fire Equipment/ Management, Emergency Response	Fuel Distribution/Public Health & Safety	Law Enforcement/ Emergency Response	Law Enforcement/ Confinement	Material Transportation	Possible Shelter/ Community Aid Centers	Public Health And Safety	Volunteer Organization/ Dispatch Center
Airport/Heliport							CL,S,V					CL,S,V			
City Hall	CC,CL, P,R,S, ST,V														
Courthouse/ Jail											CL,R,S				
Police/Sheriff Station										C,CC,C L,P,R, S,ST,V,					
Fire /Rescue Dept								CC,CL, P,R,S, ST,V							
Medical			CC,CL, S,ST,V												
Elec Pwr Distr / Comm		CC,CL, P,S,ST, V													
Potable Water Distr.														CC,CL, P,R,S, ST,V	
Waste Water Treatment														CC,CL, R,S,ST, V	
Public Work						CC,CL, R,S,ST, V								CC,CL, R,S,ST, V	
Maintenance						CC,CL, R,S,ST, V									

Table 5-14. Countywide Infrastructure Affected by Utility and Transportation System Disruptions

(Key: C – County, **CC** – Columbia City, **CL** – Clatskanie, **P** – Prescott, **R** – Rainier, **S** – Scappoose, **ST** – St Helens**, V** – Vernonia)

	Central Governance And EOC	Electrical Power Distribution	Emergency Medical Response And Care	Emergency Response Access/ Transportation Route	Emergency Response And Equipment Maintenance	Coordinate Emergency Infrastructure Repairs	Emergency Transportation	Fire Equipment/ Management, Emergency Response	Fuel Distribution/Public Health & Safety	Law Enforcement/ Emergency Response	Law Enforcement/ Confinement	Material Transportation	Possible Shelter/ Community Aid Centers	Public Health And Safety	Volunteer Organization/ Dispatch Center
Railroad							**CC, CL,P, R,S,ST**					**CL,P, R,S,ST**			
Bridges				**CC,CL, R,ST,V**			**CC,CL, R,ST,V**					**CC,CL, R,ST,V**			
Highway				**CC,CL, P,R,S, ST,V**											
Marina/Port				**CC,R, S,ST**			**CC,R, ST**					**CC,R**			
Private Fuel Distr.							**CC,CL, R,S,V**								
Private Nat. Gas Distr.							**CC,CL, R,S,V**								
Private Trans. Co.							**CL,S, ST**								
Churches													**CL,R, S,V**		
Schools & Distr Offices													**CC,CL, P,R,S, ST,V**		
Community/ Civic Ctr													**CC,CL,**		
Dam														**C,CL, R,S,ST, V**	

5.3.13.4 Extent

The extent of transportation or utility service disruptions is directly dependent on the nature and magnitude of the hazard. Minor hazard events may cause minor disruptions, while significant hazard events may cause long-term transportation and utility failures.

5.3.13.5 Probability of Future Events

Inclement weather, topography, and human influence are the usual cause for transportation and utility system failure events. Increased usage (portrayed by heavy traffic periods or increased utility needs such as summer air conditioning or winter heating) can exacerbate or accelerate these systems' failure rate. Consequently, Columbia County will continue to experience episodic utility failure.

5.3.14 Hazardous Materials

5.3.14.1 Nature

Hazardous materials can be defined as any materials having a negative impact on health; human, animal, aquatic, or environmental. Hazardous materials exposure may cause injury, illness, or death. Exposure impacts may be evident within seconds, minutes, or hours. Or impacts may not surface until days, weeks, or even years after exposure. Also, it is important to note that harmful effects can be short- or long-term.

Some hazardous materials are highly toxic so that even brief exposures to minute amounts may be dangerous or even fatal. Other hazardous materials are much less toxic. Negative effects may occur only after a significant exposure to large quantities of a substance, or exposure to smaller quantities for a prolonged period of time. The technical term "toxic," or "toxicity," which is widely used to describe hazardous materials, is simply a synonym for the more common terms "poison" or "poisonous." A toxin is thus defined as any substance that causes injury, illness, or death to living tissue by chemical activity.

The Institute of Hazardous Materials defines hazardous materials according to several regulatory agencies:

> *. . .any item or agent (biological, chemical, physical) which has the potential to cause harm to humans, animals, or the environment, either by itself or through interaction with other factors.* ***Hazardous materials professionals*** *are responsible for and properly qualified to manage such materials. This includes managing and/or advising other managers on such items at any point in their life-cycle, from process planning and development of new products; through manufacture, distribution, and use; to disposal, cleanup, and remediation.*
>
> *Hazardous materials are defined and regulated in the United States primarily by laws and regulations administered by the U.S. Environmental Protection Agency (EPA), the U.S. Occupational Safety and Health Administration (OSHA), the U.S. Department of Transportation (DOT), and the U.S. Nuclear Regulatory Commission (NRC). Each has its own definition of a "hazardous material."*
>
> *OSHA's definition includes any substance or chemical which is a "health hazard" or "physical hazard," including: chemicals which are carcinogens, toxic agents, irritants, corrosives, sensitizers; agents which act on the hematopoietic system; agents which damage*

the lungs, skin, eyes, or mucous membranes; chemicals which are combustible, explosive, flammable, oxidizers, pyrophorics, unstable-reactive or water-reactive; and chemicals which in the course of normal handling, use, or storage may produce or release dusts, gases, fumes, vapors, mists or smoke which may have any of the previously mentioned characteristics. (Full definitions can be found at 29 Code of Federal Regulations (CFR) 1910.1200.)

EPA incorporates the OSHA definition, and adds any item or chemical which can cause harm to people, plants, or animals when released by spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping or disposing into the environment. (40 CFR 355 contains a list of over 350 hazardous and extremely hazardous substances.)

DOT defines a hazardous material as any item or chemical which, when being transported or moved, is a risk to public safety or the environment, and is regulated as such under the: Hazardous Materials Regulations (49 CFR 100-180); International Maritime Dangerous Goods Code; Dangerous Goods Regulations of the International Air Transport Association; Technical Instructions of the International Civil Aviation Organization; U.S. Air Force Joint Manual, Preparing Hazardous Materials for Military Air Shipments.

The NRC regulates items or chemicals which are "special nuclear source" or by-product materials or radioactive substances. (See 10 CFR 20).

http://www.ihmm.org/dspWhatIsHazMat.cfm

Both Federal and State of Oregon statutes govern hazardous materials. Federal regulations include the Clean Air Act, Emergency Planning and Community Right to Know Act, and Superfund Amendments and Reauthorization Act. Oregon statutes are listed below:

- ORS Chapter 453, 453.001 to 453.185 and 453.605 to 453.807
- ORS Chapter 465, Hazardous Waste, Haz. Mat. I
- ORS Chapter 466, Hazardous Waste, Haz. Mat. II
- ORS Chapter 475, 475.405 to 475.495, Illegal Drug Clean-up
- ORS Chapter 480, Explosives, flammable materials, pressure vessels.

Hazards are found nearly everywhere; petroleum products, natural and synthetic gas, acids, and other acutely toxic chemicals found in everyday products such as paints, solvents, adhesives, household cleaners, pesticides and herbicides, batteries, and even medicines.

This plan does not focus on the hazards in everyday products, but rather on the larger quantities of hazardous materials classified as Hazardous Substances (HS) or Extremely Hazardous Substances (EHS) that are transported through the planning area by rail, highway, and air. Hazardous substances can present problems when spilled, however EHS potentially pose the most catastrophic threat as the category includes substances, such as chlorine and ammonia, which pose an acute inhalable toxic threat to humans and animals. (Alaska State HMP, 2007)

The toxicity of a specific substance is one important factor in determining the risk it poses, but there are other factors that can be just as, if not more, significant. Factors affecting the severity of an accidental release include toxicity, quantity, dispersal characteristics, release location, population density, environmental sensitivity, and efficacy of response and recovery actions.

Hazardous materials are generally classified by their primary health effects on humans. Some common types include the following:

- Anesthetics and narcotics depress the central nervous system.

- Asphyxiants interfere with normal breathing and can cause suffocation.
- Explosives: pose explosion, fire, and chemical danger.
- Flammable materials catch fire easily, although they may pose other dangers such as explosion or chemical effects. Gasoline, propane, and diesel fuel are common examples in this category.
- Irritants cause burns or irritation to body tissues such as eyes, nose, throat, lungs, or skin.

Hazardous substance exposure generally takes place by one, or a combination of, the following mechanisms:

- Direct contact with skin or eyes
- Ingestion via contaminated food or water
- Particulate or gas inhalation via contaminated air

Releases of HS and EHS can occur at facilities or during transport. Transportation-related releases are generally more troublesome because they may occur anywhere, including close to human populations, critical facilities, or environmentally sensitive areas. Transportation-related EHS releases can also be more difficult to mitigate due to the great area over which any given incident might occur, and the potential distance from response resources.

Natural phenomena may also cause a hazardous materials release and complicate response activities from not only the primary but also subsequent or combined secondary events. For instance, earthquakes pose a particular risk, because they can damage or destroy facilities, fires can develop, explosions can occur, and high winds can disperse the released chemical. The threat of any hazardous material event may be further amplified by restricted access, reduced fire suppression, and spill containment capability. Response personnel and equipment may have their access cutoff as roads, highways, or railroad traffic are impeded. EHS releases can trigger evacuation and short- or long-term displacement creating social and business disruptions.

5.3.14.2 History

On behalf of several federal agencies including the EPA and Department of Transportation, the National Response Center serves as the point of contact for reporting oil, chemical, radiological, biological, and etiological discharges within the U.S.

Table 5-15. National Response Center "Incidents" 1997 – 2007, Columbia County Oregon

Entity	Toxic Releases Reported	Air Releases Reported	Transport Accident	Rail	Pipeline	Other
Columbia County Total	**17**	**21**	**54**	**-**	**3**	**13**

City of Clatskanie	3	1	4	-	1	4
City of Columbia City		1	2	-	-	1
City of Prescott	-	-	-	-	-	-
City of Rainier	-	-	7	-	-	1
City of Scappoose	3	-	6	-	-	-
City of St Helens	6	17	22	-	2	4
City of Vernonia	3	2	7	-	-	3

From the State Fire Marshal's Hazardous Substance Information Data Base at *http://www.sfm.state.or.us/CR2K_IncDB/Incident_Search.html*

5.3.14.3 Location

Hazardous substances are found throughout Columbia County jurisdictions. The Oregon Fire Marshal's Office has documented 15 EHS sites with 6 identified substances as shown in Table 5-17. Additionally, 218 facilities within Columbia County jurisdiction possess HS (1,677 identified substances) as shown in Table 5-16. The County's six major cities account for only 42 percent of the facilities within the county overall. Gas stations, garages, automotive repair facilities, millwork, manufacturing, food processing plants, agricultural supply, petroleum, natural gas, and school laboratories, public swimming pools, are HS and EHS users. The vast majority of these sites would be places where an unintentional release would create an extremely localized event. Manufacturing and woodworking sites where EHS are used regularly could also create site-specific contamination from repeated spills or improper storage. The greatest exceptions to this would be an accident involving large EHS quantities used at large industrial complexes or being transported by either road, water, or rail.

Table 5-16. Hazardous Substances Listed Sites, Columbia County

Entity	# Facilities Reporting Substances
Columbia County	**218**
City of Clatskanie	30
City of Columbia City	14
City of Rainier	34
City of Scappoose	51
City of St Helens	61
City of Vernonia	28

As listed on http://www.sfm.state.or.us/CR2K - facility search

Hazardous materials at fixed sites are generally identified by an NFPA (National Fire Protection Association) placard, commonly referred to as the NFPA hazard diamond.

For Columbia County, the Hazardous Substance Information System **(**HSIS) database has hazardous materials reports for 610 companies and other entities such as cities that are required to report quantities of hazardous materials on hand. Of these reporting locations, 256 or about 42%, have reportable quantities of hazardous materials.

More detailed information about hazardous materials can be found online in the State Fire Marshal's CR2K Hazardous Substance Information Program.

Table 5-17. Geographic Distribution of EHS Sites in Columbia County

Community	Number of EHS Sites
City of Clatskanie	5
City of Columbia City	1
City of Rainier	2
City of St. Helens	3
City of Scappoose	0
City of Vernonia	2

As listed on http://www.sfm.state.or.us/CR2K - facility search

Of these 15 sites with EHS chemicals in Columbia County, 6 are telephone company sites which presumably contain small quantities of sulfuric acid. There are two forest product company sites and a utility site which contains sulfuric acid and other chemicals, along with several commercial/industrial sites that appear to contain only small quantities of EHS.

The (confidential) facility in Deer Island appears to be the only facility in Columbia County that contains substantial quantities of EHS. The Company Report for this facility in the HSIS database lists a total of 58 chemicals, of which only six, anhydrous ammonia and ammonium hydroxide, ammonium nitrate, nitric acid, urea fertilizer, and urea ammonium nitrate solution appear to be present in large quantities. Of these six chemicals, only anhydrous ammonia and nitric acid are classified as EHS.

In addition to fixed facilities, hazardous material events have the potential to occur along Highway 30. The trucks and trains that use these transportation arteries commonly carry a variety of hazardous materials including gasoline, other crude oil derivatives, and other chemicals, such as chlorine, known to cause human health problems.

The Oregon Department of Transportation (ODOT) monitored the movement of hazardous materials on Oregon roads in 1987 (most current data available). The study was conducted in three phases over three different three-day periods. Phase I was conducted in March, Phase II in August, and Phase III surveyed ports of entry at or near the borders of Washington, California, and Idaho in November.

During Phases I and II, checkpoints were set up at 11 weigh-scale locations on various interstate highways (I) 5 and 84, U.S. highways 30, 26, and 97, and State Road (SR) 99W, 99E, and 6. One checkpoint was set up in Scappoose in Columbia County on west U.S. 30.

A total of 2,511 hazardous materials placarded vehicles, representing 3,637 shipments, and 208 different hazardous commodities were surveyed. The study determined 5.5 percent (%) of total truck traffic at the survey sites carried hazardous materials. Vehicles marked with FLAMMABLE or COMBUSTIBLE placards ranked first with 54%, followed by CORROSIVE placards marking 16% of the 2,511 vehicles. Most DANGEROUS placarded vehicles carried both flammable and corrosive liquids together.

A total of 2,189 deliveries were bound for Oregon destinations, serving 186 cities in 36 counties. At the ports of entry, 35% of all vehicles were bound for out of state destinations. Most hazardous materials moved over the roads between 6 a.m. and 6 p.m. (70%) and 38% of those occurred between 8 a.m. and noon. DANGEROUS –placarded vehicles moved mostly at night between 6 p.m. and 6 a.m. Hazardous materials carrying vehicles moved at a rate of 46.5 per day or nearly 2 vehicles per hour.

Average hazardous material movement in Scappoose was recorded at 39 vehicles per day or 1.6 vehicles per hour. The checkpoint at Scappoose recorded 7.2% of the hazardous material truck traffic. Shipments bound for Columbia County included gasoline, sodium hydroxide, fuel oil, diesel fuel, oxygen, aluminum sulfate solution, and oxygen refrigerated liquid. Trucks made 127 stops in Columbia County, and 141 vehicles carrying hazardous materials passed through. Today, more than 10 million tons of freight are transported through the county annually.

Large and small facilities can experience hazardous materials events from product delivery systems via road or rail transportation events. Transportation events occur along US Highway 30 and along the railroad corridor. The trucks and trains that use these transportation arteries commonly carry a variety of hazardous materials including fuel, crude oil derivatives, and chemicals. Chlorine, ammonia, acids and other chemicals can be very devastating to human and animal life and the environment. Hazardous materials may be transported once or many times during their "life cycle" as raw materials, manufacturing, incorporation in other products, wholesale and retail trade, use, waste disposal, and recycling. The transport of hazardous materials may be local (within a single city), across a state, across the country or internationally.

For Columbia County, a general perspective on hazardous materials incidents is provided by annual statistics of hazardous materials incidents, prepared by the OSFM. These incident reports include all reported hazardous material incidents, at fixed sites and during transportation, except generally excluding:

a. motor fuels which are spilled in quantities less than 42 gallons,

b. sewage overflows,

c. structure fires or other emergencies where hazardous substances are involved as exposures, if the quantities exposed are less than 42 gallons.

For Columbia County, the general pattern of hazardous materials is likely to be similar to the statewide pattern and to be the most commonly involved materials (i.e., drug lab chemicals, fuels, and motor vehicle fluids) (Table 5-18).

Table 5-18. Hazardous Materials Incidents 2000-2007, Reported Categories of Hazardous Materials

Chemical	2000	2001	2002	2003	2004	2005	2006	2007
Diesel, Gasoline, Fuel Oil	1	-	5	-	4	5	2	2
Antifreeze, motor oil, hydraulic fluid, transmission fluid	5	2	2	-	1	-	-	5
Unknown chemical	-	1	1	5	12	5	3	-
No chemical involved	1	1	1	-	-	1	-	-
Other chemicals	-	4	13	14	2	8	4	3
Total	7	8	22	19	19	19	9	10

Source: National Response Center Database

Areas located within 0.25 miles of EHS sites and major transportation routes are identified on Figures I-15 through I-15H as areas that may be at risk of a hazardous materials event.

5.3.14.4 Extent

The extent of hazardous materials risk from any given incident depends heavily on materials dispersed, weather conditions, and water presence. Some materials, such as acids, tend to have localized fumes and destruction, while others can displace oxygen and cause suffocation. Many hazardous liquids and gases depend on wind for dispersal. Water can compound the hazard by dispersing materials or through reactions that convert chemicals into a gaseous state.

The low number of hazmat incidents for Columbia County reflects the relatively low population of the county (with correspondingly, few shipments of fuels and other hazardous commodities relative to a more populated county). Another contributing factor may be the fact that there are no major interstate highways or major through roads between major population centers passing through Columbia County.

For Columbia County, the most likely road/highway hazmat incidents involve the common chemicals shown in Table 5-19. In addition, chemicals necessary for the forest products and fertilizer industry facilities in the county may also be involved in hazmat incidents, along with outgoing shipments of fertilizer products. Road/highway hazmat incidents are most likely along Highway 30 which connects most of the population centers in the county and most of the major industrial facilities using or shipping potentially hazardous materials.

The Mist-Birkenfeld gas pipeline extends towards the southeast to connect to transmission lines in the greater Portland area and runs north to connect to a pipeline running along the Highway 30 corridor. Each of the larger cities in Columbia County (including Scappoose, St. Helens, Columbia City, Rainier, Clatskanie, and Vernonia) and many smaller communities have local natural gas distribution systems connecting to transmission lines.

Columbia County also has a natural gas distribution system operated by Northwest Natural Gas. The natural gas pipeline systems of local gas utilities, including the systems in Columbia County, almost always follow road and street patterns because of established utility rights of way and because of the need to connect with each building served. Thus, for areas served by natural gas, the local street network is essentially identical to the natural gas distribution pipe network.

The only freight railroad serving Columbia County is the Portland & Western Line that runs from Astoria through Columbia County along the Highway 30 corridor to Portland. Specific data on hazmat shipments for this rail line were not available for this mitigation plan. However, the most likely chemicals for potential spills are generally similar to those noted above for road shipments within Columbia County.

The toxicity of particular hazardous materials is an important measure of the potential impact of hazardous materials on affected communities, but not the only important measure. Other characteristics of hazardous materials, especially the quantity of material and the ease of dispersal of the material may be as important, or more important, in governing the level of potential threat to a community.

5.3.14.5 Probability of Future Events

There are many fixed locations in Columbia County with inventories, and a considerable volume, of hazardous materials being transported to, from, within, or through the county.

Historically, the safety record for hazardous materials has been good, with relatively few, mostly minor hazmat incidents. Nevertheless, there is a potential for larger hazmat incidents in Columbia County. Previous occurrences indicate the likelihood of a small oil or chemical spill occurring within the County approximately 10 times per year. However, more comprehensive information on the probability and magnitude of hazardous material events from all types of sources is not available. Wide variations among the characteristics of hazardous material sources and among the materials themselves make such an evaluation difficult. While it is beyond the scope of this HMP to make detailed hazardous materials probability and magnitude evaluations for Columbia County, it is possible to determine building and critical facility exposure to this hazard. Two hundred-seventy one sites were identified as being EHS sites from annual EPA Tier II Material Inventory Reports.

Figures I-15 through I-15H show areas vulnerable to a hazardous material event, including an area within a 1-mile radius of major highways, EHS facilities, and railroad routes.

5.3.15 Terrorism

5.3.15.1 Nature

The Homeland Security Act of 2002, Public Law 107-296, 107th Congress, Nov 25, 2002, 6 USC 101, §2(15) defines terrorism as:

> *"…any activity that involves an act that is dangerous to human life or potential destructive of critical infrastructure or key resources; and is a violation of the criminal laws of the United States or of any State or other subdivisions of the United States; and appears to be intended to intimidate or coerce a civilian population; to influence the policy of government by intimidation or coercion; or to affect the conduct of a government by mass destruction, assassination or kidnapping."*

Terrorists may use a range of possible malevolent actions, including vandalism, arson, explosions and armed attacks, as well as use of chemical, biological, radioactive or nuclear materials.

- Chemical attacks: deliberate release of a toxic agent (gaseous, liquid, or solid) that can poison people or the environment
- Biological attacks: releases of large quantities of living, disease-causing microorganisms that have extraordinary lethal potential
- Radiological attacks: deliberate dispersal of radioactive materials, via dirty bombs (conventional explosives laced with radioactive materials) or other methods.
- Nuclear attacks: explosion of nuclear devices and the radioactive fallout from such explosions.
- Cyber-terrorism: deliberate disruption/damage of computer systems and data.

5.3.15.2 History

Two major underground movements active in Columbia County, Oregon - the Earth Liberation Front (ELF) and the Animal Liberation Front (ALF) - are among the most destructive domestic terrorist groups in the United States. ALF, ELF, and related movements have claimed responsibility for more than 1,200 criminal acts since 1990 and caused more than $110 million in property damage in the United States since 1976. (J. Lewis 2005, J. Lewis 2004) Since 1996, ALF and ELF have claimed responsibility for acts which have destroyed property in excess of $13 million in Oregon alone.

In January 2006, 11 suspected members of an animal rights and environmental extremist cell in Oregon were indicted on 65 counts of conspiracy and related offenses including arson and attempted arson. The cell was allegedly responsible for a domestic terrorism campaign that spanned five Western states from 1996 to 2001. Specifically in Oregon, ELF is responsible for firebombing a Southern Oregon lumber mill office, toppling a high-tension electric line, and torching a Clatskanie tree farm. (Mail Tribune 2005) ELF burned part of the headquarters of the cottonwood plantation with damages estimated at $1 million dollars. Columbia County lost several jobs, causing families to move out and the schools to lose 40 children (due to relocation); the latter resulted in the school shutting down. (D. Pohl 2008)

5.3.15.3 Location

Oregon is home to a wide variety of criminal extremist groups including hate groups, anti-government groups, anarchists, and special issue movements like environmental and animal rights extremists, as well as activity by foreign terrorists. Individuals connected to these groups have used criminal activities to achieve their objectives, including arson, harassment, threats, extortion, home invasions, animal releases, sabotage, and destruction of private and government property. All jurisdictions throughout Columbia County are subject to impacts associated with domestic terrorism.

5.3.15.4 Extent

Because of its location among logging industries and endangered species, Columbia County is susceptible to the following types of terrorism: vandalism, cyber/computer hacking, and eco-terrorism actions.

5.3.15.5 Probability of Future Events

Within Columbia County, there is risk of terrorism incidents based on infrastructure and the environmental resources. Federal agencies work with state agencies to watch these organized groups; agencies may infiltrate their core structure and/or terminate any actions that cause harm to citizens, property, and the environment.

5.3.16 Infectious Disease Epidemic

5.3.16.1 Nature

Infectious diseases impair or damage bodily functions. They are caused by foreign organisms entering the human body and multiplying; including bacteria, viruses, fungi, and protozoa. Infections range from mild to deadly. Organisms enter the body via means such as: skin contact; inhalation; ingestion; blood (intravenous contact, bites, or punctures); sexual contact; and transmission from mothers to unborn children.

While infectious diseases pose a threat to people of any age and health condition, they are often a greater hazard to very young children, older adults, or people with compromised health. Vaccines and other advances in medical technology have reduced risks of some infectious diseases; however, new diseases emerge, new strains of existing diseases appear, and diseases that have been previously eliminated may reemerge.

When a disease spreads rapidly, affecting a greater portion of the population than would normally be expected, we call it an epidemic. An epidemic that reaches worldwide proportions is called a pandemic. When an infectious disease reaches epidemic level, it is considered to be a public health emergency. Such emergencies are commonly addressed through quarantine and immunization.

Viruses and bacteria are of particular concern in epidemics. Both types of organisms are capable of rapid mutation, and some mutations can make an organism more easily communicable, or more virulent, or resistant to the preventions or remedies that humans use against the disease. For instance, a new strain of a disease previously passed only from animal to human may be communicable between humans, and such a mutation will multiply rapidly because it affords the disease a way to colonize new hosts much more quickly. Because of the rapidly changing nature of infectious disease, even though recent historical data for Columbia County would lead one to believe that infectious disease is not a problem today, public health officials carefully monitor communicable diseases as well as those with current limitations that preclude epidemic outbreaks. (L. Rivers, personal communication)

Non-communicable, vector-borne diseases (such as those carried by mosquitoes or ticks) are important in community education, but generally would not lead to an epidemic in their current forms. It is worth noting that there is an association between climate and many infectious diseases, and global climate change will affect the range and prevalence of certain epidemics. In 2005, the World Health Organization published a report on using climate, and climate change models, to predict infectious disease epidemics. A climate-based early warning system may become an important tool for public health officials. (Khun *et al*. 2005)

In Oregon, some of the most common pathogens that cause disease outbreaks are *E. coli*, *Salmonella*, *Shigella*, and norovirus. Outbreaks of pertussis and measles still occur. Oregon is now tracking mumps as a reportable disease. (http://www.oregon.gov/DHS/ph/acd/outbreak/outbreak.shtml)

Three diseases that occur or have potential to be introduced to the residents of Columbia County are norovirus, influenza, and West Nile virus. These diseases have been documented within the State of Oregon; information is available through the Oregon Department of Human Services, Public Health Emergency Preparedness. The state also tracks other infectious diseases that could become a hazard to the community in the future, such as the emerging avian influenza (bird flu).

Influenza

Influenza viruses have been present in the human population for many years. Major changes in the virus (antigenic shifts) in the 20th century have led to three pandemics or global outbreaks of the disease, identified by the country or region that first reported the outbreak: the 1918 Spanish Influenza; 1957 Asian Influenza; and the 1968 Hong Kong Influenza. The 1918 pandemic, which was the only major influenza outbreak during which the most affected population group was young, healthy individuals (18 to 34 years old), coincided with World War I, and the movement of many young men around the globe as soldiers. (L. Rivers, personal communication; Diamond, 1997)

Influenza viruses are passed between people through respiratory droplets that are spread by coughing or sneezing. Transmission is typically via air, but may also occur by contact with infected surfaces and then touching mucous membranes, such as those in the eyes, mouth, or nose. Incubation of the virus typically ranges from 1 to 5 days and symptoms generally last for 2 to 7 days. Symptoms may include fever, muscle aches, headache, cough, sore throat, runny or stuffy nose, and fatigue.

There are three types of influenza virus (A, B, and C) and many different strains of each type. Types A and B are known to cause annual epidemics, while Type C produces mild respiratory illnesses and is not known to cause epidemics. Influenza is a virus that mutates continually and rapidly in ways that essentially disguise the virus from human immune systems, so that previous exposure to, or illness from, the virus does not confer immunity. Vaccines are updated annually for Types A and B, based on the previous year's virus. (CDC 2008a)

In the northern hemisphere, influenza generally occurs from November through May. Peak months vary, but February is often the peak of flu season. The U.S. Center for Disease Control (CDC) reports than an average of 36,000 people died annually due to influenza between 1990 and 1999. In the same time-period, an average of 226,000 people were hospitalized annually. (CDC 2008b)

Norovirus

The original strain of noroviruses appeared in Norwalk, Ohio in 1968. The virus produces a condition known as gastroenteritis, an inflammation of the stomach and intestines resulting in vomiting or diarrhea. The condition is often referred to as the "stomach flu," although it is not related to influenza. There are five groups of noroviruses and over 30 genetic clusters.

Noroviruses are transmitted between humans by eating or drinking food or water contaminated with feces from an infected person. Some reports indicate that the virus can be transmitted through droplets produced when a person is vomiting; the droplets may be swallowed by others.

The virus is known to be highly contagious; transmission of the disease is often swift in high density situations such as nursing homes, cruise ships, schools, restaurants, and catered events. Incubation of the virus typically ranges from 12 to 48 hours and symptoms generally last from 24 to 60 hours.

The CDC believe that at least 50% of all foodborne outbreaks of gastroenteritis are caused by noroviruses. From July 1997 to June 2000, 232 outbreaks of norovirus illness were reported to the CDC. Of these, 57% were foodborne, 16% were spread person-to-person, and 3% were waterborne; the cause of transmission was undetermined in 23% of outbreaks. Common settings included: restaurants and catered meals; nursing homes; schools; and vacation spots or cruise ships.

Foodborne outbreaks are most common, the most frequent cause of which is thought to be direct contamination by a food handler immediately before consumption. Cold foods, such as salads, bakery products, and sandwiches, are often implicated, as are fluid foods such as salad dressing or cake icing. Food can be contaminated at its source, as in the case of oysters from contaminated waters. Some foods have been contaminated before distribution, leading to widespread outbreaks; examples include raspberries and salads. Waterborne outbreaks are often associated with sewage contamination of drinking wells or recreational water. (CDC 2008c)

West Nile Virus

West Nile virus is a mosquito-borne illness present in Oregon. It affects humans, horses, and birds. The disease does not, at present, spread from person to person, nor from animals to humans; it can only be contracted from the bite of an infected mosquito. Most infections are mild, with no symptoms or mild fever and flu-like symptoms, but in rare cases, a severe infection can cause encephalitis or death.

There exists the possibility that the virus could mutate in a manner that would make it more severe to humans, communicable between individuals, or both. For this reason, as well as for the small number of very serious cases, the disease is being carefully tracked. There are no vaccines nor cures at this point; avoiding mosquito bites is the best prevention. More information about the virus, and guidelines for prevention can be found at www.oregon.gov/DHS/ph/acd/diseases/wnile.

5.3.16.2 History

The Oregon Department of Human Services, Health Services, tracks disease outbreaks annually. There have been no epidemics in recent history. A summary of reportable disease outbreaks in Columbia County, for the years 2009 – 20012, is provided in Table 5-20.

Causal agent	2009	2010	2011	2012
AIDS/HIV living**	25	27	30	1
Campylobacteriosis	4	13	9	7
Chlamydiosis	137	144	132	129
Cryptosporidiosis	8	8	2	5
E. coli (STEC)	0	0	0	5

Causal agent	2009	2010	2011	2012
Giardiasis	4	3	2	3
Gonorrhea	2	3	9	6
Haemophilus influenzae	1	1	1	0
Hepatitis A	0	0	0	0
Hepatitis B (acute)	0	0	0	1
Hepatitis B (chronic)	2	7	2	0
Hepatitis C (acute)	0	0	0	0
Legionellosis	0	0	0	1
Listeriosis	0	0	0	1
Lyme disease	0	1	0	1
Malaria	0	0	0	0
Meningococcal Disease	0	0	0	0
Pertussis	1	3	3	8
Rabies, animal	0	0	0	1
Salmonellosis	2	0	7	3
Shigellosis	0	0	0	0
Early Syphillis	0	0	2	0
Taeniasis	-	0	0	-
Tuberculosis	1	0	0	0
West Nile	0	0	0	0

(https://public.health.oregon.gov/DiseasesConditions/CommunicableDisease/DiseaseSurveillanceData/AnnualReports/Pages/arpt.aspx

5.3.16.3 Location

The entire population of Columbia County is potentially susceptible to infectious diseases. Infectious diseases may occur throughout a school, spread to the community, and then county-wide. Transmission of disease is often greatest in high-density situations such as nursing homes, schools, dormitories, and restaurants.

5.3.16.4 Extent

This section takes the example of an influenza epidemic or pandemic to illustrate the extent of a highly contagious disease. Planning for an influenza pandemic, whether "avian flu" or another especially virulent influenza variant, would be the same for any community in the nation. Everyone would be susceptible; it cannot be known in advance which, if any, particular population segment would be most affected. Although pharmaceutical companies have prepared a vaccine directed at the present version of the avian flu, it would have to mutate further to become a communicable pandemic, and it is unknown to what extent, if any, the vaccine would

apply to a new strain. Even if applicable, the avian vaccine cannot be grown in eggs (the standard method of mass-producing vaccines) and supply would be unlikely to meet demand. (L. Rivers, personal communication)

Immunity or resistance might then largely depend on inherent genetic diversity within the population, which is the case in any human population facing a newly emerged virulent disease. (Diamond, 1997)

5.3.16.5 Probability of Future Events

Based on historical events, Columbia County can expect that there will continue to be limited outbreaks of infectious diseases each year, including food-borne viral and bacterial pathogens, measles, pertussis, hepatitis, and influenza, among others. The likelihood of any of these diseases reaching epidemic proportions in any given year is very low.

If another influenza pandemic occurs, Columbia County is very likely to be affected. In the past century, there have been three influenza pandemics, with 40 and 10-year return intervals. The last one was in 1968, 40 years ago, which is one reason that health officials are becoming concerned about when the next one will occur. However, the emergence of pandemic illnesses depends on a number of extremely complex factors, which makes the timing of such an outbreak extremely difficult to predict.

As mentioned above, climate has an affect on communicable disease, and climate change could alter the repertoire of diseases that exist in Oregon, as well as outbreak frequency.

6. VULNERABILITY ANALYSIS

This section provides an overview of the vulnerability analysis and describes the five specific steps: asset inventory, methodology, data limitations and exposure analysis for current assets, and areas of future development. County- and city-specific asset inventory and exposure analysis tables are listed in Appendices A through H.

6.1 OVERVIEW OF VULNERABILITY ANALYSIS

A vulnerability analysis predicts the extent of exposure, and the impacts that may result from a hazard event of a given intensity in a given area. The analysis provides quantitative data that may be used to identify and prioritize potential mitigation measures by allowing communities to focus attention on areas with the greatest risk of damage. A vulnerability analysis is divided into five steps including asset inventory, methodology, data limitations, exposure analysis for current assets, and areas of future development.

The requirements for a vulnerability analysis as stipulated in DMA 2000 and its implementing regulations are described below.

- A summary of the community's vulnerability to each hazard that addresses the impact of each hazard on the community.

DMA 2000 Requirements: Risk Assessment, Assessing Vulnerability, Overview

Assessing Vulnerability: Overview

Requirement §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 summary of each hazard and its impact on the community.

Element

- Does the new or updated plan include an overall summary description of the jurisdiction's vulnerability to each hazard?
- Does the new or updated plan address the impact of each hazard on the jurisdiction?

Source: FEMA, July 2008.

- An identification of the types and numbers of existing vulnerable buildings, infrastructure, and critical facilities and, if possible, the types and numbers of vulnerable future development.

DMA 2000 Requirements: Risk Assessment, Assessing Vulnerability, Addressing Repetitive Loss Properties

Assessing Vulnerability: Addressing Repetitive Loss Properties

Requirement §201.6(c)(2)(ii): [The risk assessment]must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged by floods.

Element

- Does the new or updated plan describe vulnerability in terms of the types and numbers of repetitive loss properties located in the identified hazard areas?

Source: FEMA, July 2008.

DMA 2000 Recommendations: Risk Assessment, Assessing Vulnerability, Identifying Structures

Assessing Vulnerability: Identifying Structures

Requirement §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 area.

Element

- Does the new or updated plan describe vulnerability in terms of the types and numbers of existing buildings, infrastructure, and critical facilities located in the identified hazard areas?
- Does the new or updated plan describe vulnerability in terms of the types and numbers of future buildings, infrastructure, and critical facilities located in the identified hazard areas?

Source: FEMA, July 2008.

- Estimate of potential dollar losses to vulnerable structures and the methodology used to prepare the estimate.

DMA 2000 Recommendations: Risk Assessment, Assessing Vulnerability, Estimating Potential Losses

Assessing Vulnerability: Estimating Potential Losses

Requirement §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.

Element

- Does the new or updated plan estimate potential dollar losses to vulnerable structures?
- Does the new or updated plan describe the methodology used to prepare the estimate?

Source: FEMA, July 2008.

- Assess each jurisdiction's risks where they vary from the risks facing the entire planning area.

DMA 2000 Recommendations: Multi-Jurisdictional Risk Assessment

Assessing Vulnerability: Multi-Jurisdictional Risk Assessment

Requirement §201.6(c)(2)(iii): For multi-jurisdictional plans, the risk assessment **must** assess each jurisdiction's risks where they vary from the risks facing the entire planning area

Element

- Does the new or updated plan include a risk assessment for each participating jurisdiction as needed to reflect unique or varied risks?

Source: FEMA, July 2008.

6.2 VULNERABILITY ANALYSIS: SPECIFIC STEPS

6.2.1 Asset Inventory

An asset inventory is the first step of a vulnerability analysis. Assets throughout the County that may be affected by hazard events include population, residential and nonresidential buildings, critical facilities, and infrastructure.

The asset inventory delineates Columbia County's existing building and infrastructure assets and insured values and are identified in detail in Appendix A, Table A – 7. Jurisdiction-specific asset inventories are located in Appendices B – H.

Appendix A, Tables A – 8, 9, and 10 (and respective jurisdiction-specific appendices B – H) portray the critical infrastructure numbers and values, and their potential vulnerability by hazard type.

Within the Asset Inventory, (Table A-7,) valuations for critical facilities and infrastructure are insured values. These values have been calculated by multiplying the 2009 value by a standardized inflation rate (2009 to 2014 dollars) provided by the Bureau of Labor statistics at 9.4%. The Basic Plan committee has determined this to be the most accurate method to report current values after concluding that a process to reassess these prices, based on market influences would be unworkable.

Columbia County seeks to protect its population by supporting Oregon State initiatives, ordinances, building codes, and development regulations. One of the most important initiatives is to prohibit or not allow future development of buildings, infrastructure and critical facilities in identified high hazard areas. Any essential infrastructure component will undergo stringent review to ensure potential hazard risk is mitigated.

6.2.1.1 Population and Building Stock

Population data for all of Columbia County were obtained from the 2010 U.S. Census, which was collected at the census block level. Columbia County's total population for 2010 was 49,351with a certified estimated of 49,286 for 2012, and the Portland State University estimated an increase to 49,680 for 2013. (Appendix A) Jurisdiction specific population data are found in their respective Appendices B – H.

Estimated numbers of residential buildings and replacement values for those structures, as shown in Appendices A-f, were obtained from the 2010 U.S. Census. A total of 20,659 residential buildings were considered in this analysis, including single-family dwellings, mobile homes, multi-family dwellings, temporary lodgings, and institutional dormitory facilities.

6.2.1.2 Repetitive Loss Properties

Repetitive loss properties are properties that suffer from repeated flooding. FEMA defines a RL property as a NFIP insured property with at least two $1,000 claims within any 10-year period since 1978. Severe Repetitive Loss (SRL) properties have been identified by FEMA as most at risk for repeat flooding. These properties include every property that since 1978 has experienced: four or more separate building and content claims (that are NFIP insured) each exceeding $5,000 with cumulative claims exceeding $20,000, or at least two separate building claims with cumulative losses exceeding the value of the property (that is, the value of the structure).

Table 6-1 shows general NFIP data located for the county. Locations for both RL and SRL properties are not available for publication, however this information is maintained by the NFIP Coordinator, at the Oregon Department of Land Conservation and Development.

Table 6-1. Summary of NFIP Data – Columbia County
NFIP Insurance Report

Jurisdiction	Total Premiums ($)	Policies A-Zone	Total Policies	Total Coverage ($)	Average Premium ($)	Total Claims Since 1978	Total Paid Since 1978 ($)	Rep Loss Properties[1]
Columbia County	288,832	197	421	92,276,900	686	100	4,705,049	0
Clatskanie	40,547	19	24	7,694,500	1689	8	591,978	1
Columbia City	7,013	7	15	4,402,800	468	0	0	0
Prescott	412	0	1	350,000	412	0	0	0
Rainier	5,529	1	4	1,690,000	1,382	1	2,129	0
St. Helens	70,421	32	86	22,659,600	819	12	202,357	1
Scappoose	91,133	82	148	32,448,900	616	17	1,234,482	1
Vernonia	127,383	110	189	41,652,400	674	209	1,1805,798	3[2]

Source: FEMA SQANet, OEM BureauNet 5/22/2014.
[1]Content and building claims.
[2]One of these properties (Vernonia School) is awaiting final disposition before being removed from the list of Repetitive Loss Properties

The following list contains the location of the Repetitive Loss structures – 17 claims on six structures - in Columbia County and a brief description of the property.

- *Clatskanie* - commercial property, 3 losses
- *St Helens* - residential property, 2 losses
- *Scappoose* – residential property 3 losses
- *Vernonia* - This is the former Vernonia School, the school has since been removed, 3 losses
- *Vernonia* – residential property, 2 losses
- *Vernonia* – residential property, 4 losses

6.2.1.3 Critical Facilities and Infrastructure

A critical facility is defined as a local (non-State or Federal) facility in either the public or private sector that provides essential products and services to the general public, such as preserving life in Columbia County and fulfilling essential public safety, emergency response, and disaster recovery functions. The critical facilities profiled in this plan include the following:

- Essential local government facilities, such as departments, agencies, and administrative offices
- Emergency response facilities, including police, fire, and Emergency Operations Centers

- Educational facilities, including grades 1-12
- Care facilities, such as congregate living health, residential care, and continuing care retirement facilities
- Public Health Clinics

The total number of county-identified critical facilities is listed in Appendix A. The incorporated city-specific critical facilities are listed in their corresponding appendices.

Similar to critical facilities, critical infrastructure includes infrastructure that is essential to preserving life and safety of Columbia County. Critical infrastructure profiled in this plan includes the following:

- State and Federal Highways
- Railroad Tracks
- Local, State, and Federal bridges
- Utilities, including communication (cell, radio, and television), water and wastewater, and electrical facilities

6.2.2 Methodology

A conservative exposure-level analysis was conducted to assess the risks of the identified hazards. This analysis is a simplified assessment of the potential effects of the hazards on values at risk without consideration of probability or level of damage.

Using census block level information, a spatial proportion was used to determine the percentage of the population and residential and nonresidential structures located where hazards are likely to occur. Census blocks that are completely within the boundary of a hazard area were determined to be vulnerable and were totaled. A spatial proportion was also used to determine the amount of linear assets, such as highways, within a hazard area. The exposure analysis for linear assets was measured in miles.

Replacement values or insurance coverage were developed for physical assets. These values were provided by the county and each jurisdiction. For facilities that didn't have specific values per building in a multi-building scenario (e.g., schools), the buildings were grouped together and assigned one value where available. Value information is not available for all critical facilities at this time and will be collected as it becomes available. For each physical asset located within a hazard area, exposure was calculated by assuming the worst-case scenario (that is, the asset would be completely destroyed and would have to be replaced). Finally, the aggregate exposure, in terms of replacement value or insurance coverage, for each category of structure or facility was calculated.

A similar analysis was used to evaluate the proportion of the population at risk. However, the analysis simply represents the number of people at risk; no estimate of the number of potential injuries or deaths was prepared.

6.2.3 Data Limitations

The vulnerability estimates provided herein use the best data currently available, and the methodologies applied result in an approximation of risk. These estimates may be used to understand relative risk from hazards and potential losses. However, uncertainties are inherent in any loss estimation methodology, arising in part from incomplete scientific knowledge concerning hazards and their effects on the built environment as well as the use of approximations and simplifications that are necessary for a comprehensive analysis.

It is also important to note that the quantitative vulnerability assessment results are limited to the exposure of people, buildings, and critical facilities and infrastructure to the identified hazards. It was beyond the scope of this MHMP to develop a more detailed or comprehensive assessment of risk (including annualized losses, people injured or killed, shelter requirements, loss of facility/system function, and economic losses). Such impacts may be addressed with future updates of the MHMP.

6.2.4 Exposure Analysis

The results of the exposure analysis for loss estimations in Columbia County and each participating jurisdiction are located in Appendices A – H. Each appendix represents a jurisdiction and lists the critical facilities and the specific hazard areas in which each facility is located.

6.2.5 Areas of Future Development

Columbia County and the participating jurisdictions represented in this MHMP seek to protect its population by supporting Oregon State initiatives, ordinances, building codes, and development regulations. One of the most important initiatives is to prohibit or not allow future development of buildings, infrastructure and critical facilities in identified high hazard areas. Any proposed essential infrastructure component will undergo stringent review and design to ensure potential hazard risk is mitigated.

7. MITIGATION STRATEGY

This section outlines the four-step process for preparing a mitigation strategy including:

- Developing mitigation goals,
- Identifying mitigation actions,
- Evaluating mitigation actions, and
- Implementing mitigation action plans.

In 2014 The County Steering Committee, reviewed potential mitigation actions, and approved the Mitigation Action Plan for the unincorporated portion of the County. The incorporated jurisdictions pursued the same process. As such, County and city-specific Appendices (Appendices A – H) are provided with their respective information.

7.1 DEVELOPING MITIGATION GOALS

The requirements for the local hazard mitigation goals, as stipulated in DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Mitigation Strategy – Local Hazard Mitigation Goals

Local Hazard Mitigation Goals

Requirement §201.6(c)(3)(i): [The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

Element

- Does the new or updated plan include a description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards? (GOALS are long-term; represent what the community wants to achieve, such as "eliminate flood damage," and are based on the risk assessment findings.)

Source: FEMA, July 2008.

Throughout the 2014 update, the County and participating jurisdictions steering committees reviewed County and city-specific analysis results as a basis for developing the mitigation goals and potential mitigation actions (Appendices A – H).

Mitigation goals are defined as general guidelines that explain what a community wants to achieve in terms of hazard and loss prevention. Goal statements are typically long-range, policy-oriented statements representing community-wide visions. As such, the Basic Plan Review Committee decided to keep their original goals (Table 7-1) reflected in their 2009 HMP which are focused on reducing or avoiding long-term vulnerabilities to the identified hazards.

Table 7-1. Mitigation Goals

Goal Number	Goal Description
1	**Reduce the Threat to Life Safety** Enhance life safety by minimizing the potential for deaths and injuries in future disaster events.
2	**Protect Critical Facilities and Enhance Emergency and Essential Services** • Implement activities or projects to protect critical facilities and infrastructure. • Seek opportunities to enhance, protect, and integrate emergency and essential services. • Strengthen emergency operations plans and procedures by increasing collaboration and coordination among public agencies, non-profit organizations, business, and industry.
3	**Reduce the Threat to Property** • Seek opportunities to protect, enhance, and integrate emergency and essential services. • Strengthen emergency operations plans and procedures by increasing collaboration and coordination among public agencies, non-profit organizations, business, industry and the citizens of Columbia County.
4	**Create a Disaster Resistant and Disaster-Resilient Economy** • Develop and implement activities to protect economic well-being and vitality while reducing economic hardship in post disaster situations. • Reduce insurance losses and repetitive claims for chronic hazard events. • Work with State and Federal Partners to reduce short-term and long-term recovery and reconstruction costs. • Work with local organization, such as Columbia Emergency Planning Association (CEPA). • Expedite pre-disaster and post-disaster grants and program funding.
5	**Increase Public Awareness, Education, Outreach, and Partnerships** • Coordinate and collaborate, where possible, risk reduction outreach efforts with the Oregon Partners for Disaster Resistance & Resilience and other public and private organizations. • Develop and implement risk reduction education programs to increase awareness among citizens, local, county, and regional agencies, non-profit organizations, businesses, and industry. • Promote insurance coverage for catastrophic hazards • Strengthen communication and coordinate participation in and between public agencies, citizens, nonprofit organizations, businesses, and industry.

7.2 IDENTIFYING MITIGATION ACTIONS

The requirements for the mitigation actions identification and analysis, as stipulated in DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Mitigation Strategy - Identification and Analysis of Mitigation Actions

Identification and Analysis of Mitigation Actions

Requirement §201.6(c)(3)(ii): [The mitigation strategy shall include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.

Element

- Does the new or updated plan identify and analyze a comprehensive range of specific mitigation actions and projects for each hazard?
- Do the identified actions and projects address reducing the effects of hazards on new buildings and infrastructure?
- Do the identified actions and projects address reducing the effects of hazards on existing buildings and infrastructure?

Source: FEMA, July 2008.

The County and Jurisdictional steering committees then proceeded to evaluate potential mitigation actions after finalizing the mitigation goals. Mitigation actions are activities, measures, or projects that help achieve the goals of a mitigation plan. Appendix A depicts the County's existing and newly considered mitigation actions developed during this mitigation plan update. The appendix further defines whether the existing actions were completed, deleted, deferred, or ongoing. Appendices B through H contain jurisdiction specific mitigation actions considered as part of this MHMP update.

Appendices A through H contain County and jurisdiction-specific mitigation actions to reduce hazard impacts to new and existing buildings and infrastructure.

DMA 2000 Requirements: Mitigation Strategy - National Flood Insurance Program (NFIP) Compliance

National Flood Insurance Program (NFIP) Compliance

Requirement §201.6(c)(3)(ii): [The mitigation strategy] must also address the jurisdiction's participation in the National Flood Insurance Program (NFIP), and continued compliance with NFIP requirements, as appropriate.

Element

- Does the new or updated plan describe the jurisdiction(s) participation in the NFIP?
- Does the mitigation strategy identify, analyze and prioritize actions related to continued compliance with the NFIP?

Source: FEMA, July 2008.

Columbia County, and the Cities of Clatskanie, Columbia City, Prescott, Rainier, St. Helens, Scappoose, and Vernonia all actively participate in FEMA's National Flood Insurance Program (NFIP) and have implemented floodplain policies, regulations, and ordinances to protect their threatened population and infrastructure to assure NFIP compliance.

Each jurisdiction's Mitigation Strategy identified and analyzed potential flood mitigation actions that will fulfill NFIP initiatives. They subsequently selected and prioritized County or community appropriate actions to ensure an effective flood mitigation program. The County and jurisdictional appendices (A – H) describe their respective processes. Each jurisdiction also specifically addressed RL properties.

7.3 EVALUATING AND PRIORITIZING MITIGATION ACTIONS

The requirements for the evaluation and implementation of mitigation actions, as stipulated in DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Mitigation Strategy - Implementation of Mitigation Actions

Implementation of Mitigation Actions

Requirement: §201.6(c)(3)(iii): [The mitigation strategy section shall include] an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

Element

- Does the new or updated mitigation strategy include how the actions are prioritized? (For example, is there a discussion of the process and criteria used?)
- Does the new or updated mitigation strategy address how the actions will be implemented and administered, including the responsible department, existing and potential resources, and the timeframe to complete the action?
- Does the new or updated prioritization process include an emphasis on the use of a cost-benefit review to maximize benefits?
- Does the updated plan identify the completed, deleted, or deferred mitigation actions as a benchmark for progress, and if activities are unchanged (i.e., deferred), does the updated plan describe why no changes occurred?

Source: FEMA, July 2008.

The steering committees met to evaluate and prioritize each of the mitigation actions to determine which considered actions would be included in the jurisdiction-specific Mitigation Action Plans update as outlined in Appendices A-H.

The committees then met to determine the responsible agency and potential funding sources. The jurisdiction-specific Mitigation Action Plans represents mitigation projects and programs to be implemented through the cooperation of multiple entities.

The steering committees evaluated the simplified STAPLEE evaluation criteria (shown in Table 7-2) to consider the opportunities and constraints of implementing each particular mitigation action.

Table 7-2. Evaluation Criteria for Mitigation Actions

Evaluation Category	Discussion "It is important to consider…"	Considerations
Social	The public support for the overall mitigation strategy and specific mitigation actions.	Community acceptance Adversely affects population
Technical	If the mitigation action is technically feasible and if it is the whole or partial solution.	Technical feasibility Long-term solutions Secondary impacts
Administrative	If the community has the personnel and administrative capabilities necessary to implement the action or whether outside help will be necessary.	Staffing Funding allocation Maintenance/operations
Political	What the community and its members feel about issues related to the environment,	Political support Local champion

Table 7-2. Evaluation Criteria for Mitigation Actions

Evaluation Category	Discussion "It is important to consider…"	Considerations
	economic development, safety, and emergency management.	Public support
Legal	Whether the community has the legal authority to implement the action, or whether the community must pass new regulations.	Local, State, and Federal authority Potential legal challenge
Economic	If the action can be funded with current or future internal and external sources, if the costs seem reasonable for the size of the project, and if enough information is available to complete a FEMA Benefit-Cost Analysis.	Benefit/cost of action Contributes to other economic goals Outside funding required FEMA Benefit-Cost Analysis
Environmental	The impact on the environment because of public desire for a sustainable and environmentally healthy community.	Effect on local flora and fauna Consistent with community environmental goals Consistent with local, State, and Federal laws

The steering committees reviewed and discussed each action, and then determined the priority order by committee member consensus. Subsequently, those actions listed in the Mitigation Action Plans (Appendices A-H) are the highest priority for each jurisdiction. They are listed by hazard, in priority order only within each hazard.

Upon review and consensus, the Steering Committees assigned a high priority ranking to actions that best fulfill the goals of the MHMP and are appropriate and feasible for each jurisdiction and responsible entities to implement during the 5-year lifespan of this version of the MHMP.

7.4 IMPLEMENTING A MITIGATION ACTION PLAN

The requirements for the identification of a mitigation action for each participating jurisdiction, as stipulated in DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Mitigation Strategy – Identification of Multi-Jurisdictional Mitigation Actions

Identification of Multi-Jurisdictional Mitigation Actions

Requirement §201.6(c)(3)(iv): For multi-jurisdictional plans, there must be identifiable action items specific to the jurisdiction requesting FEMA approval or credit of the plan.

Element

- Does the new or updated plan include identifiable action items for each jurisdiction requesting FEMA approval of the plan?
- Does the updated plan identify the completed, deleted or deferred mitigation actions as a benchmark for progress, and if activities are unchanged (i.e., deferred), does the updated plan describe why no changes occurred?

Source: FEMA, July 2008.

Columbia County and jurisdictional appendixes identify "existing" mitigation action's status (i.e. completed, deleted or deferred mitigation actions) and provided comments regarding those

actions that were deferred. The tables indicate "Ongoing" for those actions that were implemented and are now continuous initiatives.

Columbia County's Mitigation Action Plan matrix (Appendix A) states that the benefit-costs consideration will be determined once an action undergoes development, and how each mitigation action will be implemented and administered by the responsible entity where appropriate.

The Action Plan Matrix for each jurisdiction and the county each share a common feature. Actions are prioritized from highest to lowest *within each section for each hazard*.

Roadblocks to Implementing Mitigation Actions:

- All jurisdictions rely heavily on available and consistent programmatic funding to ensure existing programs remain viable. Fluctuations within these funding streams will dramatically affect each jurisdiction's mitigation strategies. Reductions will severely limit successful mitigation action plan implementation.
- Permitting processes vary by jurisdiction and regulatory agency. There is no established clearinghouse or one-stop-shopping process. Coordinating between regulatory agencies like Fish and Game, the Department of Natural Resources, the Army Corps of Engineers, and other agencies can be cumbersome and time consuming.
- Limited available funding prevents preparing potential mitigation project Benefit/Cost Analysis prior to project development and submittal for grant application development.

8. PLAN MAINTENANCE

This section describes a formal plan maintenance process to ensure that the MHMP remains an active and applicable document. It includes an explanation of how Columbia County Emergency Management and the Steering Committees intend to organize their efforts to ensure that improvements and revisions to the MHMP occur in a well-managed, efficient, and coordinated manner.

The following three process steps are addressed in detail below:

- Monitoring, evaluating, and updating the MHMP
- Implementation through existing planning mechanisms
- Continued public involvement

8.1 MONITORING, EVALUATING, AND UPDATING THE MHMP

The requirements for monitoring, evaluating, and updating the MHMP, as stipulated in the DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Plan Maintenance Process - Monitoring, Evaluating, and Updating the Plan

Monitoring, Evaluating and Updating the Plan

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 mitigation plan within a five-year cycle.

Element

- Does the new or updated plan describe the method and schedule for monitoring the plan, including the responsible department?
- Does the new or updated plan describe the method and schedule for evaluating the plan, including how, when and by whom (i.e. the responsible department)?
- Does the new or updated plan describe the method and schedule for updating the plan within the five-year cycle?

Source: FEMA, July 2008.

The MHMP was prepared as a collaborative effort among Columbia County Emergency Management (CCEM) and the Steering Committees of the participating jurisdictions. To maintain momentum and build upon previous hazard mitigation planning efforts and successes, CCEM will use the Steering Committees to monitor, evaluate, and update the MHMP. Columbia County Emergency Management, Emergency Manager, will serve as the primary point-of-contact and will coordinate all local efforts to monitor, evaluate, and revise the MHMP.

Each participating jurisdiction will be responsible for implementing the county- or city-specific Mitigation Action Plan. CCEM will serve as the primary point of contact and will coordinate all local efforts to monitor, evaluate, and revise the MHMP.

Each member of the Steering Committee, or representative from each participating jurisdiction, will conduct an annual review to monitor the progress in implementing the MHMP, particularly the County- or city-specific Mitigation Action Plan. As shown in Appendix J, the Annual Review Worksheet will provide the basis for possible changes to the overall MHMP Mitigation Action Plan and each County- or city-specific Mitigation Action Plan by refocusing on new or

more threatening hazards, adjusting to changes to, or increases in, resource allocations, and engaging additional support for the MHMP implementation.

CCEM will initiate an annual review one month prior to the adoption date anniversary. The findings from these reviews will be presented at the annual Steering Committee meeting.

The review will contain an evaluation of the MHMP implementation progress, particularly the Mitigation Action Plan Appendices (A-H). The CCEM will use the Annual Review Worksheet (Appendix J) to document possible changes to the Mitigation Action Plan.

Each review, as shown on the Annual Review Worksheet, will include an evaluation of the following:

- Participation of each jurisdiction and others in the MHMP implementation
- Notable changes in the countywide risk of natural or human-caused hazards
- Impacts of land development activities and related programs on hazard mitigation
- Progress made with the countywide Mitigation Action Plan as well as each county- or city-Mitigation Action Plan (identify problems and suggest improvements as necessary)
- The adequacy of local and county resources for implementation of the MHMP

Each participating jurisdiction will submit a Progress Report (Appendix J) to the planning coordinator, annually. The report will include the current status of the Mitigation Action Plan's mitigation projects, including any changes made to the projects, the identification of implementation problems and appropriate strategies to overcome them, and whether or not the project has achieved the appropriate goals identified in the plan.

In addition to the annual review, the Steering Committee will update the MHMP every five (5) years. To ensure that this update occurs, in the third year following adoption of the MHMP, CCEM and the Steering Committees will undertake the following activities:

- Submit a request for eligible grant-funding for the MHMP update (2019) from the State of Oregon Division of Emergency Management.
- Review FEMA MHMP update requirements for the new planning cycle.
- Thoroughly analyze and update the risk of natural and human-caused hazards countywide.
- Provide a copy of the County and its participating jurisdictions' prior and current years annual reviews.
- Complete a detailed mitigation strategy review and revision.
- Update the Mitigation Action Plan for all participating jurisdictions identifying the status of the currently identified actions and adding newly considered, prioritized, and assigned actions.
- Prepare a new draft MHMP and submit it to the each appropriate governing body for review.
- Submit an updated MHMP to the Oregon Division of Emergency Management and FEMA for review.

- Present MHMP with FEMA's "Conditional Approval" to the County and City Councils for adoption
- Return a copy of the finalized MHMP with adoption resolutions from all participating jurisdictions to FEMA to finalize FEMA's approval.

8.2 IMPLEMENTATION THROUGH EXISTING PLANNING MECHANISMS

The requirements for implementation through existing planning mechanisms, as stipulated in the DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Plan Maintenance Process - Incorporation into Existing Planning Mechanisms

Incorporation into Existing Planning Mechanisms

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 improvement plans, when appropriate.

Element

- Does the new or updated plan identify other local planning mechanisms available for incorporating the mitigation requirements of the mitigation plan?
- Does the new or updated plan include a process by which the local government will incorporate the mitigation strategy and other information contained in the plan (e.g., risk assessment) into other planning mechanisms, when appropriate?
- Does the updated plan explain how the local government incorporated the mitigation strategy and other information contained in the plan (e.g., risk assessment) into other planning mechanisms, when appropriate?

Source: FEMA, July 2008.

The original 2005 Hazard Mitigation Plan called for a steering committee to be convened on a periodic basis to focus efforts on maintaining the plan and implementing the mitigation strategy and applicable initiatives. This has occurred at the local level in most instances. Existing programs continue to address statewide planning goals and legislative requirements. The County's comprehensive land use plan, capital improvement plan, mandated standards and building codes currently address identified mitigation initiatives and code compliance requirements. The county strives to incorporate mitigation actions into existing programs and procedures as the opportunity arises.

Table 3 in each of appendices A-H identifies the local planning mechanisms and regulatory tools available for incorporating the mitigation requirements of the mitigation plan.

The Steering Committee, after MHMP adoption, will ensure that the MHMP, in particular each Mitigation Action Plan is incorporated into existing planning mechanisms. Each Steering Committee will achieve this incorporation by undertaking the following activities.

- Conduct a review of the community-specific regulatory tools to assess the schedule for integration of the mitigation strategy. These regulatory tools are identified in each community-specific capability assessment presented in Appendices A-H.
- Work with pertinent community departments and agencies to increase MHMP awareness and provide assistance in integrating the mitigation strategy into relevant planning

mechanisms. Implementation of these requirements may require updating or amending specific planning mechanisms.

There were no specific documents identified that had incorporated the results of the original 2005 HMP or of the 2009 MHMP. However, the steering committee members are now aware of the resources available in this updated document and how they can be utilized to enhance other planning activities.

8.3 CONTINUED PUBLIC INVOLVEMENT

The requirements for continued public involvement, as stipulated in the DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Plan Maintenance Process - Continued Public Involvement

Continued Public Involvement

Requirement §201.6(c)(4)(iii): [The plan maintenance process shall include a] discussion on how the community will continue public participation in the plan maintenance process.

Element

- Does the new or updated plan explain how continued public participation will be obtained? (For example, will there be public notices, an ongoing mitigation plan committee, or annual review meetings with stakeholders?)

Source: FEMA, July 2008.

CCEM and each of the seven incorporated cities within the County are dedicated to involving the public directly in the continual reshaping and updating of the MHMP. Electronic and hard copies of the MHMP will be provided to Columbia County and each city. In addition, a downloadable copy of the MHMP and any proposed changes will be posted on CCEM's Web site. This site will also contain an e-mail address and phone number to which people can direct their comments or concerns.

CCEM and the steering committees will also identify opportunities to raise community awareness about the MHMP and the hazards that affect the County and participating jurisdictions. This effort could include attendance and provision of materials at County-, city-, and school-sponsored events; through the American Red Cross, the Columbia County Fire Districts, AARP, and other outreach programs and public mailings. Any public comments received regarding the MHMP will be collected by CCEM, included in the annual report, and considered during future MHMP updates.

Any public comments received regarding the MHMP will be collected by the Steering Committee leader, included in the annual Steering Committee Meeting's report, and considered during future MHMP updates.

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Appendix G
City of Scappoose

Table of Contents

Appendix G
City of Scappoose

This appendix contains the specific City of Scappoose information to support the Columbia County Multi-Jurisdictional Hazard Mitigation Plan update.

This section further supports the County's planning process by summarizing the review and incorporation of existing plans, studies, and reports used to develop this MHMP.

DMA 2000 Requirements: Planning Process

Multi-Jurisdictional Planning Participation

Requirement §201.6(a)(3): Multi-jurisdictional plans (e.g., watershed plans) may be accepted, as appropriate, as long as each jurisdiction has participated in the process … Statewide plans will not be accepted as multi-jurisdictional plans.

Element

- Does the new or updated plan describe how each jurisdiction participated in the plan's development?
- Does the updated plan identify all participating jurisdictions, including new, continuing, and the jurisdictions that no longer participate in the plan?

Planning Process

Requirement §201.6(b): An open public involvement process is essential to the development of an effective plan.

Documentation of the Planning Process

Requirement §201.6(b): In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:

Element

- An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;
- 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 nonprofit interests to be involved in the planning process; and
- Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

Requirement §201.6(c)(1): [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.

Element

- Does the plan provide a narrative description of the process followed to prepare the new or updated plan?
- Does the new or updated plan indicate who was involved in the planning process? (For example, who led the development at the staff level and were there any external contributors such as contractors? Who participated on the plan committee, provided information, reviewed drafts, etc.?)
- Does the new or updated plan indicate how the public was involved? (Was the public provided an opportunity to comment on the plan during the drafting stage and prior to the plan approval?)
- Does the new or updated plan discuss the opportunity for neighboring communities, agencies, businesses, academia, nonprofits, and other interested parties to be involved in the planning process?
- Does the planning process describe the review and incorporation, if appropriate, of existing plans, studies, reports, and technical information?
- Does the updated plan document how the planning team reviewed and analyzed each section of the plan and whether each section was revised as part of the update process?

Source: FEMA, July 2008.

The City of Scappoose is dedicated to mitigating potential natural and technological hazard threats to its population and infrastructure. To fulfill that goal, the City organized a Hazard Mitigation Plan development Steering Committee dedicated to identifying hazard threats and developing actions to mitigate damage and life losses from those threats.

Table G-1 contains the City's Steering Committee participant list to augment the Columbia County MHMP planning elements.

Table G-1. City of Scappoose Steering Committee

Member	Position
Brian Varricchione	City Planner
Norm Miller	Interim Police Chief
Don Sallee	Building Official
Mike Greisen	Fire Chief

Table G-2 contains the summary of the City's public involvement and planning meeting activities.

Table G-2. City of Scappoose Public Involvement Mechanisms

Mechanism	Description
April 10, 2014 Countywide Public Meeting, 10 a.m. Columbia 911 Center, St Helens, OR	Columbia County Presented draft risk assessment results and provided opportunity to comment.
April 23, 2014 City public meeting, 9:30 a.m. at Scappoose CDC building	Present draft risk assessment results and provided opportunity to comment.
May 19, 2014 Public Hearing	Public meeting at the City Council Meeting to discuss plan contents
City of Scappoose website www.ci.scappoose.or.us	The City of Scappoose will place a copy of the public input form on the City's website.
City of Scappoose website www.ci.scappoose.or.us	The City of Scappoose will place a copy of the Hazard Mitigation plan on the City's website.

CAPABILITY ASSESSMENT

Table G-3, G-4, and G-5 contain the City's resources used to support planning activities, including the reports and studies reviewed as part of the update process.

Table G-3. City of Scappoose Legal and Regulatory Resources Available for Hazard Mitigation

Regulatory Tool	Name	Effect on Hazard Mitigation
Plans	Emergency Operations Plan (2002) Updated (2008)	Identifies emergency planning, policies, procedures, and response to extraordinary emergency situations associated with natural disasters, technological incidents, and national security emergencies.
	Comprehensive Plan (1991)	Location of future growth by classification
	Transportation Plans	Defines transportation infrastructure and delineates problem areas. Street layout incorporated.
	Water and Sewer Plan	Defines water and sewer infrastructure
	Storm Water Plans	Defines storm water management process
	Floodplain Management Plan	CRS community, has CRS rating of "7" for reduced insurance premium costs to participants
	Scappoose Comprehensive Urban Forestry Management Plan: Street Trees	Defines forestry management plan and long-term potential for future development
	Business Plan	Defines future goals for the community
Programs	National Flood Insurance Program (NFIP)	Makes affordable flood insurance available to homeowners, business owners, and renters in participating communities. In exchange, those communities must adopt and enforce minimum floodplain management regulations to reduce the risk of damage from future floods.
Policies (Municipal Codes)	Scappoose Municipal Code of Ordinances	Floodplain, steep slope, cut and fill regs-All development regulated by the code. Includes Floodplain ordinances
	Current State Building Code	Seismic standards-updates regularly
	City of Scappoose Charter of 2011	Identifies city boundaries, governance, and plan and project approval process

Table G-4. City of Scappoose Administrative and Technical Resources for Hazard Mitigation	
Staff/Personnel Resources	**Department/Division Position**
Planner(s) or engineer(s) with knowledge of land development and land management practices	City Engineer-Gordon Munro (contract-with Kennedy Jenks) City Planner-Brian Varricchione - Staff
Engineer(s) or professional(s) trained in construction practices related to buildings and/or infrastructure	City Engineer-Munro (contract) - Infrastructure and Building Official (Don Sallee-Staff) - Buildings
Planner(s) or engineer(s) with an understanding of manmade or natural hazards	City Engineer-Munro (contract) - Infrastructure and Building Official (Don Sallee-Staff) –Planner Brian Varricchione (Staff)
Floodplain manager	City Planner-Brian Varricchione - Staff
Personnel skilled in GIS and/or HAZUS-MH	Brian Varricchione
Director of Emergency Services	Local EOM-City Manager, Incident commander; (police Chief) (Fire Chief) alternate or situational ICs
Finance (grant writers, purchasing)	City Manager and Jill Herr-Finance Administrator City of Scappoose
Public Information Officers	City Manager

Table G-5. City of Scappoose Financial Resources for Hazard Mitigation	
Financial Resources	**Effect on Hazard Mitigation**
General funds	Yes
Authority to levy taxes for specific purposes	Yes w/ voter approval
Incur debt through general obligation bonds	Yes
Incur debt through special tax and revenue bonds	Yes
Incur debt through private activity bonds	No
Hazard Mitigation Grant Program (HMGP)	FEMA funding which is available to local communities after a Presidentially-declared disaster. It can be used to fund both pre- and post-disaster mitigation plans and projects.
Pre-Disaster Mitigation (PDM) grant program	FEMA funding which is available on an annual basis. This grant can only be used to fund pre-disaster mitigation plans and projects only.
Flood Mitigation Assistance (FMA) grant program	FEMA funding which is available on an annual basis. This grant can be used to mitigate repetitively flooded structures and infrastructure to protect repetitive flood structures.
United States Fire Administration (USFA) Grants	The purpose of these grants is to assist state, regional, national or local organizations to address fire prevention and safety. The primary goal is to reach high-risk target groups including children, seniors and firefighters.
Fire Mitigation Fees	Finance future fire protection facilities and fire capital expenditures required because of new development within Special Districts.

HAZARD IDENTIFICATION AND SCREENING

The following section defines hazard identification as stipulated in DMA 2000 and its implementing regulations.

DMA 2000 Requirements: Risk Assessment: Identifying Hazards

Identifying Hazards
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.
Element
- Does the new or updated plan include a description of the types of all natural hazards that affect the jurisdiction?

Source: FEMA, July 2008.

The City of Scappoose's Steering Committee determined that the following hazards could potentially threaten the community.

Natural Hazards	
Flood	X
Winter Storm	X
Landslide	X
Fire (Wildland/Urban)	X
Earthquake	X
Volcano	X
Wind	X
Erosion	X
ENSO (El Niño / La Niña)	X
Expansive Soils	
Drought	X
Technological Hazards	
Dam Failure	X
Disruption of Utility and Transportation Systems (DUTS)	X
Hazardous Materials	X
Terrorism	X
Infectious Disease Epidemic	X

OVERVIEW OF VULNERABILITY ANALYSIS

This section summarizes community specific vulnerability information for the City of Scappoose to augment the MHMP development process. It comprises:

- An identification of the types and numbers of existing vulnerable buildings, infrastructure, and critical facilities and, if possible, the types and numbers of vulnerable future development.
- Estimate of potential dollar losses to vulnerable structures and the methodology used to prepare the estimate.
- Assess each jurisdiction's risks where they vary from the risks facing the entire planning area.

The following section defines vulnerability analysis as stipulated in DMA 2000 and its implementing regulations.

DMA 2000 Requirements: Risk Assessment, Assessing Vulnerability, Overview

Assessing Vulnerability: Overview
Requirement §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 summary of each hazard and its impact on the community.
Element
- Does the new or updated plan include an overall summary description of the jurisdiction's vulnerability to each hazard?
- Does the new or updated plan address the impact of each hazard on the jurisdiction?

Source: FEMA, July 2008.

DMA 2000 Requirements: Risk Assessment, Assessing Vulnerability, Addressing Repetitive Loss Properties

Assessing Vulnerability: Addressing Repetitive Loss Properties
Requirement §201.6(c)(2)(ii): [The risk assessment]must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged by floods.
Element
- Does the new or updated plan describe vulnerability in terms of the types and numbers of repetitive loss properties located in the identified hazard areas?

DMA 2000 Recommendations: Risk Assessment, Assessing Vulnerability, Identifying Structures

Assessing Vulnerability: Identifying Structures
Requirement §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 area.
Element
- Does the new or updated plan describe vulnerability in terms of the types and numbers of existing buildings, infrastructure, and critical facilities located in the identified hazard areas?
- Does the new or updated plan describe vulnerability in terms of the types and numbers of future buildings, infrastructure, and critical facilities located in the identified hazard areas?

Source: FEMA, July 2008.

The City of Scappoose actively participates in FEMA's National Flood Insurance Program (NFIP) and has implemented floodplain policies, regulations, and ordinances to protect their threatened population and infrastructure to assure NFIP compliance.

The City's Mitigation Strategy identified and analyzed potential flood mitigation actions that would fulfill NFIP initiatives, and prioritized County or community appropriate actions to assure an effective flood mitigation program.

DMA 2000 Recommendations: Risk Assessment, Assessing Vulnerability, Estimating Potential Losses

Assessing Vulnerability: Estimating Potential Losses
Requirement §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.
Element
- Does the new or updated plan estimate potential dollar losses to vulnerable structures?
- Does the new or updated plan describe the methodology used to prepare the estimate?

Source:

DMA 2000 Recommendations: Multi-Jurisdictional Risk Assessment

Assessing Vulnerability: Multi-Jurisdictional Risk Assessment
Requirement §201.6(c)(2)(iii): For multi-jurisdictional plans, the risk assessment must assess each jurisdiction's risks where they vary from the risks facing the entire planning area
Element
- Does the new or updated plan include a risk assessment for each participating jurisdiction as needed to reflect unique or varied risks?

Source: FEMA, July 2008.

VULNERABILITY ANALYSIS: SPECIFIC STEPS

Asset Inventory

Asset inventory is the first step of a vulnerability analysis. Assets within each community that may be affected by hazard events include population, residential and nonresidential buildings, critical facilities, and infrastructure.

The asset inventory delineates the City's existing building and infrastructure assets and insured values and are identified in detail in Tables G-6A, G-6B and G-7.

Tables G-8, G-9, and G-10 portray the City's critical infrastructure numbers and values, and their potential vulnerability by hazard type.

The City of Scappoose seeks to protect its population by supporting Columbia County and Oregon State initiatives, ordinances, building codes, and development regulations. One of the most important initiatives is to prohibit or not allow future development of buildings, infrastructure and critical facilities in identified high hazard areas. Any essential infrastructure component will undergo stringent review to ensure potential hazard risk will be mitigated.

Population and Building Stock

Population data listed in Table G-6A were obtained from the 2010 U.S. Census, UGB report and Portland State University. It comprises census block level data, and estimates from university conducted community research.
The City's existing building and infrastructure and insured values are identified in Tables G-6A, G-6B, and G-7.

Table G-6A. City of Scappoose Estimated Population and Building Inventory				
Population			Residential Buildings	
2010 Census	Estimated 2013 Census	Estimated 2015 Census[2]	Total Building Count	Total Value of Buildings ($)[1]
6,592	6,700	6,971	2,256	509,082,743.

Source: FEMA HAZUS-MH, Version 2006 and U.S. Census 2000.
[1] Average insured structural value of all residential buildings (including single-family dwellings, mobile homes, etc., is $150,700 per structure).
[2] Portland State University (PSU) 2007 Oregon Population Report.

Table G-6B. City of Scappoose NFIP Insurance Report								
City of	Total Premiums ($)	Policies A-Zone	Total Policies	Total Coverage ($)	Average Premium ($)	Total Claims Since 1978	Total Paid Since 1978 ($)	Rep Loss Properties[1]
Scappoose	91,133	82	148	32,448,900	616	17	1,234,482	1[2]

Source: FEMA SQANet.
[1] Content and building claims.
[2] 33367 NW EJ Smith Rd., Scappoose

Table G-7. City of Scappoose Critical Facilities and Infrastructure			
Facility Type	Name / Number	Address	Value[1]
Government	Scappoose City Hall (includes Police Department and Municipal Court	33568 E Columbia Ave	1,482,112
Emergency Response	Scappoose Rural Fire District	52751 Columbia River Hwy	2,510,000
Educational	Scappoose Peterson Elementary School	52050 SE 3rd Street	15,198,000
	Scappoose Grant Watts Elementary School	52000 SE 3rd PL	5,503,047
	Scappoose Middle School	52265 Columbia River Hwy	8,036,448

Table G-7. City of Scappoose Critical Facilities and Infrastructure			
Facility Type	**Name / Number**	**Address**	**Value**[1]
	Scappoose High School	33700 SE High School Way	26,494,279
	Scappoose School District Office	33589 SE High School Way	614,040
	OHSU Family Medicine Clinic	Old Portland Road	Unknown
Community	Watts House Pioneer Museum	52432 SE 1st St	Unknown
	Scappoose Public Library	52469 SE 2nd St	1,543,000
	Scappoose Four Square Church	33404 SW JP West Rd	Unknown
	Church of Jesus Christ	53987 Columbia River Highway	$170,560
	Grace Lutheran Church	51737 South Columbia River Hwy	$648,000
	St Wenceslause Catholic Church	51555 Old Portland Rd	Unknown
	Scappoose Senior Center	33342 SW Meadow Dr	Unknown
	Creekside Baptist Church	51681 SW Old Portland Rd	$693,290
State and Federal Highways	US Hwy 30	3 miles at $385,000 per mile	1,155,000
Railroads	Portland Western (short line with switching facility and staging line)		3 miles
Bridges	Bridge #1	Hwy 30	$2,600,000
	Bridge # 2 (County #7)	EJ Smith Road	$1,400,000
	Bridge # 3 (County #1)	EM Watts Street	$1,600,000
	Bridge # 4 (County #6)	JP West Road	$1,600,000
	Bridge # 5 (County #10)	Scappoose Vernonia Hwy	$1,900,000
	Bridge # 6 County #121)	Dutch Canyon Road	$1,400,000
Transportation Facilities	Scappoose Airpark (non towered) with Heliport	Airport Road	Unknown
	First Student Bus Line Inc	Hwy 30	Unknown
Utilities	Wireless company/tower @ high school		Unknown
	Qwest Telephone		Unknown
	Water Treatment Plant		$6,000,000
	Miller Road Water Treatment Plan		$4,500,000
	Waste Water Treatment Plant		$15,000,000
	Dutch Canyon Well		$199,196
	Reservoirs (3-storage tanks) (2M, 1M, and 350K gallon)		$4,500,000
	Reservoirs (2-storage tanks) 350K gallon capacity 300K gallon capacity		$1,500,000

Table G-7. City of Scappoose Critical Facilities and Infrastructure			
Facility Type	**Name / Number**	**Address**	**Value[1]**
	EJ Smith Waste Lift station		$1,200,000
	Hwy 30, Keys Landing, Seven Oaks and Spring Lake Waste Lift station		$1,600,000
	Columbia River PUD Power Plant/Substations		
Dams	Gourley Creek Dam		$1,500,000
	South Fork Dam		$1,500,000
	Lacey Creek Dam		$750,000

Sources: FEMA HAZUS-MH, local jurisdictions, City of Scappoose.
[1]Estimated and/or insured structural value for critical facilities and estimated values for critical infrastructure.
NA = Not Available.

VULNERABILITY ANALYSIS

The vulnerability analysis development process is thoroughly discussed in the Columbia County MHMP, Section 6, which generated the following Hazard Exposure Analysis Overviews. Tables G-8, G-9, and G-10 depict in tabular form results obtained from the GIS analysis depicted in hazard figures located in Appendix I.

Table G-8. City of Scappoose Potential Hazard Exposure Analysis Overview-Population and Buildings

			Population	Buildings			
				Residential		Non-Residential	
Hazard Type	**Hazard Area**	**Methodology**	**Number**	**Number**	**Value ($)[1]**	**Number**	**Value ($)[1]**
Flood	Moderate	500-year floodplain	--	1,328	200,129,600	7	unknown
	High	100-year floodplain	--	874	131.711,800	6	unknown
Winter Storm		descriptive	6,700	2,171	399,730,798	14	unknown
Landslide	Moderate	>14-32 degrees	--	705	106,243,500	3	unknown
	High	>32-56 degrees	--	344	51,840,800	3	unknown
Wildland Fire	Moderate	Moderate fuel rank	--	2,170	399,730,798	14	unknown
	High	High fuel rank	--	882	132,917,400	8	unknown
	Very High	Very high fuel rank	--	433	65,253,100	3	unknown
	Extreme	Extreme fuel rank	--	116	17,481,200	0	unknown
Earthquake	Strong	9-20% (g)	--	2,171	399,730,798	14	unknown
	Very strong	20-40% (g)	--	0	--	0	unknown
	Severe	>40-60% (g)	--	0	--	0	unknown
Volcano		descriptive	6,700	2,171	399,730,798	14	unknown
Wind		descriptive	6,700	2,171	399,730,798	14	unknown
Erosion		within 300' of potential areas of erosion	--	49	7,384,300	unknown	unknown
Drought		descriptive	--	--	--	--	unknown
Dam Failure	High	Inundation area	--	1,049	158,084,300	6	unknown
Disruption of Utility and Transportation Systems		descriptive	6,700	--	--	--	unknown

Table G-8. City of Scappoose Potential Hazard Exposure Analysis Overview-Population and Buildings							
			Population	Buildings			
				Residential		Non-Residential	
Hazardous Material Event	1/4-mile buffered transportation routes	1/4-mile buffered transportation routes	--	825	124,327,800	9	unknown
	1/4-mile buffered EHS sites	1/4-mile buffered EHS sites	--	--	--	--	--
Terrorism		descriptive	--	--	--	--	--
Infectious Disease Epidemic		descriptive	6,700	--	--	--	--

[1] Average insured structural value of all residential buildings (including single-family dwellings, mobile homes, etc., is $150,700 per structure).
Note-population by parcel was not available at the time this document was prepared. Once this data is available, a useful analysis of population and residential structures by hazard can easily be completed. *0.25 mile-buffered EHS sites were unable to be determined due to the use of census block data.

Table G-9. City of Scappoose Potential Hazard Exposure Analysis Overview-Critical Facilities

			Government		Emergency Response		Educational		Care		Community	
Hazard Type	**Hazard Area**	**Methodology**	**No.**	**Value ($)[1]**	**No.**	**Value ($)[1]**	**No.**	**Value ($)[1]**	**No.**	**Value ($)[1]**	**No.**	**Value ($)[1]**
Flood	Moderate	500-year floodplain	--	--	1	2.3M	2	13.3M	none	none	4	unknown
	High	100-year floodplain	--	--	1	2.3M	1	3.6M	none	none	3	78K
Winter Storm		descriptive	1	1.1M	1	2.5M	10	59.7M	none	none	16	2.5M
Landslide	Moderate	>14-32 degrees	--	--	--	--	3	7.7M	none	none	3	213K
	High	>32-56 degrees	--	--	--	--	--	--	none	none	1	77K
Wildland Fire	Moderate	Moderate fuel rank	1	1.1M	1	2.3M	9	19.5M	none	none	16	2.5M
	High	High fuel rank	--	--	--	--	6	17.9M	none	none	4	272K
	Very High	Very high fuel rank	--	--	--	--	--	--	none	none	1	78K
	Extreme	Extreme fuel rank	--	--	--	--	--	--	none	none	--	--
Earthquake	Strong	9-20% (g)	1	1.1M	1	2.3M	10	59.7M	none	none	16	2.5M
	Very strong	20-40% (g)	--	--	--	--	--	--	none	none	--	--
	Severe	>40-60% (g)	--	--	--	--	--	--	none	none	--	--
Volcano		descriptive	1	1.1M	1	2.3M	10	59.7M	none	none	16	2.5M
Wind		descriptive	1	1.1M	1	2.3M	10	59.7M	none	none	16	2.5M
Erosion		within 300' of potential areas of erosion	--	--	--	--	1	3.6M	none	none	--	--
Drought		descriptive	1	1.1M	1	2.3M	10	21M	none	none	16	2.5M
Dam Failure	High	Inundation area	1	1M	1	2.3M	5	12.7M			7	1.7M
Disruption of Utility and Transportation Systems		descriptive	1	1.1M	1	2.3M	10	21M	none	none	16	2.5M
Hazardous Material Event	1/4-mile buffered transportation routes	1/4-mile buffered transportation routes	1	1.1M	1	2.3M	8	15.8M	none	none	15	2.4M
	1/4-mile buffered EHS sites	1/4-mile buffered EHS sites	1	1.1M	1	2.3M	8	15.8M	none	none	14	2.4M
Terrorism		descriptive	1	1.1M	1	2.3M	10	21M	none	none	16	2.5M
Infectious Disease Epidemic		descriptive	1	1.1M	1	2.3M	10	21M	none	none	16	2.5M

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Table G-10. City of Scappoose Potential Hazard Exposure Analysis Overview-Critical Infrastructure

			Highways		Railroads		Bridges		Transportation Facilities		Utilities		Dams	
Hazard Type	**Hazard Area**	**Methodology**	**Miles**	**Value ($)[1]**	**Miles**	**Value ($)[1]**	**No.**	**Value ($)[1]**	**No.**	**Value ($)[1]**	**No.**	**Value ($)[1]**	**No.**	**Value ($)[1]**
Flood	Moderate	500-year floodplain	--	--	--	--	5	5.1M	--	--	3	19.5M	--	--
	High	100-year floodplain	--	--	--	--	6	10.7M	--	--	2	15.2M	--	--
Winter Storm			1 unknown	unknown	1 unknown	unknown	6	10.7M	2	unknown	5	24.2M	--	--
Landslide	Moderate	>14-32 degrees	--	--	--	--	1	1.4M	--	--	2	4.7M	--	--
	High	>32-56 degrees	--	--	--	--	--	--	--	--	--	--	--	--
Wildland Fire	Moderate	Moderate fuel rank	1 unknown	unknown	1 unknown	unknown	6	10.7M	2	unknown	5	24.2M	--	--
	High	High fuel rank	--	--	--	--	--	--	1	unknown	3	4.7M	--	--
	Very High	Very high fuel rank	--	--	--	--	--	--	--	--	--	--	--	--
	Extreme	Extreme fuel rank	--	--	--	--	--	--	--	--	--	--	--	--
Earthquake	Strong	9-20% (g)	1 unknown	unknown	1 unknown	unknown	6	10.7M	2	unknown	5	24.2M	--	--
	Very strong	20-40% (g)	--	--	--	--	--	--	--	--	--	--	--	--
	Severe	>40-60% (g)	--	--	--	--	--	--	--	--	--	--	--	--
Volcano			1 unknown	unknown	1 unknown	unknown	6	10.7M	2	unknown	5	24.2M	--	--
Wind			1 unknown	unknown	1 unknown	unknown	6	10.7M	2	unknown	5	24.2M	--	--
Erosion		within 300' of potential areas of erosion	--	--	--	--	6	10.7M	--	--	1	unknown	--	--
Drought		descriptive	3	1.2M	3	unknown	6	10.7M	2	unknown	9	32M	3	3.8M
Dam Failure	High	Inundation area	--	--	--	--	2	3.6M	2	unknown	4	19.7M		
Disruption of Utility and Transportation Systems		descriptive	3	1.2M	3	unknown	6	10.7M	2	unknown	9	32M	3	3.8M
Hazardous Material Event	1/4-mile buffered transportation routes	1/4-mile buffered transportation routes	1 unknown	unknown	1 unknown	unknown	4	4.7M	1	unknown	2	200K	--	--
	1/4-mile buffered EHS sites	1/4-mile buffered EHS sites	--	--	--	--	4	4.7M	2	unknown	5	24.2M	--	--
Terrorism		descriptive	3	1.2M	3	unknown	6	10.7M	2	unknown	9	32M	3	3.8M
Infectious Disease Epidemic		descriptive	3	1.2M	3	unknown	6	10.7M	2	unknown	9	32M	3	3.8M

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SUMMARY OF VULNERABILITIES AND IMPACTS TO IDENTIFIED HAZARDS

The following section describes community specific vulnerabilities and impacts from natural hazards in addition to technological and manmade hazards identified in the 2009 Columbia County MHMP and 2010 FEMA flood map.

The following is derived from the best available data for facility locations and values. In many cases, values were unavailable, and therefore the totals listed below should be considered incomplete and likely less than the actual costs associated with the respective hazards.

Flood

FEMA FIRMs were used to outline the 100-year and 500-year floodplains for the City of Scappoose. The 100-year floodplain delineates an area of high risk, while the 500-year floodplain delineates an area of moderate risk.

There are 874 residential structures (worth $131.7M), six non-residential structures (value unknown), one emergency response facility (worth $2.3M), three community facilities (worth $78K), six bridges (worth $10.5M) and two utilities (worth $15.2M) within the boundaries of the 100-year floodplain.

There are 1,328 residential structures (worth $250M), seven non-residential structures (value unknown), one emergency response facility (worth $2.3M) four community facilities (value unknown), five bridges (worth $8.5M) and three utilities (worth $19.5M) within the 500-year floodplain.

Winter Storm

The natural hazards resulting from winter storms, such as ice, cold, wind and floods, are often widespread. A single event is capable of impacting all people, critical facilities and infrastructure within the City of Scappoose, and therefore the entire population (6,700 people), including 2,171 residential structures (worth $327.2M), 14 non-residential structures (value unknown), one government facility (worth $1.1M), one emergency response facility (worth $2.3M), seven educational facilities (worth $59.7M), 16 community facilities (value $2.5M), six bridges (worth $10.7M), one highway (value unknown), one railroad (value unknown), two transportation facilities (value unknown), and five utilities (worth $24.2M) are located in the winter storm area.

Landslide

The potential impacts from landslides can be widespread. Potential debris flows and landslides can impact transportation and rail routes, utility systems, and water and waste treatment infrastructure along with public, private, and business structures located adjacent to steep slopes, along riverine embankments, or within alluvial fans or natural drainages. Response and recovery efforts will likely vary from minor cleanup to more extensive utility system rebuilding. Utility disruptions are usually local and terrain dependent. Damages may require reestablishing electrical, communication, and gas pipeline connections occurring from specific breakage points. Initial debris clearing from emergency routes and high traffic areas may be required. Water and

waste water utilities may need treatment to quickly improve water quality by reducing excessive water turbidity and reestablishing waste disposal capability.

USGS elevation datasets were used to determine the landslide hazard areas within the City of Scappoose. Risk was assigned based on slope angle. A slope angle less than 14 degrees was assigned a low risk, a slope angle between 14 and 32 degrees was assigned a medium risk, and a slope angle greater than 32 degrees was assigned a high risk.

There are 705 residential structures (worth $106.2M), three non-residential structures (value unknown), two educational facilities (worth $8.1M), three community facilities (worth $213K), one bridge (worth $1.4M) and two utilities (worth $4.7M) in the medium landslide risk area. There are 344 residential structures (worth $51.8M), three non-residential structures (value unknown), and one community facility (worth $77K) in the high landslide risk area.

Wildland Fires

Wildland fire hazard areas were identified using a model incorporating slope, aspect, and fuel load. South-facing, steep, and heavily vegetated areas were assigned the highest fuel values while areas with little slope and natural vegetation were assigned the lowest fuel values. Risk levels of moderate, high, very high, and extreme were assigned to the entire region based on the results of this modeling.

There are 2,209 residential structures (worth $327M), 14 non-residential structures (value unknown), one government facility (worth $1.1M), one emergency response facility (worth $2.3M), seven educational facilities (worth $59.7M), 16 community facilities (value $2.5M), six bridges (worth $5.7M), one highway (value unknown), one railroad (value unknown), two transportation facilities (value unknown), and five utilities (worth $24.2M) located in moderate fire risk areas.

There are 882 residential structures (worth $132.9M), eight non-residential structures (value unknown), seven educational facilities (worth $59.7M), four community facilities (value $272K), one transportation facility (value unknown), two bridges (worth $2.8M), and three utilities (value $4.7M) located in the high fire risk areas.

There are 433 residential structures (worth $65.3M), three non-residential structures (value unknown), one community facility (worth $78K), and two utilities (worth $4.7M) located in very high fire risk areas. There were 116 residential structures (worth $17.5M) and no critical facilities identified in the extreme fire risk area.

Earthquake

Based on PGA shake maps produced by the USGS, the western portion of Columbia County is likely to experience higher levels of shaking than the eastern portion, as a result of its proximity to the Cascadia Subduction Zone. Ground movement in both areas, however, is likely to cause damage to weak, unreinforced masonry buildings, and to induce small landslides along unstable slopes. As well as landslide, earthquakes can trigger other hazards such as dam failure and disruption of transportation and utility systems.

The eastern portion of Columbia County is likely to experience strong shaking should a subduction zone earthquake occur (9-20 percent of the acceleration of gravity). In contrast, the

far western portion of the county is likely to experience very strong shaking (20-25 percent). This rating represents the peak acceleration of the ground caused by the earthquake.

Due to City of Scappoose's proximity to the eastern portion of the county, all people, critical facilities and infrastructure within the City of Scappoose, and therefore the entire population (6,700 people), including 2,209 residential structures (worth $450M), 14 non-residential structures (value unknown), one government facility (worth $1.1M), one emergency response facility (worth $2.3M), seven educational facilities (worth $59.7M), 16 community facilities (value $2.5M), six bridges (worth $10.5M), one highway (value unknown), one railroad (value unknown), two transportation facilities (value unknown), and five utilities (worth $24.2M) are located in the strong shaking (9-20 percent) area.

Volcano

A volcanic eruption would have a minor impact on The City of Scappoose due to the proximity to volcanoes within the Cascade region. The major resources of concern include air quality and waterway sedimentation. During previous eruptions, ashfall has drifted to the east of the volcanoes. (State Interagency Hazard Mitigation Team 2006)

The City of Scappoose will likely only experience damage from volcanic eruption columns and clouds which contain volcanic gases, minerals, and rock. The columns and clouds form rapidly and extend several miles above an eruption. Solid particles within the clouds present a serious aviation threat, can distribute acid rain (sulfur dioxide gas and water), can create risk of suffocation (carbon dioxide is heavier than air and collects in valleys and depressions threatening human and animals), and pose a toxic threat from fluorine which clings to ash particles potentially poisoning grazing livestock and contaminating domestic water supplies.

Buildings streets and roads throughout the city may require minor cleanup with negligible impacts. Temporary utility interruptions are likely, and minor cleanup may be required for electrical and other utility services. Water treatment facilities may require additional attention to address high turbidity water. River traffic along the Columbia River could be disrupted due to sedimentation from a large eruption from Mt. St. Helens or Hood and dredging to restore channel depths may be necessary. Injuries associated with respiratory problems may result. (Goettel 2005)

Due to the nature of the hazard, it is impossible to predict the location or extent of future events with any probability, although it can be assumed that all critical facilities and infrastructure within the City of Scappoose are at risk including the entire population (6,700 people), including 2,209 residential structures (worth $450M), 14 non-residential structures (value unknown), one government facility (worth $1.1M), one emergency response facility (worth $2.3M), seven educational facilities (worth $59.7M), 16 community facilities (value $2.5M), six bridges (worth $10.5M), one highway (value unknown), one railroad (value unknown), two transportation facilities (value unknown), and five utilities (worth $24.2M).

Wind

Many buildings, utilities and transportation systems in open areas, natural grasslands, or agricultural lands are especially vulnerable to wind damage. Impacts associated with wind can

include damage to power lines, trees, and structures, and can also cause temporary disruptions of power. Additionally, high winds can cause significant damage to forestlands.

All areas within the City of Scappoose are equally at risk of a windstorm event including all people, critical facilities and infrastructure, and therefore the entire population (6,090 people), including 2,209 residential structures (worth $450M), 14 non-residential structures (value unknown), one government facility (worth $1.1M), one emergency response facility (worth $2.3M), seven educational facilities (worth $59.7M), 16 community facilities (value $2.5M), six bridges (worth $10.7M), one highway (value unknown), one railroad (value unknown), two transportation facilities (value unknown), and five utilities (worth $24.2M).

Erosion

Riverine and stream erosion rarely causes death or injury. However, erosion causes significant destruction of property, development, and infrastructure. Erosion hazard data is not readily available; however, descriptions of several localized areas were identified during the development of this document and are identified only by location on a map referencing the river or stream reach described. Critical facilities that may be at risk of erosion were identified using a 300 foot-buffer in the areas identified as having historic erosion impacts to conservatively account for building footprints.

The City of Scappoose has 49 residential structures (worth $7.4M), one educational facility (worth $3.6M), and six bridges (worth $10.7M) within potential erosion hazard areas. There is also one pump station (worth 1.2M) and sewer and water lines (values unknown) in close proximity (within 30 feet) of Scappoose Creek which posses an erosion threat to the infrastructure.

Drought

State-wide droughts have historically occurred in Oregon, and as it is a region-wide phenomenon, all residents are equally at risk. Structural damage from drought is not expected; rather the risks are present to humans and resources. Agriculture, fishing, and timber have historically been impacted, as well as local and regional economies.

Dam Failure

US Army Corps of Engineers inundation data for the Columbia River and the PacifiCorp inundation data for the Lewis River in the State of Washington were used to determine the impacts from dam failure upriver from the City of Scappoose. There are 1,049 residential structures (worth $200M), six non-residential structures (value unknown), one government facility (value $1M), one emergency response facility (value $2.3M), seven educational facilities (worth $59.7M), seven community facilities (value $1.7M), two bridges (worth $3.6M), two transportation facilities (value unknown), and four utilities (value $19.7M) located in the inundation area.

Disruption of Utility and Transportation Systems

Transportation system disruption impacts range from effects on life, health, and safety (emergency vehicle mobility, access to hospitals, access to evacuation routes, access to vital

supplies if transport is seriously disrupted for a long time) to the economic effects of delays, lost commerce, and lost time. Similarly, disruption of utility systems can affect the county at the level of commerce and recreation as well as at the level of fundamental health and safety. County-wide as well as localized areas of disruption are likely to impact all residents equally. Structural damage from disruption to these systems is not expected; rather the risks are present to residents and those traveling in the area.

Hazardous Material Event

The National Response Center and the EPA's Environmental Facts Multisystem Query were used to locate hazardous waste handling facilities and businesses that generate hazardous waste from their activities. (In Progress) Transportation routes likely to carry hazardous waste were examined, and all facilities within a 0.25 mile radius of those are considered at risk.

There are 825 residential structures (worth $150M), nine non-residential structures (value unknown), one government facility (worth $1.1M), one emergency response facility (worth $2.3M), seven educational facilities (worth $59.7M), 15 community facilities (worth $2.4M), one highway (value unknown), one railroad (value unknown), 4 bridges (worth $7.2M), one transportation facility (value unknown), and two utilities (worth $200K) located within 0.25 mile of a transportation route and may be at risk from a hazardous material event.

Facilities considered at risk near 0.25 mile-buffered EHS Sites include one government facility (worth $1.1M), one emergency response facility (worth $2.3M), seven educational facilities (worth $59.7M), 14 community facilities (worth $2.4M), 4 bridges (worth $7.2M), two transportation facilities (value unknown), and five utilities (worth $24.2M).

Terrorism

It is difficult to determine the scope of any terrorist threat to the City of Scappoose. Although there seem to be few high-profile targets present, it is impossible to predict future terrorist events. Depending on the extent of the action, the community may suffer economic loss, disruption of utilities, and cleanup relating to explosions and other facility damages. Structural damage, injuries or casualties may occur, however, it is beyond the scope of this analysis to estimate losses.

Infectious Disease Epidemic

The consequences of a pandemic as described in Chapter 5 could be devastating. In the event of a poor-fit vaccine or very limited vaccine supply, the public health measures that would work best include: isolation and quarantine; restricting movement between and within communities; prohibiting public gatherings and group activities; and closing schools.

The county and state have isolation and quarantine laws; cities can also apply quarantines and restrict public movement in a public health emergency. The recently passed public health emergency law in Oregon provides a process for such mechanisms to be implemented.

Impacts associated with infectious disease epidemics in general have the potential to include loss of life and shutdown of critical facilities. Furthermore, an epidemic level of infectious disease in the community could overwhelm local resources, although there are no structural risks or losses

associated with this hazard. The entire population of 6,700 is at risk from the effects of an infectious disease epidemic.

MITIGATION STRATEGY

IDENTIFYING MITIGATION ACTIONS

The following section defines identification and analysis of mitigation actions as stipulated in DMA 2000 and its implementing regulations.

DMA 2000 Requirements: Mitigation Strategy - Identification and Analysis of Mitigation Actions

Identification and Analysis of Mitigation Actions

Requirement §201.6(c)(3)(ii): [The mitigation strategy shall include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.

Element

- Does the new or updated plan identify and analyze a comprehensive range of specific mitigation actions and projects for each hazard?
- Do the identified actions and projects address reducing the effects of hazards on new buildings and infrastructure?
- Do the identified actions and projects address reducing the effects of hazards on existing buildings and infrastructure?

Source: FEMA, July 2008.

The Steering Committee assessed whether to adopt Columbia County's hazard mitigation goals listed in Table G-11, or to revise them to better meet the City's needs. The City then proceeded to evaluate potential mitigation actions after finalizing the mitigation goals.

Mitigation actions are activities, measures, or projects that help achieve the goals of a mitigation plan. Table G-12 depicts the City's "considered" mitigation actions developed during this mitigation planning process. The revised list in Table G-14 delineates those actions the City will strive to implement within this five year planning cycle.

DMA 2000 Requirements: Mitigation Strategy - National Flood Insurance Program (NFIP) Compliance

National Flood Insurance Program (NFIP) Compliance

Requirement §201.6(c)(3)(ii): [The mitigation strategy] must also address the jurisdiction's participation in the National Flood Insurance Program (NFIP), and continued compliance with NFIP requirements, as appropriate.

Element

- Does the new or updated plan describe the jurisdiction(s) participation in the NFIP?
- Does the mitigation strategy identify, analyze and prioritize actions related to continued compliance with the NFIP?

Source: FEMA, July 2008.

The City of Scappoose actively participates in FEMA's National Flood Insurance Program (NFIP) and have implemented floodplain policies, regulations, and ordinances to protect their threatened population and infrastructure to assure NFIP compliance.

The City's Mitigation Strategy identified and analyzed potential flood mitigation actions that would fulfill NFIP initiatives, and prioritized City appropriate actions to assure an effective flood mitigation program.

MITIGATION GOALS AND ACTION ITEMS CONSIDERED

Table G-11. 2014 Columbia County Mitigation Goals-Considered

Goal Number	Goal Description
1	**Reduce the Threat to Life Safety** Enhance life safety by minimizing the potential for deaths and injuries in future disaster events.
2	**Protect Critical Facilities and Enhance Emergency and Essential Services** • Implement activities or projects to protect critical facilities and infrastructure. • Seek opportunities to enhance, protect, and integrate emergency and essential services. • Strengthen emergency operations plans and procedures by increasing collaboration and coordination among public agencies, non-profit organizations, business, and industry.
3	**Reduce the Threat to Property** • Seek opportunities to protect, enhance and integrate emergency and essential services. • Strengthen emergency operations plans and procedures by increasing collaboration and coordination among public agencies, non-profit organizations, business, industry and the citizens of Columbia County.
4	**Create a Disaster Resistant and Disaster-Resilient Economy** • Develop and implement activities to protect economic well-being and vitality while reducing economic hardship in post disaster situations. • Reduce insurance losses and repetitive claims for chronic hazard events. • Work with State and Federal Partners to reduce short-term and long-term recovery and reconstruction costs. • Work with local organization, such as Columbia Emergency Planning Association (CEPA). • Expedite pre-disaster and post-disaster grants and program funding.
5	**Increase Public Awareness, Education, Outreach, and Partnerships** • Coordinate and collaborate, where possible, risk reduction outreach efforts with the Oregon Partners for Disaster Resistance & Resilience and other public and private organizations. • Develop and implement risk reduction education programs to increase awareness among citizens, local, county, and regional agencies, non-profit organizations, business, and industry. • Promote insurance coverage for catastrophic hazards • Strengthen communication and coordinate participation in and between public agencies, citizens, nonprofit organizations, business, and industry.

Table G-12. City of Scappoose Mitigation Actions Considered			
Hazard	**Status**	**Comment**	**Description**
Natural Hazards			
Multi-Hazard			
MH	***Ongoing***		Develop and incorporate building ordinances commensurate with building codes to reflect survivability from wind, seismic, fire, and other hazards to ensure occupant safety.
MH	***Ongoing***		Review ordinances and develop outreach programs to assure mobile homes and manufactured buildings are protected from severe wind and flood hazards. (Anchoring, elevation, and other methods as applicable)
MH	***Ongoing***		Cross reference and incorporate mitigation planning provisions into all community planning processes such as comprehensive, capital improvement, land use, transportation plans, etc to demonstrate multi-benefit considerations and facilitate using multiple funding source consideration.
MH	***Ongoing***		Develop and incorporate mitigation provisions and recommendations into zoning ordinances and community development processes to maintain the floodway and protect critical infrastructure and private residences from other hazard areas.
MH	***Ongoing***		Increase power line wire size and incorporate quick disconnects (break away devices) to reduce ice load and wind storm power line failure during severe wind or winter ice storm events.
MH	***Ongoing***		Purchase and install generators with main power distribution disconnect switches for identified and prioritized critical facilities susceptible to short term power disruption. (i.e. first responder and medical facilities, schools, correctional facilities, and water and sewage pump stations, etc.)
MH	Consider		Install lightening grade surge protection devices on critical electronic components such as warning systems, communications equipment, and computers for critical facilities.
MH	***Ongoing***		Develop, produce, and distribute information materials concerning mitigation, preparedness, and safety procedures for all natural hazards.
MH	***Ongoing***		Explore the need for, develop, and implement hazard zoning ordinances for high-risk hazard area land-use.
MH	***Ongoing***		Based on known high-risk hazard areas, identify hazard-specific signage needs and purchase and install hazard warning signs near these areas to notify and educate the public of potential hazards.
MH	***Ongoing***		Identify and list repetitively flooded structures and infrastructures, analyze the threat to these facilities, and prioritize mitigation actions to acquire, relocate, elevate, and/or flood proof to protect the threatened population.
MH	***Ongoing***		Perform hydrologic and hydraulic engineering, and drainage studies and analyses. Use information obtained for feasibility determination and project design. This information should be a key component, directly related to a proposed project.
MH	***Ongoing***		Develop vegetation projects to restore clear cut and riverine erosion damage and to increase landslide susceptible slope stability.
MH	***Ongoing***		Retrofit structures to protect them from seismic, floods, high winds, earthquakes, or other natural hazards.
MH	***Ongoing***	1 City Admin/PW	Acquire, demolish, or relocate structures from hazard prone area. Property deeds shall be restricted for open space uses in perpetuity to keep people from rebuilding in hazard areas.
MH	***Ongoing***		Harden utility headers located along river embankments to mitigate potential flood, debris, and erosion damages.

Table G-12. City of Scappoose Mitigation Actions Considered			
Hazard	**Status**	**Comment**	**Description**
MH	***Ongoing***		Establish a formal role for the jurisdictional Hazard Mitigation Planning Committees to develop a sustainable process to implement, monitor, and evaluate citywide mitigation actions.
MH	***Ongoing***	2 City Admin	Identify and pursue funding opportunities to implement mitigation actions.
MH	***Ongoing***		Develop public and private sector partnerships to foster hazard mitigation activities.
MH	***Ongoing***		Integrate the Mitigation Plan findings into planning and regulatory documents and programs and into enhanced emergency planning.
MH	***Ongoing***		Review City insurance to ensure infrastructure is properly covered.
Flood			
Flood	***Ongoing***		Develop and maintain GIS mapped critical facility inventory for all structures located within 100-year and 500-year floodplains.
Flood	***Ongoing***		Develop and maintain GIS mapped inventory, and develop prioritized list of residential and commercial buildings within 100-year and 500-year floodplains.
Flood	***Ongoing***	**1** **City Admin/PW**	Develop and maintain GIS mapped inventory of repetitive loss properties to include the types and numbers of properties.
Flood	***Ongoing***	**2** **City Admin/PW**	Develop and implement mitigation actions for repetitive loss properties.
Flood	***Ongoing***		Establish flood mitigation priorities for critical facilities and residential and commercial buildings located within the 100- year floodplain using survey elevation data.
Flood	***Ongoing***		Implement mitigation measures identified by critical facilities' owners, and other facility owners, to protect facilities located within the 100-year floodplain.
Flood	***Ongoing***		Develop and maintain an inventory of locations subject to frequent storm water flooding based on most current USACOE flood data.
Flood	Consider		Request DOGAMI debris flow and lahar data be included in FIRM updates. Use the updated FIRMS for land use and mitigation planning.
Flood	Consider		Determine and implement most cost beneficial and feasible mitigation actions for locations with repetitive flooding and significant damages or road closures.
Flood	***Ongoing***		Develop an outreach program to educate public concerning NFIP participation benefits, floodplain development, land use regulation, and NFIP flood insurance availability to facilitate continued compliance with the NFIP.
Flood	***Ongoing***		Develop, implement, and enforce floodplain management ordinances.
Flood	***Ongoing***		Develop outreach program to educate residents concerning flood proofed well and sewer/septic installation.
Flood	***Ongoing***		Acquire, relocate, elevate, or otherwise flood-proof identified properties.
Flood	***Ongoing***		Acquire, relocate, elevate, or otherwise flood-proof critical facilities.
Flood	***Ongoing***		Install new streamflow and rainfall measuring gauges.
Flood	***Ongoing***		Develop, or revise, adopt, and enforce storm water ordinances and regulations to manage run-off from new

Table G-12. City of Scappoose Mitigation Actions Considered			
Hazard	**Status**	**Comment**	**Description**
			development, including buffers and retention basins.
Flood	Consider		Construct earthen berms to divert flood flows into bridge or culvert openings. The earth fill should be erosion-resistant and the berms should be covered with erosion-resistant fabric, armoring materials, or vegetation.
Flood	***Ongoing***		Increase culvert size to increase its drainage efficiency.
Flood	***Ongoing***		Construct debris basins to retain debris in order to prevent downstream drainage structure clogging.
Flood	Consider		Install debris cribs over culvert inlets to prevent inflow of coarse bed-load and light floating debris.
Flood	Consider		Construct debris deflectors to deflect the major portion of debris away from culvert entrances and bridge piers. They are normally "V" shaped.
Flood	Consider		Install debris fins upstream of a culvert to align debris so that the debris will pass through a drainage opening without clogging the inlet. They are sometimes used on bridge piers to deflect drifting materials.
Flood	Consider		Create detention storage basins, ponds, reservoirs etc. to allow water to temporarily accumulate to reduce pressure on culverts and low water crossings. Water ultimately returning to its watercourse at a reduced flow rate.
Flood	Consider		Install triangular or circular flow deflectors on or immediately upstream from bridge footings to deflect water flow and reduce flow velocities preventing footing scour.
Flood	Consider		Construct low water crossings in a road prism to carry flood flows from an intermittent drainage
Flood	Consider		Construct a high water overflow crossing to carry flood flows from over bank areas.
Flood	Consider		Realign bridge piers & abutments to be parallel with the stream's centerline. This prevents pier and abutment undermining and reduces debris catchment.
Flood	Consider		Create relief drainage ditch opening using a culvert, bridge, or multiple culverts; to relieve rapid water accumulation during high water flow events. .
Flood	Consider		Raise bridge height or convert bridge from a multi-span to single span to increase water flow and reduce debris catchment.
Flood	Consider		Modify existing culverts by developing a ring compression, by flattening, or beveling the end of a circular culvert to match the angle of the embankment. May need to install flanges to stiffen the beveled section of the culvert.
Flood	Consider		Construct spur dikes along the embankments to direct flood flows into a bridge opening or away from a continuous impact site.
Flood	Consider		Construct concrete wing walls at culvert or bridge entrances and outlets to direct water flow into their openings
Flood	Consider		Provide flood protection to mitigate damage and contamination of wastewater treatment systems.
Flood	Consider		Develop and implement flood risk reduction program and outreach efforts considering upstream storage, channel improvements, and flood walls or levee construction.
Flood	***Ongoing***		Develop and maintain GIS mapped critical facility inventory for all structures located within 100-year and 500-year floodplains.
Flood	***Ongoing***		Develop and maintain GIS mapped inventory, and develop prioritized list of residential and commercial buildings within 100-year and 500-year floodplains.

Table G-12. City of Scappoose Mitigation Actions Considered			
Hazard	**Status**	**Comment**	**Description**
Flood	***Ongoing***		Develop and maintain GIS mapped inventory of repetitive loss properties to include the types and numbers of properties.
Flood	***Ongoing***		Develop and implement mitigation actions for repetitive loss properties.
Winter Storm			
Winter Storm	***Ongoing***		Develop and implement strategies and educational outreach programs for debris management from severe winter storms.
Winter Storm	***Ongoing***		Develop and implement programs to coordinate maintenance and mitigation activities to reduce risk to public infrastructure from severe winter storms.
Winter Storm	***Ongoing***		Update or develop, implement, and maintain jurisdictional debris management plans.
Winter Storm	***Ongoing***	1 City Admin/PW/ PD/Fire District	Develop critical facility list needing emergency back-up power systems, prioritize, seek funding and implement mitigation actions.
Winter Storm	***Ongoing***	2 City Admin/PW/ PD/Fire District	Develop and maintain severe winter storm public outreach program defining mitigation activity benefits through educational outreach aimed at households and businesses while targeting of special needs populations.
Winter Storm	***Ongoing***		Develop and implement tree clearing mitigation programs to keep trees from threatening lives, property, and public infrastructure from severe weather events.
Winter Storm	***Ongoing***		Develop, implement, and maintain partnership program with electrical utilities to use underground utility placement methods where possible to reduce or eliminate power outages from severe winter storms. Consider developing incentive programs.
Winter Storm	Consider		Develop personal use and educational outreach training for a “tree safety” program. Implement along utility and road corridors, preventing potential winter storm damage.
Winter Storms	***Ongoing***		Purchase NOAA Weather radios and develop a web portal linking residents to various weather information sites. (NWS, FEMA, The Weather Channel).
Winter Storms	Consider		Install new streamflow and precipitation measuring gauges and develop monitoring and early warning program.
Winter Storms	Consider		Develop outreach program with school district contests having students develop, display, and explain mitigation projects or initiatives.
Winter Storms	Consider		Develop early warning test program partnering with NOAA, City Police, and Fire District to coordinate tests.
Winter Storms	***Ongoing***		Implement and enforce the most current Uniform International, and State, Building Codes to ensure structures can withstand winter storm hazards such as high winds, rain, water and snow.
Winter Storms	***Ongoing***		Increase power line wire size and incorporate quick disconnects (break away devices) to reduce ice load power line severe wind or winter ice storm event failure.
Winter	***Ongoing***		Review critical facilities and government building energy efficiency, winter readiness, and electrical protection

Table G-12. City of Scappoose Mitigation Actions Considered			
Hazard	**Status**	**Comment**	**Description**
Storms			capability. Identify, prioritize, and implement infrastructure upgrade or rehabilitation project prioritization and development.
Landslide			
Landslide	***Ongoing***	1 City Admin/PW	Complete a landslide location inventory, identify threatened critical facilities and other buildings and infrastructure using GIS.
Landslide	***Ongoing***		Develop prioritized list of mitigation actions for threatened critical facilities and other buildings or infrastructure.
Landslide	***Ongoing***		Develop process to limit future development in high landslide potential areas (permitting, geotechnical review, soil stabilization techniques, etc).
Landslide	***Ongoing***		Update the storm water management plan to include regulations to control runoff, both for flood reduction and to minimize saturated soils on steep slopes that can cause landslides.
Landslide	Consider		Develop comprehensive geological landslide and rockslide prone area maps.
Landslide	***Ongoing***		Develop a vegetation management plan addressing slope-stabilizing root strength while facilitating precipitation containment.
Landslide	Consider		Identify and seasonally restrict recreational and construction activities in high landslide areas.
Landslide	***Ongoing***		Develop, implement and enforce property development landslide risk assessment procedures to identify potential facility vulnerability.
Wildland Fire			
Wildland Fire	***Ongoing***		Identify critical facilities and vulnerable populations based on mapped high hazard areas.
Wildland Fire	***Ongoing***		Identify evacuation routes away from high hazard areas and develop outreach program to educate the public concerning warnings and evacuation procedures.
Wildland Fire	***Ongoing***		Develop Community Wildland Fire Protection Plans for all at-risk communities.
Wildland Fire	***Ongoing***		Provide real-time internet access and interagency cooperation to decrease wildland fire warning times.
Wildland Fire	***Ongoing***		Hold FireWise workshop to educate residents and contractors concerning fire resistant landscaping.
Wildland Fire	***Ongoing***		Promote FireWise building siting, design, and construction materials.
Wildland Fire	***Ongoing***		Retrofit structures with FireWise building design materials.
Wildland Fire	***Ongoing***		Develop FireWise Public Service Announcements (PSA).
Wildland Fire	***Ongoing***		Provide wildland fire information in an easily distributed format for all residents.
Wildland Fire	***Ongoing***		Schedule and perform government facility "fire drills" at least twice per year.
Wildland Fire	***Ongoing***		Conduct residential audits for wildland and building fire hazard identification then develop an outreach program to covey the findings.
Wildland Fire	***Ongoing***	2 City Admin Fire District	Develop, adopt, and enforce burn ordinances that require burn permits, restricts campfires, and controls outdoor burning.
Wildland Fire	***Ongoing***	1	Develop outreach program to educate and encourage fire-safe construction practices for existing and new

Table G-12. City of Scappoose Mitigation Actions Considered			
Hazard	**Status**	**Comment**	**Description**
		City Admin Fire District	construction in high risk areas.
Wildland Fire	***Ongoing***		Develop outreach program to educate and encourage home landscape cleanup (defensible space) and define debris disposal programs.
Wildland Fire	***Ongoing***		Identify, develop, and implement, and enforce mitigation actions such as fuel breaks and reduction zones for potential wildland fire hazard areas.
Earthquake			
Earthquake	***Ongoing***		Supplement State Seismic Needs Analysis data (schools, fire, law enforcement). Complete inventory of public and commercial buildings that may be particularly vulnerable to earthquake damage.
Earthquake	***Ongoing***	**1 City Admin/PW/ PD/FD/School D/Utilities**	Identify high seismic hazard areas using GIS; develop a wood-frame residential building inventory and an outreach program to educate population concerning facilities particularly vulnerable to earthquake damage, such as pre-1940s homes and homes with cripple wall foundations.
Earthquake	***Ongoing***		Disseminate FEMA pamphlets to educate and encourage homeowners concerning seismic structural and non-structural retrofit benefits.
Earthquake	***Ongoing***		Retrofit important public facilities with significant seismic vulnerabilities, such as unreinforced masonry construction.
Earthquake	***Ongoing***		Retrofit bridges that are not seismically adequate for lifeline transportation routes.
Earthquake	***Ongoing***	**2 City Admin/PW/ PD/FD/School D/Utilities**	Update existing (or adopt the most current) Uniform Building Code
Earthquake	***Ongoing***		Implement and enforce the Uniform, International, and State Building Codes.
Earthquake	***Ongoing***		Inspect and/or certify all new construction.
Earthquake	***Ongoing***		Develop public outreach program to train earthquake safety; perform drop-cover-hold drills at schools and public facilities.
Earthquake	***Ongoing***		Develop outreach program to educate population concerning household, business, and public facility mitigation measures. For example, staff public information tables at fairs, safety events, and festivals.
Earthquake	***Ongoing***		Develop outreach program to educate residents concerning benefits of increased seismic resistance and modern building code compliance during rehabilitation or major repairs for residences or businesses.
Earthquake	***Ongoing***		Inspect, prioritize, and retrofit any critical facility or public infrastructure that does not meet current Building Codes.
Earthquake	***Ongoing***		Identify and prioritize a list of critical facilities with unreinforced masonry problems including non-structural

Table G-12. City of Scappoose Mitigation Actions Considered			
Hazard	**Status**	**Comment**	**Description**
			projects such as brick chimney bracing or replacement, water heater bracing, and anchoring, etc.
Earthquake	***Ongoing***		Evaluate critical public facility seismic performance for fire stations, public works buildings, potable water systems, wastewater systems, electric power systems, and bridges within the jurisdiction.
Earthquake	Consider		Develop outreach program for educating private facilities concerning alternative or emergency power source acquisition to enable them to deliver food, fuel, and medical services during disaster emergency response and recovery efforts.
Earthquake	***Ongoing***		Encourage utility companies to evaluate and harden vulnerable infrastructure elements for sustainability.
Earthquake	***Ongoing***		Develop partnerships to mitigate hazards that result in jurisdictional facility lifeline or emergency transportation route closures.
Volcano			
Volcano	***Ongoing***		Update public emergency notification procedures and develop an outreach program for ash fall events.
Volcano	***Ongoing***	**1 City Admin/PW/ PD/FD/School D/Utilities**	Update emergency response planning and develop client focused outreach program for ash fall events affecting river, air, and highway transportation, and industrial facilities and operations.
Volcano	Consider		Evaluate capability of water treatment plants to deal with high turbidity from ash falls, update emergency response plans, and upgrade treatment facilities' physical plant to deal with ash falls. Prioritize and initiate actions to fill capability gaps.
Volcano	Consider		Evaluate ash impact on storm water drainage system and develop mitigation actions.
Wind			
Wind	***Ongoing***		Review ordinances and develop outreach programs to assure manufactured buildings are protected from severe wind and flood hazards. (Anchoring, elevation, siting, and other methods as applicable)
Wind	***Ongoing***	**City Admin/PW**	Identify using GIS and prioritize critical facilities' overhead utilities that could be placed underground to reduce power disruption from wind storm / tree blow down damage.
Wind	***Ongoing***		Revise requirements to place utilities underground to reduce power disruption from wind storm / tree blow down damage when upgrading or during new development.
Wind	***Ongoing***		Increase power line wire size and incorporate quick disconnects (break away devices) to reduce ice load power line failure during severe wind or winter ice storm events.
Erosion			
Erosion	***Ongoing***		Maintain and update erosion hazard locations, identify critical facilities potentially impacted and develop mitigation initiatives such as bank stabilization or facility relocation to prevent or reduce the threat.
Erosion	Consider		Relocate buildings that are at risk of being affected by erosion.
Erosion	***Ongoing***	**1**	Apply for grants/funds to implement stream bank protection methods.

Table G-12. City of Scappoose Mitigation Actions Considered			
Hazard	**Status**	**Comment**	**Description**
		City Admin PW Scappoose Bay Watershed Council	
Erosion	***Ongoing***		Hold series of community meetings and other outreach efforts to provide erosion hazard specific information to residents.
Erosion	***Ongoing***		Develop and provide information to all residents on riverbank erosion and methods to prevent it in an easily distributed format
Erosion	***Ongoing***		Develop outreach program to educate the public concerning planting processes and materials used to stabilize hill slopes or stream banks. This is known as bio-engineering; which uses logs, root wads, or wood debris or other vegetation to reduce scour and erosion.
Erosion	Consider		Harden culvert entrance bottoms to reduce erosion or scour.
Erosion	***Ongoing***	**2 City Admin PW Scappoose Bay Watershed Council**	Install embankment protection such as vegetation and other bio-engineered materials to reduce or eliminate erosion.
Erosion	Consider		Install walls at the end of a drainage structure to prevent embankment erosion at its entrance or outlet. (end walls).
Erosion	***Ongoing***		Construct a rock or concrete structure to dissipate energy or reduce flow velocity to prevent erosion of the streambed and banks.
Erosion	***Ongoing***		Install flared outlets or end sections at culvert entrances and outlets to match the embankment slope to reduce erosion and scour at the entrance and exit points during high flow.
Erosion	Consider		Install bank revetment protection to prevent erosion.
Drought			
Drought	***Ongoing***	1 City Admin	Develop educational programs and initiatives related to water conservation and irrigation during drought periods.
Dam Failure			
Dam Failure	Consider		Prepare high resolution dam failure inundation area maps; use to update emergency response plans, evacuation route identification, public notification, and evacuation procedures.
Dam Failure	***Ongoing***		Encourage the USACOE to prioritize dams according to hazard risks such as seismic vulnerability and make seismic improvements as necessary.
Dam Failure	Consider		Implement land use and management strategies where dam failure threats dictate.

Table G-12. City of Scappoose Mitigation Actions Considered			
Hazard	**Status**	**Comment**	**Description**
Dam Failure	Consider		Encourage the USACOE to conduct assessments for dams upstream of heavily populated areas.
Dam Failure	***Ongoing***	**1 City Admin/PW/ Scappoose Drainage Corp**	Evaluate the adequacy of dike systems for both floods and earthquakes and implement mitigation measures as necessary.
Disruption of Utility and Transportation Systems (DUTS)			
DUTS	***Ongoing***	**1 City Admin PD/FD/PW/School District/Utilities**	Develop outreach program to educate and encourage residents to maintain several days of emergency supplies for power outages or road closures.
DUTS	***Ongoing***		Review and update emergency response plans for utility disruptions.
DUTS	***Ongoing***		Review and update emergency response plans for transportation route disruptions.
DUTS	***Ongoing***		Identify and prioritize all "jurisdiction owned" & "non-jurisdiction owned" critical facilities that have backup power and emergency operations plans.
DUTS	***Ongoing***		Purchase backup power systems for all identified critical facilities.
Hazardous Materials (HAZMAT)			
HAZMAT	Consider		Annually review and update HAZMAT inventories and ensure that emergency responders are trained for site-specific incidents.
HAZMAT	***Ongoing***	**1 City Admin PD/FD/PW/ School District**	Enhance emergency planning, emergency response training, and equipment acquisition to address hazardous materials incidents for emergency and first responders and public works staff.
HAZMAT	***Ongoing***		Evaluate existing security measures for sites with large quantities of hazardous substances (HS) or any quantities of extremely hazardous substances (EHS) and enhance security as necessary.
HAZMAT	***Ongoing***		Evaluate seismic bracing/anchoring for sites with large quantities of hazardous substances (HS) or any quantities of extremely hazardous substances (EHS).
HAZMAT	Consider		Train Public Works staff to identify extremely hazardous substances (EHS) and to follow EMS protocols.
HAZMAT	Consider		Develop outreach program to educate the public regarding chemical hazards, safe handling, storage, and disposal procedures.
HAZMAT	Consider		Research, develop, and implement methods to protect waterways from hazardous materials events.
HAZMAT	***Ongoing***		Prepare a site-specific summary of hazardous materials used, stored, and commonly transported in the jurisdictional area. The summary should include mapped facility locations with a hazardous materials inventory, emergency response protocols, and mitigation actions.

Table G-12. City of Scappoose Mitigation Actions Considered			
Hazard	**Status**	**Comment**	**Description**
Terrorism			
Terrorism	***Ongoing***	**1 City Admin PD/FD/PW/School District/Utilities**	Enhance emergency planning, organization, equipment, exercise, and emergency response training to address all potential terrorism incidents.
Terrorism	***Ongoing***		Upgrade physical security, detection, and response capability for critical facilities using information obtained from hazard assessments and risk analysis. Include water systems and any high-profile facilities such as major timber industry facilities and sites with large quantities of hazardous substances (HS) and extremely hazardous substances (EHS).
Infectious Disease Epidemic			
Infectious Disease Epidemic	***Ongoing***	**1 County Public Health Department PD/FD/School D**	Develop a public health emergency response operations plan that includes, but is not limited to, identification and an inventory of sites with the capacity to treat large numbers of infected individuals and identification of a quarantine facility.
Infectious Disease Epidemic	***Ongoing***		Identify sectors of the population that are vulnerable to potential infectious diseases and develop strategies to communicate and serve those identified populations.
Infectious Disease Epidemic	***Ongoing***		Determine public health authorities and responsibilities during disaster and emergency situations, e.g., quarantine, shelter hygiene, public sanitation, and immunization.
Infectious Disease Epidemic	***Ongoing***		Research and obtain necessary specialized training for public health officials to respond to an infectious disease epidemic.
Infectious Disease Epidemic	***Ongoing***		Identify state and federal resources for establishing and improving public health response capacity.
Infectious Disease Epidemic	***Ongoing***		Identify appropriate manpower to respond to an infectious disease epidemic.

EVALUATING AND PRIORITIZING MITIGATION ACTIONS

The following section defines mitigation action evaluation and implementation as stipulated in DMA 2000 and its implementing regulations.

DMA 2000 Requirements: Mitigation Strategy - Implementation of Mitigation Actions

Implementation of Mitigation Actions

Requirement: §201.6(c)(3)(iii): [The mitigation strategy section shall include] an action plan describing how the actions identified in **section (c)(3)(ii)** will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

Element

- Does the new or updated mitigation strategy include how the actions are prioritized? (For example, is there a discussion of the process and criteria used?)
- Does the new or updated mitigation strategy address how the actions will be implemented and administered, including the responsible department, existing and potential resources, and the timeframe to complete the action?
- Does the new or updated prioritization process include an emphasis on the use of a cost-benefit review to maximize benefits?
- Does the updated plan identify the completed, deleted, or deferred mitigation actions as a benchmark for progress, and if activities are unchanged (i.e., deferred), does the updated plan describe why no changes occurred?

Source: FEMA, July 2008.

The Steering Committee met on April 10, 2014 to evaluate and prioritize each of the mitigation actions to determine which considered actions would be included in the Mitigation Action Plan. The Committee then conferred on multiple dates to determine the responsible agency and potential funding sources. The Mitigation Action Plan represents mitigation projects and programs to be implemented through the cooperation of multiple entities.

To complete this task, the Steering Committee reviewed the simplified STAPLEE evaluation criteria and the Benefit-Cost Analysis Fact Sheet (Appendix N) to consider the opportunities and constraints of implementing each particular mitigation action.

STAPLEE Evaluation Criteria for Mitigation Actions

Evaluation Category	Discussion "It is important to consider…"	Considerations
Social	The public support for the overall mitigation strategy and specific mitigation actions.	Community acceptance Adversely affects population
Technical	If the mitigation action is technically feasible and if it is the whole or partial solution.	Technical feasibility Long-term solutions Secondary impacts
Administrative	If the community has the personnel and administrative capabilities necessary to implement the action or whether outside help will be necessary.	Staffing Funding allocation Maintenance/operations

STAPLEE Evaluation Criteria for Mitigation Actions		
Evaluation Category	**Discussion "It is important to consider…"**	**Considerations**
Political	What the community and its members feel about issues related to the environment, economic development, safety, and emergency management.	Political support Local champion Public support
Legal	Whether the community has the legal authority to implement the action, or whether the community must pass new regulations.	Local, State, and Federal authority Potential legal challenge
Economic	If the action can be funded with current or future internal and external sources, if the costs seem reasonable for the size of the project, and if enough information is available to complete a FEMA Benefit-Cost Analysis.	Benefit/cost of action Contributes to other economic goals Outside funding required FEMA Benefit-Cost Analysis
Environmental	The impact on the environment because of public desire for a sustainable and environmentally healthy community.	Effect on local flora and fauna Consistent with community environmental goals Consistent with local, State, and Federal laws

Upon review, the Steering Committee assigned a high priority ranking to actions that best fulfill the goals of the MHMP and are appropriate and feasible for the City and responsible entities to implement during the 5-year lifespan of this version of the MHMP. As such, the Steering Committee determined that only the mitigation actions that received a high priority ranking would be included in the City's Mitigation Action Plan. Table G-14 depicts the City's mitigation actions grouped by hazard and in descending priority order within each hazard.

MITIGATION GOALS AND ACTIONS PRIORITIZED & ASSIGNED

The City of Scappoose reviewed the Columbia County goals and determined they meet the City's needs and subsequently implemented the Goals in Table G-13 for the current planning period.

Table G-13. City of Scappoose Mitigation Goals

Goal Number	Goal Description
1	**Reduce the Threat to Life Safety** Enhance life safety by minimizing the potential for deaths and injuries in future disaster events.
2	**Protect Critical Facilities and Enhance Emergency and Essential Services** • Implement activities or projects to protect critical facilities and infrastructure. • Seek opportunities to enhance, protect, and integrate emergency and essential services. • Strengthen emergency operations plans and procedures by increasing collaboration and coordination among public agencies, non-profit organizations, business, and industry.
3	**Reduce the Threat to Property** • Seek opportunities to protect, enhance and integrate emergency and essential services. • Strengthen emergency operations plans and procedures by increasing collaboration and coordination among public agencies, non-profit organizations, business, industry and the citizens of Columbia County.
4	**Create a Disaster Resistant and Disaster-Resilient Economy** • Develop and implement activities to protect economic well-being and vitality while reducing economic hardship in post disaster situations. • Reduce insurance losses and repetitive claims for chronic hazard events. • Work with State and Federal Partners to reduce short-term and long-term recovery and reconstruction costs. • Work with local organization, such as Columbia Emergency Planning Association (CEPA). • Expedite pre-disaster and post-disaster grants and program funding.
5	**Increase Public Awareness, Education, Outreach, and Partnerships** • Coordinate and collaborate, where possible, risk reduction outreach efforts with the Oregon Partners for Disaster Resistance & Resilience and other public and private organizations. • Develop and implement risk reduction education programs to increase awareness among citizens, local, county, and regional agencies, non-profit organizations, business, and industry. • Promote insurance coverage for catastrophic hazards • Strengthen communication and coordinate participation in and between public agencies, citizens, nonprofit organizations, business, and industry.

IMPLEMENTING A MITIGATION ACTION PLAN

The following section defines the mitigation action identification process for each participating jurisdiction as stipulated in DMA 2000 and its implementing regulations.

DMA 2000 Requirements: Mitigation Strategy-Identification of Multi-Jurisdictional Mitigation Actions

Identification of Multi-Jurisdictional Mitigation Actions

Requirement §201.6(c)(3)(iv): For multi-jurisdictional plans, there must be identifiable action items specific to the jurisdiction requesting FEMA approval or credit of the plan.

Element

- Does the new or updated plan include identifiable action items for each jurisdiction requesting FEMA approval of the plan?
- Does the updated plan identify the completed, deleted or deferred mitigation actions as a benchmark for progress, and if activities are unchanged (i.e., deferred), does the updated plan describe why no changes occurred?

Source: FEMA, July 2008.

This appendix identifies action items specific to the City of Scappoose. Since the update includes incorporation of the City of Scappoose as part of the MHMP, all actions in this appendix are considered new. Table G-14 displays the City of Scappoose's Mitigation Action Plan matrix that lists mitigation actions by hazard and are only prioritized within each hazard, not in total. Each mitigation action will be implemented and administered by the applicable managing department, agency, or responsible entity.

***Whenever TBD is used, it means that a benefit/cost analysis will be completed as a project is developed to validate the most appropriate mitigation action.*

Table G-14. City of Scappoose Mitigation Action Plan Matrix						
Hazard	**Description**	**Managing Department / Agency**	**Timeframe**	**Potential Funding Source(s)**	**Benefit-Costs / Technical Feasibility**	**Comments**
Multi-Hazard (MH)						
MH	Acquire, demolish, or relocate structures from hazard prone area. Property deeds shall be restricted for open space uses in perpetuity to keep people from rebuilding in hazard areas.	City Admin/PW	Ongoing	Sewer Fund, FMA, HMGP, PDM	BC: TBD TF: Yes	
MH	Identify and pursue funding opportunities to implement mitigation actions.	City Admin	Ongoing	General Fund	BC: TBD TF: Yes	
Flood						
Flood	Assist local drainage district with implementing flood dike certification	LDS, Rainier DD, Beaver, DD Scappoose DD, EM	2014	HMPG	BC: Acceptable TF: Yes	
Flood	Develop and maintain GIS mapped inventory of repetitive loss properties to include the types and numbers of properties.	City Admin/PW	Ongoing	General Fund	BC: TBD TF: Yes	
Flood	Develop and implement mitigation actions for repetitive loss properties.	City Admin/PW	Ongoing	Sewer Fund, FMA, HMGP, PDM	BC: TBD TF: Yes	
Winter Storm						
Winter Storm	Develop critical facility list needing emergency back-up power systems, prioritize, seek funding and implement mitigation actions.	City Admin/PW/ PD/Fire District	Ongoing	General Fund	BC: TBD TF: Yes	
Winter Storm	Develop and maintain severe winter storm public outreach program defining mitigation activity	City Admin/PW/	Ongoing	General Fund,	BC: TBD TF: Yes	

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	benefits through educational outreach aimed at households and businesses while targeting of special needs populations.	PD/Fire District		HMGP		
Landslide						
Landslide	Complete a landslide location inventory, identify threatened critical facilities and other buildings and infrastructure using GIS.	City Admin/PW	Ongoing	General Fund	BC: TBD TF: Yes	
Wildland Fire						
Wildland Fire	Develop outreach program to educate and encourage fire-safe construction practices for existing and new construction in high risk areas.	City Admin Fire District	Ongoing	General Fund, FMAP	BC: TBD TF: Yes	
Wildland Fire	Develop, adopt, and enforce burn ordinances that require burn permits, restricts campfires, and controls outdoor burning.	City Admin Fire District	Ongoing	General Fund	BC: TBD TF: Yes	
Earthquake						
Earthquake	Use GIS to identify high seismic hazard areas and develop a wood-frame residential building inventory and an outreach program to educate population concerning facilities particularly vulnerable to earthquake damage, such as pre-1940s homes and homes with cripple wall foundations.	City Admin /PW/PD/FD/School District/Utilities	Ongoing	General Fund	BC: TBD TF: Yes	
Earthquake	Update existing (or adopt the most current) Uniform Building Code	City Admin /PW/PD/FD/School District/Utilities	Ongoing	General Fund	BC: TBD TF: Yes	
Volcano						
Volcano	Update emergency response planning and develop client focused outreach program for ash fall events affecting river, air, and highway transportation, and	City Admin /PW/PD/FD/School District/Utilities	Ongoing	General Fund, NOAA/	BC: TBD TF: Yes	

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	industrial facilities and operations.			NWS, HMGP		
Wind						
Wind	Use GIS to identify and prioritize critical facilities' overhead utilities that could be placed underground to reduce power disruption from wind storm / tree blow down damage.	City Admin /PW	Ongoing	General Fund	BC: TBD TF: Yes	
Erosion						
Erosion	Apply for grants/funds to implement stream bank protection methods.	City Admin /PW/Scappoose Bay Watershed Council	Ongoing	General Fund	BC: TBD TF: Yes	
Erosion	Install embankment protection such as vegetation and other bio-engineered materials to reduce or eliminate erosion.	City Admin /PW/Scappoose Bay Watershed Council	Ongoing	General Fund, HMA, HMGP	BC: TBD TF: Yes	
Drought						
Drought	Develop educational programs and initiatives related to water conservation and irrigation during drought periods.	City Admin	Ongoing	General Fund	BC: TBD TF: Yes	
Dam Failure						
Dam Failure	Evaluate the adequacy of dike systems for both floods and earthquakes and implement mitigation measures as necessary.	City Admin /PW/Scappoose Drainage Corp	Ongoing	General Fund	BC: TBD TF: Yes	
Disruption of Utility and Transportation Systems (DUTS)						
(DUTS	Develop outreach program to educate and encourage residents to maintain several days of emergency supplies for power outages or road closures.	City Admin PD/FD/PW/School District/Utilities	Ongoing	General Fund	BC: TBD TF: Yes	

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Hazardous Materials (HAZMAT)						
HAZMAT	Enhance emergency planning, emergency response training, and equipment acquisition to address hazardous materials incidents for emergency and first responders and public works staff.	City Admin PD/FD/PW/School District/Utilities	Ongoing	General Fund, CERCLA, SARA	BC: TBD TF: Yes	
Terrorism						
Terrorism	Enhance emergency planning, organization, equipment, exercise, and emergency response training to address all potential terrorism incidents.	City Admin PD/FD/PW/School District/Utilities	Ongoing	General Fund, HSGP	BC: TBD TF: Yes	
Infectious Disease Epidemic						
Infectious Disease Epidemic	Develop a public health emergency response operations plan that includes, but is not limited to, identification and an inventory of sites with the capacity to treat large numbers of infected individuals and identification of a quarantine facility.	County Public Health Department (Lead) City Admin PD/FD/School District	Ongoing	General Fund, County CDC Public Health Funds	BC: TBD TF: Yes	

HISTORY

Hazard Mitigation Completion 2009-2014

The Scappoose School District replaced the Otto Peterson Elementary School with a new structure meeting all building and seismic codes. A backup power generator was installed to operate the Otto Peterson School along with a power generator at the high school for the School District computer system.

The Scappoose Fire District completed a seismic upgrade to the Scappoose Fire Station.

The City of Scappoose installed larger power generators at the waste water treatment plant and the Keys road water treatment plant.