Siskiyou County

Hazard Mitigation Plan
Volume 1: Planning-Area-Wide Elements

DRAFT

August 2018

Siskiyou County

HAZARD MITIGATION PLAN
VOLUME 1: PLANNING-AREA-WIDE ELEMENTS

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Siskiyou County
Hazard Mitigation Plan;
Volume 1—Planning-Area-Wide Elements

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The Disaster Mitigation Act (DMA) is federal legislation enacted to promote proactive pre-disaster planning as a condition of receiving financial assistance under the Robert T. Stafford Act. The DMA emphasizes planning for disasters before they occur. It established a Pre-Disaster Mitigation Program and new requirements for the national post-disaster Hazard Mitigation Grant Program.

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

Siskiyou County and nine local government planning partners worked together to create this Siskiyou County Hazard Mitigation Plan, fulfilling the DMA requirements for all participating partners. This effort was funded by a Hazard Mitigation Planning grant from the Federal Emergency Management Agency (FEMA), administered by the California Office of Emergency Services (Cal OES).

PLAN PURPOSE

Several factors initiated this planning effort for Siskiyou County and its planning partners:

- The Siskiyou County area has significant exposure to numerous natural hazards that have caused millions of dollars in past damage.
- Local resources for risk reduction are limited. Being able to leverage federal financial assistance is paramount to successful hazard mitigation in the area.
- The partners wanted to be proactive in preparing for the impacts of natural hazards

With these factors in mind, Siskiyou County committed to meeting with local partners and move forward with planning for the future and continuing to evaluate our risk in county. We set down as a committee to reevaluate our risk and perform a risk assessment sense the plan was developed in 2012. After closely looking at past events and disasters that have plagued the county in the past 5 years we determined that the risk have not changed. We still are dealing with the same hardships as we were in the past.

THE PLANNING PARTNERSHIP

A planning partnership was assembled consisting of Siskiyou County, nine incorporated cities and four special purpose districts, all defined as “local governments” under the DMA. This partnership represents approximately 30 percent of the eligible local governments in the planning area. Jurisdictional annexes are included in Volume 2 of this plan for the 10 planning partners who completed all required phases of the plan’s development. Jurisdictions not covered by this process can link to this plan at a future date by following prescribed linkage procedures identified in Appendix B of Volume 2.

PLAN DEVELOPMENT METHODOLOGY

Under Chapter 44 of the Code of Federal regulations (44 CFR), a local hazard mitigation plan must include the following:

- A description of the planning process

- Risk assessment (applicable to each planning partner)
- Mitigation strategy
  - Goals
  - Review of alternatives
  - Prioritized "action plan"
- A plan maintenance section
- Documentation of adoption.

The Siskiyou County Hazard Mitigation Plan was developed as follows to meet federal requirements:

- **Phase 1, Organize Resources**— A Planning Partnership was formed, and a 10-member Steering Committee was assembled to oversee development of the plan, consisting of planning partners and other planning area stakeholders. A multimedia public involvement strategy, centered on the plan being put on the county website for public review, was implemented. Coordination occurred with local, state and federal agencies involved in hazard mitigation. A review was conducted of existing programs in the planning area that may support hazard mitigation actions.
- **Phase 2, Hazard Identification & Profiling; Phase 3, Asset Inventory and Vulnerability Analysis**—Risk assessment is the process of assessing the vulnerability of people, buildings and infrastructure to natural hazards by estimating potential hazard-related loss of life, personal injury, economic loss, and property damage. It focuses on the following:
  - Hazard identification and profiling
  - The impact of hazards on physical, social and economic assets
  - Vulnerability identification
  - Estimates of the cost of damage or costs that can be avoided through mitigation.
- **Phase 4, Develop Mitigation Initiatives**—This phase included development of a guiding principle, goals and measurable objectives; comprehensive review of mitigation alternatives; development of a benefit/cost review methodology for prioritizing actions; ranking of risk to support prioritization of actions; review of jurisdiction-specific capabilities; identification of recommended mitigation initiatives (actions); and prioritization of the actions.
- **Phase 5, Prepare Draft Plan**—The Steering Committee assembled key information from Phases 1 and 2 into a document to meet the DMA requirements. The document was produced in two volumes: Volume 1 including all information that applies to the entire planning area; and Volume 2, including jurisdiction-specific information.
- **Phase 6, Plan Review and Revision—**The draft plan was circulated to planning partners, stakeholders, and agencies to solicit comment on the recommended actions. The plan was presented to the public for review and comment via the public involvement strategy developed under Phase 1. The means of engaging the public were web-based tools. A pre-adoption review draft of the plan was prepared along with a DMA compliance "crosswalk," which was submitted to Cal OES for review and approval. Cal OES will forward the plan to FEMA Region IX for approval upon determining that the plan is compliant with federal requirements.

- **Phase 7, Plan Adoption and Submittal**— Final plan adoption occurs once pre-adoption approval has been granted by Cal OES and FEMA. Each planning partner is required to adopt the plan according to its own formal adoption protocol.

MITIGATION GUIDING PRINCIPLE, GOALS AND OBJECTIVES

The following guided the Steering Committee and the Planning Partners in selecting the initiatives contained in this plan:

- Guiding Principle**—**Through partnerships among local jurisdictions, identify and reduce the vulnerability to natural hazards in order to protect the health, safety, quality of life, environment and economy of the diverse communities within Siskiyou County.
- Goals:
  - 1. Protect life, health, property and the environment.
  - 2. Increase public awareness of vulnerability and enable the public to mitigate, prepare for, respond to and recover from the impacts of hazards and disasters.
  - 3. Reduce the adverse impacts of disasters on the economy.
  - 4. Improve cooperative emergency management capabilities among all entities.
  - 5. Facilitate the development and implementation of long-term, cost-effective and environmentally sound mitigation projects and programs
- Objectives:
  - 1. Eliminate or minimize disruption of local government operations caused by natural hazards.
  - 2. Increase resilience of (or protect and maintain) infrastructure and critical facilities.
  - 3. Consider the impacts of natural hazards on future land uses within the planning area.
  - 4. Sustain reliable local emergency operations and facilities during and after a disaster.
  - 5. Educate the public on the risk from natural hazards and increase awareness, preparation, mitigation, response, and recovery activities.
  - 6. Retrofit, relocate or elevate structures in high hazard areas including those known to be repetitively damaged.
  - 7. Improve understanding of the location, causes and potential impacts of natural hazards.
  - 8. Encourage coordination among all jurisdictions, adjoining communities and stakeholders.
  - 9. Develop or improve early warning emergency response systems, communications and evacuation procedures.

MITIGATION INITIATIVES

In this document, mitigation initiatives are defined as activities designed to reduce or eliminate losses resulting from natural hazards. The mitigation initiatives are the key element of the hazard mitigation plan. Implementing the initiatives will help the Planning Partners become disaster-resistant.

Although grant funding eligibility was a driving influence for preparing this plan, the plan's purpose goes beyond access to federal funding. It was important to the Planning Partnership and the Steering

Committee to look at initiatives that will work through all phases of emergency management. Some of the initiatives outlined in this plan are not grant eligible—grant eligibility was not the focus of the selection. Rather, the focus was the initiatives' effectiveness in achieving the goals of the plan and whether they are within each jurisdiction's capabilities.

This planning process resulted in the identification 156 mitigation actions to be targeted for implementation by the Planning Partners. Jurisdiction-specific initiatives are listed in Volume 2 of this plan. In addition, a series of countywide initiatives were identified by the Steering Committee and the Planning Partnership. These are initiatives that benefit the whole partnership, to be implemented by pooling resources based on capability. These initiatives are summarized in Table ES-1.

CONCLUSION

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

TABLE ES-1.
ACTION PLAN—COUNTYWIDE MITIGATION INITIATIVES

Hazards Addressed	Lead Agency	Possible Funding Sources or Resources	Time Line[a]	Objectives
CW-1—Continue to maintain a countywide hazard mitigation plan website to house the plan and plan updates, in order to provide the public an opportunity to monitor plan implementation and progress. Each planning partner may support the initiative by including an initiative in its action plan and creating a web link to the website.				
All Hazards	County OES	General Fund	Short term/ongoing	1, 5, 7, 8
CW-2—Leverage public outreach partnering capabilities to inform and educate the public about hazard mitigation and preparedness.				
All Hazards	County OES	General Fund	Short term/ongoing	1, 5, 7, 8, 9
CW-3—Coordinate all mitigation planning and project efforts, including grant application support, to maximize all resources available to the planning partnership.				
All Hazards	County OES	General Fund, FEMA mitigation grants	Short term/ongoing	1, 2, 3, 4, 5, 7, 8, 9
CW-4—Support the collection of improved data (hydrologic, geologic, topographic, volcanic, historical, etc.) to better assess risks and vulnerabilities.				
All Hazards	County OES	General Fund, FEMA mitigation grants	Short term/ongoing	1, 3, 5, 7, 8
CW-5—Provide coordination and technical assistance in grant application preparation that includes assistance in cost vs. benefit analysis for grant-eligible projects.				
All Hazards	County OES	General Fund, FEMA mitigation grants	Short term/ongoing	1, 8
CW-6—Where appropriate, support retrofitting, purchase, or relocation of structures or infrastructure located in hazard-prone areas to protect structures/infrastructure from future damage, with repetitive loss and severe repetitive loss properties as priority when applicable.				
All Hazards	County OES	FEMA mitigation grants	Long term	1, 2, 4, 5, 6
CW-7— Continue to maintain the Steering Committee as a viable committee to monitor the progress of the hazard mitigation plan, provide technical assistance to Planning Partners and oversee the update of the plan as necessary.				
All Hazards	County OES	General Fund	Short term/ongoing	1, 8
CW-8— In areas of the County with urban/wildland fire interface exposure, continue to promote access for ingress and egress as part of a defensible space initiative.				
Wildfire	Siskiyou Area Fire Safe Council	FEMA mitigation Grants, Fire Safe Council funding sources	Short term/ongoing	1,5,7,8,9
CW-9— Promote landscape approach to fuel reduction as part of a defensible space initiative in areas with high wildfire exposure.				
Wildfire	Siskiyou Area Fire Safe Council	FEMA mitigation Grants, Fire Safe Council funding sources	Short term/ongoing	1,5,7,8,9

PART 1 —
THE PLANNING PROCESS

CHAPTER 1.
INTRODUCTION TO THE PLANNING PROCESS

1.1. WHY PREPARE THIS PLAN?

1.1.1 The Big Picture

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

The federal Disaster Mitigation Act (DMA) of 2000 (Public Law 106-390) required state and local governments to develop hazard mitigation plans as a condition for federal disaster grant assistance. Prior to 2000, federal disaster funding focused on disaster relief and recovery, with limited funding for hazard mitigation planning. The DMA increased the emphasis on planning for disasters before they occur.

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

1.1.2 Local Concerns

Several factors initiated this planning effort for Siskiyou County and its planning partners:

- The Siskiyou County area has significant exposure to natural hazards, and disasters have caused costly damage in the past.
- Limited local resources make it difficult to be pre-emptive in risk reduction initiatives. Being able to leverage federal financial assistance is paramount to successful hazard mitigation in the area.
- The partners wanted to be proactive in its preparedness for the probable impacts of natural hazards.

With these factors in mind, Siskiyou County committed to the preparation of the plan to continue the effort and then securing technical assistance to facilitate a planning process that would comply with all program requirements. Due to past experiences, Siskiyou County recognized that disasters are not always contained by political boundaries and therefore invited multiple local jurisdictions (municipalities and special purpose districts) within the County to participate in the hazard mitigation planning process.

1.1.3 Purposes for Planning

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

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

1.2. WHO WILL BENEFIT FROM THIS PLAN?

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

1.3. HOW TO USE THIS PLAN

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

- **Volume 1**—Volume 1 includes all federally required elements of a disaster mitigation plan that apply to the entire planning area. This includes the description of the planning process, public involvement strategy, goals and objectives, countywide hazard risk assessment, countywide mitigation initiatives, and a plan maintenance strategy.
- **Volume 2**—Volume 2 includes all federally required jurisdiction-specific elements, in annexes for each participating jurisdiction. It includes a description of the participation requirements established by the Steering Committee, as well as instructions and templates that the partners used to complete their annexes. Volume 2 also includes "linkage" procedures for eligible jurisdictions that did not participate in development of this plan but wish to adopt it in the future.

All planning partners will adopt Volume 1 in its entirety and at least the following parts of Volume 2: Part 1; each partner's jurisdiction-specific annex; and the appendices.

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

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

CHAPTER 2.
PLAN METHODOLOGY

To develop the Siskiyou County Hazard Mitigation Plan, the County followed a process that had the following primary objectives:

- Form a planning team
- Establish a planning partnership
- Define the planning area
- Establish a steering committee
- Coordinate with other agencies
- Review existing programs
- Engage the public.

Chapter 3 describes the public involvement. The other objectives are discussed in the following sections.

2.1. FORMATION OF THE PLANNING TEAM

A planning team was formed to lead the planning effort, made up of the following members:

- Jasen Vela, Siskiyou County Office of Emergency Services (OES) Deputy Director (Project Manager)
- Tom Morton (OES Staff Service Analyst)
- Katie Eastman (Public Health Preparedness)
- Holly Baun (GIS/ lead)
- Jacqueline Nushi (OES Volunteer/Public)
- Christy Cummings Dawson (Deputy Director of Planning)

2.2. ESTABLISHMENT OF THE PLANNING PARTNERSHIP

Siskiyou County opened this planning effort to all eligible local governments in the County. The planning team introduced the planning process and solicited planning partners at a meeting on May 17, 2017. Meeting objectives were as follows:

- Provide an overview of the Disaster Mitigation Act.
- Describe the reasons for a plan.
- Outline the County work plan.
- Outline planning partner expectations.
- Seek commitment to the planning partnership.
- Seek volunteers for the Steering Committee.

Each jurisdiction wishing to join the planning partnership was asked to provide a “letter of intent to participate” that designated a point of contact and confirmed the jurisdiction’s commitment to the process and understanding of expectations. Procedures have been established for any jurisdiction wishing to link to this plan in the future (see Volume 2). Letters of intent were received from 14 planning partners, establishing a 15-member planning partnership including the County (see Table 2-1).

**TABLE 2-1.
PLANNING PARTNERS**

Jurisdiction	Point of Contact	Title
Siskiyou County	Jasen Vela	OES Deputy Director
City of Dorris	Wayne Frost	Fire Chief
City of Dunsmuir	Mark Brannigan	City Manager
City of Etna	Sara Griggs	City Clerk
City of Montague	Dave Dunn	Public Works Supervisor
City of Mt. Shasta	Juliana Lucchesi	City Planner
City of Tulelake	Jenny Coelho	City Clerk
City of Weed	Ron Stock	City Administrator
City of Yreka	Steve Baker	City Manager
Lake Shastina Community Services District	Mike Wilson	General Manager
McCloud Community Services District	Kimberly Paul	General Manager

2.3. DEFINING THE PLANNING AREA

The defined planning area for this planning effort consists of all of Siskiyou County as shown in Figure 2-1. All partners to this plan have jurisdictional authority over specific locations within this planning area.

2.4. THE STEERING COMMITTEE

Hazard mitigation planning enhances collaboration and support among diverse parties whose interests can be affected by hazard losses. A steering committee was formed to oversee development of this plan. Committee members included key planning partner staff and other planning area stakeholders. The planning team assembled a list of interests within the planning area that could have recommendations for the plan or be impacted by its recommendations. The partnership confirmed a committee of 14 members at the kickoff meeting. Table 2-2 lists the committee members.

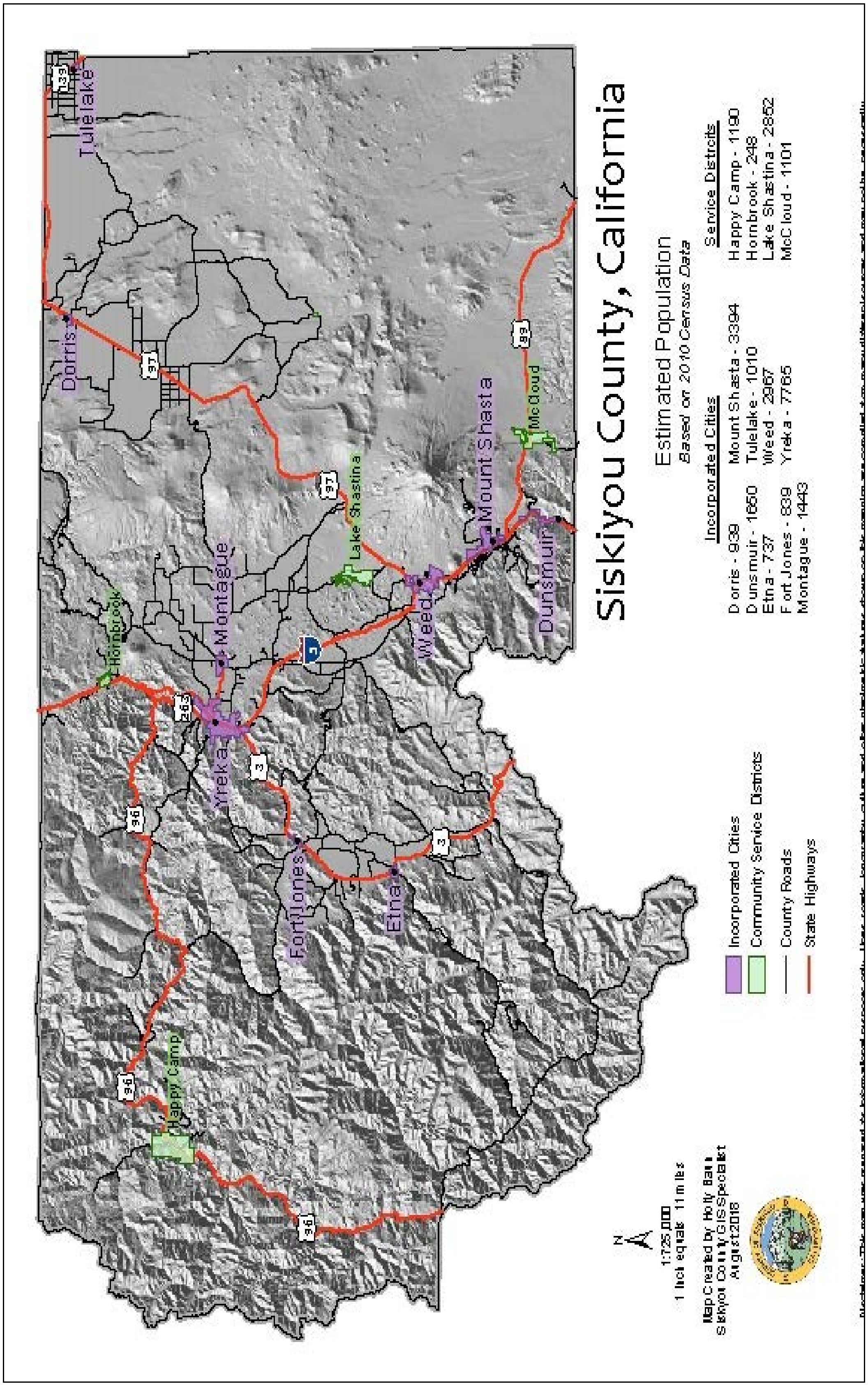


Figure 2-1. Hazard Mitigation Planning Area

**TABLE 2-2.
STEERING COMMITTEE MEMBERS**

Name	Title	Jurisdiction/Agency	Representing
Jasen Vela	OES Deputy Director	Siskiyou County	Planning Partner
Darrin Quigley	Fire Chief	City of Weed	Planning Partner
Brett Neystrom	Public Works Director	City of Tulelake	Planning Partner
Wayne Frost	Council Member	City of Dorris	Planning Partner
Tom Morton	Public Health	Siskiyou County	Planning Partner
Jacqueline Nushi	Teacher Assistant	Evergreen Elementary	Stakeholder
Phil Anzo	Fire Warden	California Department of Forestry and Fire Protection (CAL FIRE)	Stakeholder
Katie Eastman	Public Health	Siskiyou County	Planning Partner
Kimberly Paul	General Manager	McCloud Community Services District	Planning Partner
Steve Baker	City Manager	City of Yreka	Planning Partner
Sara Griggs	City Clerk	City of Etna	Planning Partner

Leadership roles and ground rules were established during the Steering Committee's initial meeting on May 17, 2017. The Steering Committee agreed to meet monthly or as needed throughout the course of the plan's development. The planning team facilitated each Steering Committee meeting, which addressed a set of objectives based on the work plan established for the plan. The Steering Committee met 5 times from May 2017 through June 2018. Meeting agendas, notes and attendance logs are available for review upon request. All Steering Committee meetings were open to the public (see Chapter 3).

2.5. COORDINATION WITH OTHER AGENCIES

Federal emergency management regulations require that hazard mitigation planning efforts provide involvement opportunities for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development, businesses, academia and other private and nonprofit interests (44CFR Section 201.6.b(2)). This task was accomplished by the planning team as follows:

- **Steering Committee Involvement**—Agency representatives were invited to participate on the Steering Committee.
- **Agency Notification**—The following agencies were invited to participate in the plan development process from the beginning and were kept apprised of plan development milestones:
  - FEMA Region IX
  - California Office of Emergency Services
  - California Department of Transportation
  - CAL FIRE
  - College of the Siskiyous

  - Klamath National Forest
  - U.S. Forest Service
  - Karuk Tribe
  - Cities/towns of Dorris, Dunsmuir, Etna, Fort Jones, Montague, Mt. Shasta, Tulelake, Weed, and Yreka

  These agencies received meeting announcements, meeting agendas by e-mail throughout the plan development process. They supported the effort by attending meetings or providing feedback on issues.

- **Pre-Adoption Review**—All the agencies listed above were provided an opportunity to review and comment on this plan (see Chapter 3). Each agency was sent an e-mail message informing them that draft portions of the plan were available for review.

2.6. REVIEW OF EXISTING PROGRAMS

Hazard mitigation planning must include review and incorporation, if appropriate, of existing plans, studies, reports and technical information (44 CFR, Section 201.6(b)(3)). Chapter 8 of this plan provides a review of laws and ordinances in effect within the planning area that can affect hazard mitigation initiatives. In addition, the following programs can affect mitigation within the planning area:

- Siskiyou County Code
- Siskiyou County Land Development Manual (2011)
- State of California Code, Chapter 2 Hazardous Fire Areas
- Siskiyou County General Plan (2010)
- State of California Multi-Hazard Mitigation Plan (2018)
- Siskiyou County Fire Plan (2018)
- General/Comprehensive Plans for each of the incorporated city planning partners

An assessment of all planning partners' regulatory, technical and financial capabilities to implement hazard mitigation initiatives is presented in Chapter 20 and in the individual jurisdiction-specific annexes in Volume 2. Many of these relevant plans, studies and regulations are cited in the capability assessment.

2.7. PLAN DEVELOPMENT CHRONOLOGY/MILESTONES

Table 2-3 summarizes important milestones in the development of the plan.

**TABLE 2-3.
PLAN DEVELOPMENT MILESTONES**

Date	Event	Description	Attendance
2009			
6/15	County submits grant application	Seek funding for plan development process	N/A
12/15	County receives notice of grant award	Funding secured.	N/A
2010			
4/19	County selects Tetra Tech to facilitate plan development	Facilitation contractor secured	N/A
6/22	Planning team identified	Formation of the planning team	N/A
7/28	Stakeholder meeting	Presentation on plan process given to potential planning partners.	13
8/20	Public Outreach	Information announcing hazard mitigation plan published in Siskiyou Daily News Ridin' Point column by Steering Committee member Marcia Armstrong.	N/A
10/20	Planning partnership finalized	Deadline for submittal of letters of intent to participate in the planning effort.	N/A
10/20	Steering Committee formed	Planning partners nominated potential committee members. The planning team received commitments from 14 members, finalizing the formation of the Steering Committee.	N/A
10/20	Steering Committee Meeting #1	• Review purposes for mitigation plan • Organize Steering Committee • State plan review • Public involvement strategy	14
12/1	Steering Committee Meeting #2	• Review/approve Steering Committee ground rules • Risk assessment update • State plan review observations • Critical facilities definitions • Public outreach—design survey/questionnaire	11
2011			
1/5	Steering Committee Meeting #3	• Planning partner status & deadlines • Risk assessment update • Critical facilities decisions • Guiding principle • Public outreach campaign	15
1/24	Public Outreach	Hazard mitigation plan website established on the OES web page at http://www.co.siskiyou.ca.us/phs/emerg/hazard_mitigation.aspx	N/A
2/2	Steering Committee Meeting #4	• Risk assessments • Establishing critical facilities data deadline • Determining the guiding principle • Defining goals • Public outreach campaigns	15
2/4	Public Outreach	Weekly column, "Ridin' Point" requesting hazard mitigation plan input from citizens published in Siskiyou Daily News by Steering Committee member Marcia Armstrong.	N/A

**TABLE 2-3.
PLAN DEVELOPMENT MILESTONES**

Date	Event	Description	Attendance
2/23	Public Outreach	A hazard mitigation survey/questionnaire was deployed on-line. Web links and hard copies were distributed to planning partners and steering committee members for dissemination to the public.	N/A
3/2	Steering Committee Meeting #5	• Risk assessment updates • Hazard maps & critical facilities data discussion • Finalizing goals of the plan • Identifying plan objectives • Public outreach campaign	12
4/6	Steering Committee Meeting #6	• Risk assessment updates • Hazard maps & critical facilities data discussion • Finalizing plan objectives • Public outreach campaign	9
4/13	Public Outreach	County distributed a press release to local media outlets advertising the upcoming open houses. Flyers distributed to stakeholders and planning partners and posted throughout Siskiyou County.	N/A
5/4	Public Outreach	Mount Shasta Area Newspapers publishes article about Hazard Mitigation Planning process, survey and invites citizens to open houses.	N/A
5/11	Public Outreach	A public open houses was held in Yreka at the Jackson Street Middle School. The presentation, maps and information were on display in the evening.	13
5/12	Public Outreach	A public open house was held at the Mount Shasta City Park. The evening presentation and maps were viewed by six citizens.	6
6/1	Steering Committee Meeting #7	• Public meeting follow-up • Risk assessment updates • Review strengths, weaknesses, obstacles and opportunities • Scheduling annex workshops	10
6/1	Public Outreach	County OES held a public meeting in Happy Camp as an opportunity for citizens in the Happy Camp area to provide comment on the planning process.	4
7/6	Jurisdictional Annex Workshop	Mandatory session for planning partners. Workshop held in Yreka focused on how to complete the jurisdictional annex template.	21
11/1	Draft Plan	Internal review draft provided to Steering Committee by planning team	N/A
12/7	Steering Committee Meeting #8	• Provide comments on Draft Plan • Confirm plan maintenance strategy • Confirm County-wide initiatives • Determine public comment process	12
12/12	Public Comment Period	Initial public comment period of draft plan opens. Draft plan posted on plan website with press release notifying public of plan availability	N/A
12/29	Press coverage	Article in the Siskiyou Daily advertising the public comment period for the draft plan.	N/A
12/30	Adoption	Adoption window of final plan opens	N/A

**TABLE 2-3.
PLAN DEVELOPMENT MILESTONES**

Date	Event	Description	Attendance
2012			
1/31	Plan submittal	Final draft plan submitted for review and approval	N/A
2017			
3/10	Planning team identified	Formation of the planning team	N/A
4/27	Steering Committee Meeting	Review/approve Steering Committee • Perform Risk assessment • State plan review observations • Critical facilities definitions	6
5/17	Steering Committee Meeting	Continue Plan Review	5
7/19	Planning Partnership	Deadline for submittal of letters of intent to participate in the planning effort.	N/A
10/16	Steering Committee Meeting	• Risk assessments • Establishing critical facilities data deadline • Determining the guiding principle	5
11/2	Meeting Yreka City	Risk Assessments and plan overview	4
2018			
1/11	Meeting City of Etna	Risk Assessments and plan overview	3
1/24	Steering Committee Meeting	Reached out to other jurisdictions about plan updates	4
2/8	Meeting Tulelake	Risk Assessments and plan overview	4
2/13	Jurisdictional Annex Workshop	Mandatory session for planning partners. Workshop held in Yreka focused on how to complete the jurisdictional annex template.	21
4/8	Steering Committee Meeting	Reached out to other jurisdictions about plan updates	N/A
7/23	Cal OES Call	Updates on for City Annex's given to Cal OES	N/A
8/2	Steering Committee Meeting	GIS Data	2
8/13	Steering Committee Meeting	Plan overview	2
8/29	Public Comment Period	Initial public comment period of draft plan opens. Draft plan posted on plan website with press release notifying public of plan availability as shown in Appendix B. It was out for public comment from August 29th to September 13th	N/A
X/X	Plan Approval	Final plan approved by FEMA	N/A

CHAPTER 3.
PUBLIC INVOLVEMENT

Broad public participation in the planning process helps ensure that diverse points of view about the planning area's needs are considered and addressed. The public must have opportunities to comment on disaster mitigation plans during the drafting stages and prior to plan approval (44CFR, Section 201.6(b)(1)). The Community Rating System expands on these requirements by making CRS credits available for optional public involvement activities.

3.1. STRATEGY

The strategy for involving the public in this plan emphasized the following elements:

- Establish a website that will house the plan and provide public access to the planning process.
- Use a questionnaire to determine if the public's perception of risk and support of hazard mitigation has changed since the initial planning process.
- Attempt to reach as many planning area citizens as possible using multiple media.
- Identify and involve planning area stakeholders.

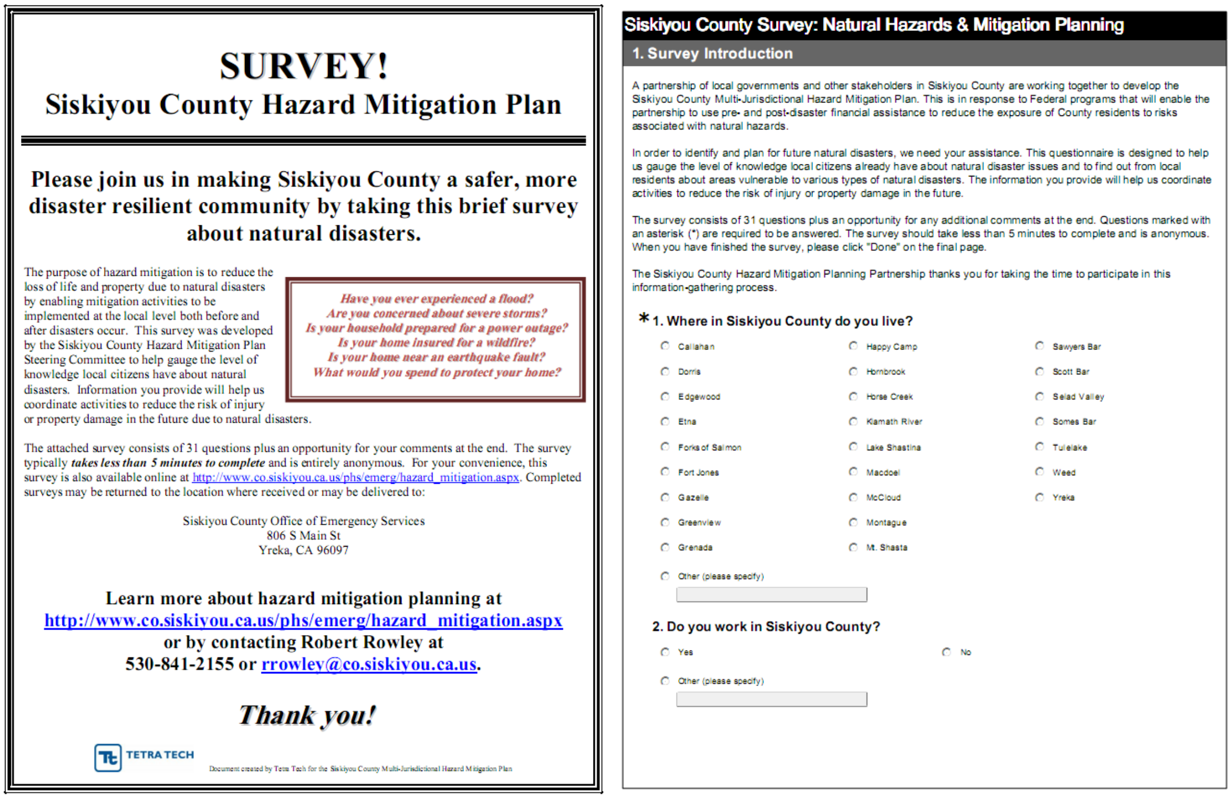
3.1.1 Stakeholders and the Steering Committee

Stakeholders are the individuals, agencies and jurisdictions that have a vested interest in the recommendations of the hazard mitigation plan, including planning partners. The effort to include stakeholders in this process included stakeholder participation on the Steering Committee.

All members of the Steering Committee live or work in Siskiyou County. Committee members represented government agencies, emergency managers, health services, tribes, fire and community service districts. The Steering Committee met eight times during the course of the plan's development and all meetings were posted and open to the public. Protocols for managing public comments were established in the ground rules developed by the Steering Committee.

3.1.2 Questionnaire

A hazard mitigation plan questionnaire (see Figure 3-1) was developed by the planning team with guidance from the Steering Committee. The questionnaire was used to gauge household preparedness for natural hazards and the level of knowledge of tools and techniques that assist in reducing risk and loss from natural hazards. This questionnaire was designed to help identify areas vulnerable to one or more natural hazards. The answers to its 32 questions helped guide the Steering Committee in selecting goals, objectives and mitigation strategies. Over 200 hard copies of the questionnaires were disseminated throughout the planning area by multiple means. Additionally, a web-based version of the questionnaire was made available on the hazard mitigation plan website. Over 440 questionnaires were completed during the course of this planning process. The complete questionnaire and a summary of its findings can be found in Appendix B of this volume.



SURVEY!

Siskiyou County Hazard Mitigation Plan

Please join us in making Siskiyou County a safer, more disaster resilient community by taking this brief survey about natural disasters.

The purpose of hazard mitigation is to reduce the loss of life and property due to natural disasters by enabling mitigation activities to be implemented at the local level both before and after disasters occur. This survey was developed by the Siskiyou County Hazard Mitigation Plan Steering Committee to help gauge the level of knowledge local citizens have about natural disasters. Information you provide will help us coordinate activities to reduce the risk of injury or property damage in the future due to natural disasters.

Have you ever experienced a flood?
Are you concerned about severe storms?
Is your household prepared for a power outage?
Is your home insured for a wildfire?
Is your home near an earthquake fault?
What would you spend to protect your home?

The attached survey consists of 31 questions plus an opportunity for your comments at the end. The survey typically ***takes less than 5 minutes to complete*** and is entirely anonymous. For your convenience, this survey is also available online at http://www.co.siskiyou.ca.us/phs/emerg/hazard_mitigation.aspx. Completed surveys may be returned to the location where received or may be delivered to:

Siskiyou County Office of Emergency Services
806 S Main St
Yreka, CA 96097

Learn more about hazard mitigation planning at http://www.co.siskiyou.ca.us/phs/emerg/hazard_mitigation.aspx or by contacting Robert Rowley at 530-841-2155 or rrowley@co.siskiyou.ca.us.

Thank you!

TETRA TECH

Document created by Tetra Tech for the Siskiyou County Multi-Jurisdictional Hazard Mitigation Plan

Siskiyou County Survey: Natural Hazards & Mitigation Planning

1. Survey Introduction

A partnership of local governments and other stakeholders in Siskiyou County are working together to develop the Siskiyou County Multi-Jurisdictional Hazard Mitigation Plan. This is in response to Federal programs that will enable the partnership to use pre- and post-disaster financial assistance to reduce the exposure of County residents to risks associated with natural hazards.

In order to identify and plan for future natural disasters, we need your assistance. This questionnaire is designed to help us gauge the level of knowledge local citizens already have about natural disaster issues and to find out from local residents about areas vulnerable to various types of natural disasters. The information you provide will help us coordinate activities to reduce the risk of injury or property damage in the future.

The survey consists of 31 questions plus an opportunity for any additional comments at the end. Questions marked with an asterisk (*) are required to be answered. The survey should take less than 5 minutes to complete and is anonymous. When you have finished the survey, please click "Done" on the final page.

The Siskiyou County Hazard Mitigation Planning Partnership thanks you for taking the time to participate in this information-gathering process.

*** 1. Where in Siskiyou County do you live?**

Callahan	Happy Camp	Sawyers Bar
Dorris	Hornbrook	Scott Bar
Edgewood	Horse Creek	Seiad Valley
Etna	Klamath River	Somes Bar
Forks of Salmon	Lake Shastina	Tulelake
Fort Jones	Macdoel	Weed
Gazelle	McCloud	Yreka
Greenview	Montague	
Grenada	Mt. Shasta	

Other (please specify)

2. Do you work in Siskiyou County?

Yes   No

Other (please specify)

Figure 3-1. Sample Pages from Questionnaire Distributed to the Public

3.1.3 Opportunity for Public Comment

Public Meetings

Open-house public meetings were held on May 11, 2011 in Yreka and on May 12, 2011 in Mt. Shasta, (see Figure 3-2 through Figure 3-5). The Yreka meeting ran from 6:30 p.m. to 8:30 p.m. and the meeting in Mt. Shasta was took place from 6:00 p.m. to 8:00 p.m. The events were advertised with flyers posted throughout the county (see Figure 3-6).

The meeting format allowed attendees to examine maps and handouts and have direct conversations with project staff. Reasons for planning and information generated for the risk assessment were shared with attendees via a PowerPoint presentation. Tables were set up for each of the primary hazards to which the County is most vulnerable. A HAZUS-MH workstation allowed citizens to see information on their property, including exposure and damage estimates for earthquake and flood hazard events. Participating property owners were provided printouts of this information for their properties. This tool was effective in illustrating risk to the public. Planning partners and the planning team were present to answer questions. Each citizen attending the open houses was asked to complete a questionnaire, and each was given an opportunity to provide written comments to the Steering Committee. Local media outlets were informed of the open houses by a press release from the County.

Figure 3-2. Yreka Public Meeting Photo 1

Figure 3-3. Yreka Public Meeting Photo 2

Figure 3-4. Mt. Shasta Public Meeting Photo 3

Figure 3-5. Mt. Shasta Public Meeting Photo 4

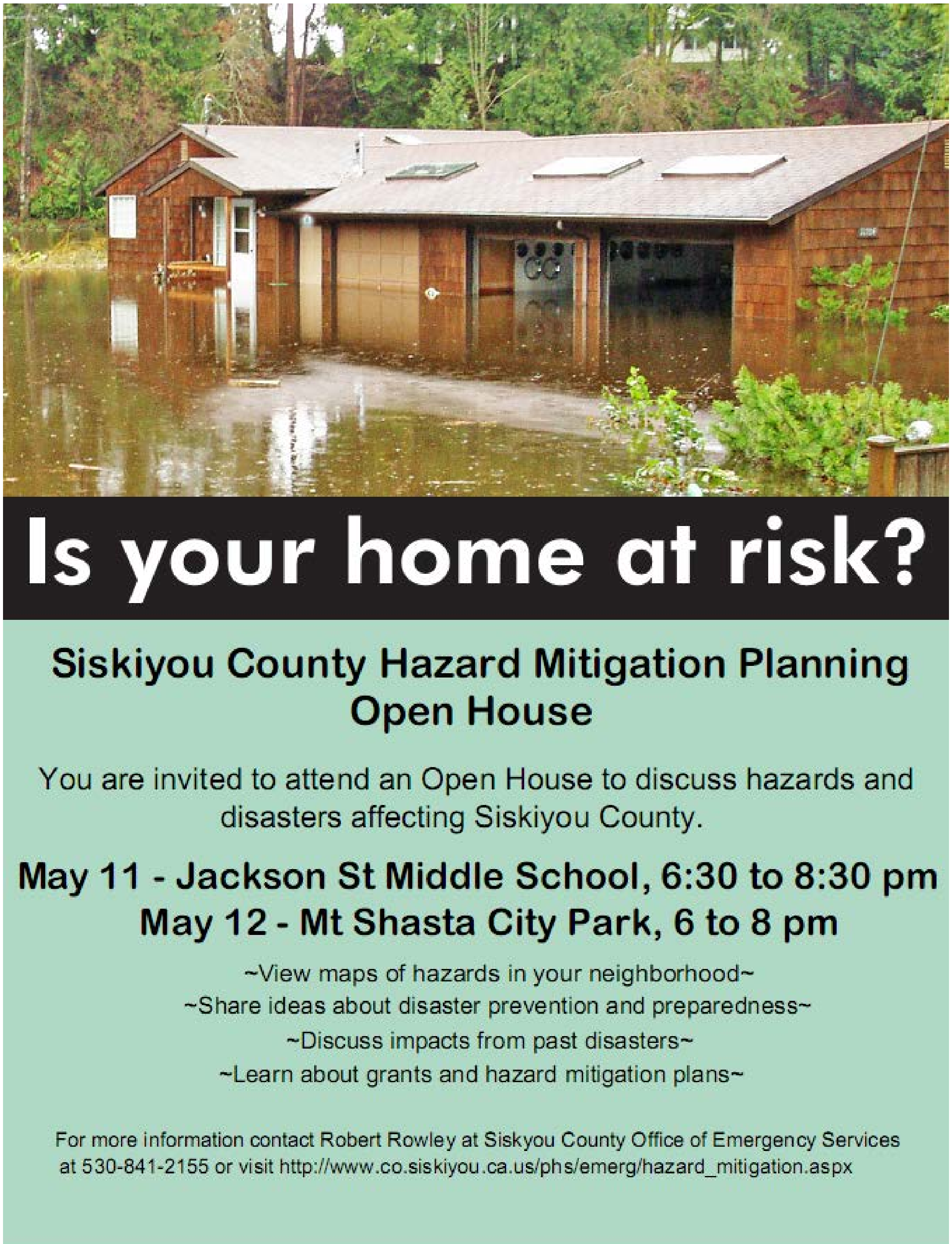
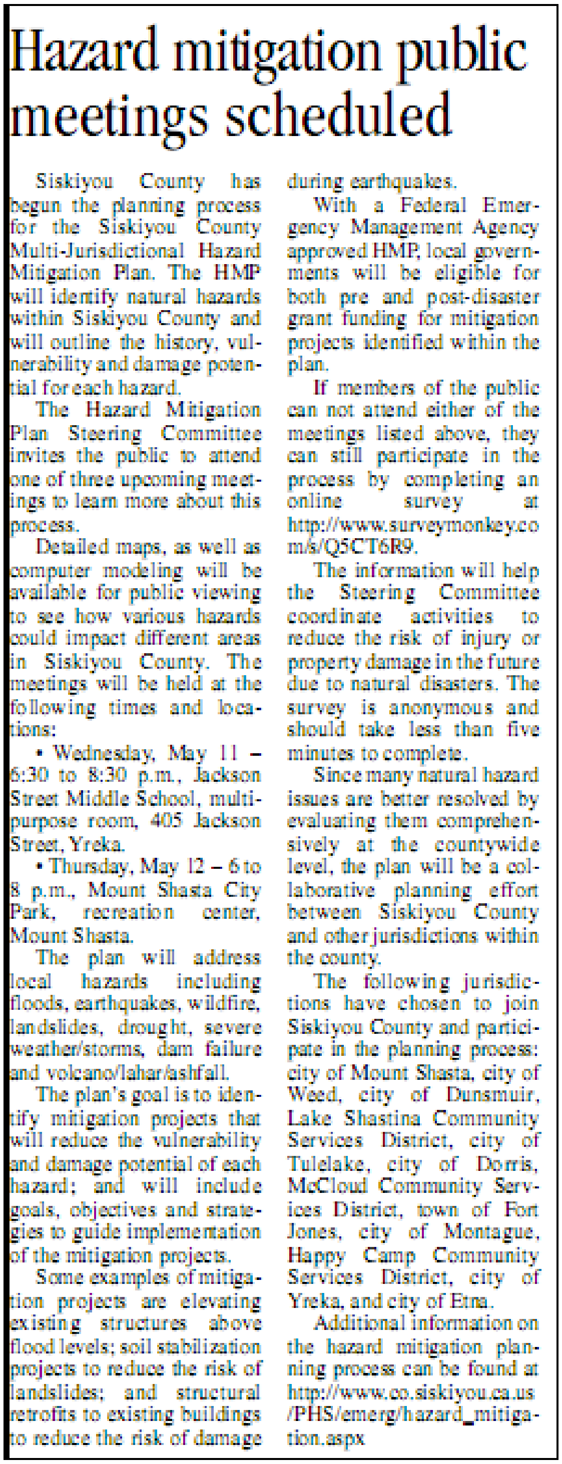


Figure 3-6. Open House Flyers Posted Throughout County

Press Releases

Press releases were distributed over the course of the plan's development as key milestones were achieved and prior to each public meeting. The planning effort received coverage in the May 4, 2011 Mount Shasta Area Newspapers (see Figure 3-7).



Hazard mitigation public meetings scheduled

Siskiyou County has begun the planning process for the Siskiyou County Multi-Jurisdictional Hazard Mitigation Plan. The HMP will identify natural hazards within Siskiyou County and will outline the history, vulnerability and damage potential for each hazard.

The Hazard Mitigation Plan Steering Committee invites the public to attend one of three upcoming meetings to learn more about this process.

Detailed maps, as well as computer modeling will be available for public viewing to see how various hazards could impact different areas in Siskiyou County. The meetings will be held at the following times and locations:

• Wednesday, May 11 – 6:30 to 8:30 p.m., Jackson Street Middle School, multi-purpose room, 405 Jackson Street, Yreka.

• Thursday, May 12 – 6 to 8 p.m., Mount Shasta City Park, recreation center, Mount Shasta.

The plan will address local hazards including floods, earthquakes, wildfire, landslides, drought, severe weather/storms, dam failure and volcano/lahar/ashfall.

The plan's goal is to identify mitigation projects that will reduce the vulnerability and damage potential of each hazard; and will include goals, objectives and strategies to guide implementation of the mitigation projects.

Some examples of mitigation projects are elevating existing structures above flood levels; soil stabilization projects to reduce the risk of landslides; and structural retrofits to existing buildings to reduce the risk of damage during earthquakes.

With a Federal Emergency Management Agency approved HMP, local governments will be eligible for both pre and post-disaster grant funding for mitigation projects identified within the plan.

If members of the public can not attend either of the meetings listed above, they can still participate in the process by completing an online survey at http://www.surveymonkey.com/s/Q5CT6R9.

The information will help the Steering Committee coordinate activities to reduce the risk of injury or property damage in the future due to natural disasters. The survey is anonymous and should take less than five minutes to complete.

Since many natural hazard issues are better resolved by evaluating them comprehensively at the countywide level, the plan will be a collaborative planning effort between Siskiyou County and other jurisdictions within the county.

The following jurisdictions have chosen to join Siskiyou County and participate in the planning process: city of Mount Shasta, city of Weed, city of Dunsmuir, Lake Shastina Community Services District, city of Tulelake, city of Dorris, McCloud Community Services District, town of Fort Jones, city of Montague, Happy Camp Community Services District, city of Yreka, and city of Etna.

Additional information on the hazard mitigation planning process can be found at http://www.co.siskiyou.ca.us/PHS/emerg/hazard_mitigation.aspx

Figure 3-7. News Article from the May 4, 2011 Mount Shasta Area Newspapers

A press release was sent to all media outlets on December 12, 2011, advertising the public comment period for the draft plan. In response to this press release, the process received coverage in the Siskiyou Daily on December 29, 2011. An article was published about the process, advertising the final public comment period for the draft plan. See Appendix B for a copy of this article.

Internet

The plan development process was added to the county website to keep the public posted on plan development milestones and to solicit relevant input (see Figure 3-8):

Public Involvement Results

By engaging the public through the public involvement strategy, the concept of mitigation was introduced to the public, and the Steering Committee received feedback that was used in developing the components of the plan. The committee received one comment but did not relate to the plan. Details of attendance and comments received are summarized in Table 3-1.

**TABLE 3-1.
SUMMARY OF PUBLIC MEETINGS**

Date	Location	Number of Citizens in Attendance	Number of Comments Received	Number of Questionnaires Received
5/11	Yreka	13	0	3
5/12	Mt. Shasta	6	0	6
5/12	Happy Camp	4	0	0
12/12	Public Comment period	N/A	0	0
8/18	Public Comment period	N/A	0	0
9/7	Public Comment period	N/A	1	0
Total		**23**	**0**	**9**

CHAPTER 4.
GUIDING PRINCIPLE, GOALS AND OBJECTIVES

Hazard mitigation plans must identify goals for reducing long-term vulnerabilities to identified hazards (44CFR Section 201.6(c)(3)(i)). The Steering Committee established a guiding principle, a set of goals and measurable objectives for this plan, based on data from the preliminary risk assessment and the results of the public involvement strategy. The guiding principle, goals, objectives and actions in this plan are linear and support each other. Goals were selected to support the guiding principle. Objectives were selected that met multiple goals. Actions were prioritized based on the number of objectives met.

4.1. GUIDING PRINCIPLE

A guiding principle focuses the range of objectives and actions to be considered. This is not a goal because it does not describe a hazard mitigation outcome, and it is broader than a hazard-specific objective. The guiding principle for the Siskiyou County Hazard Mitigation Plan is as follows:

Through partnerships among local jurisdictions, identify and reduce the vulnerability to natural hazards in order to protect the health, safety, quality of life, environment and economy of the diverse communities within Siskiyou County.

4.2. GOALS

The following are the mitigation goals for this plan:

1. Protect life, health, property and the environment.
2. Increase public awareness of vulnerability and enable the public to mitigate, prepare for, respond to and recover from the impacts of hazards and disasters.
3. Reduce the adverse impacts of disasters on the economy.
4. Improve cooperative emergency management capabilities among all entities.
5. Facilitate the development and implementation of long-term, cost-effective and environmentally sound mitigation projects and programs.

The effectiveness of a mitigation strategy is assessed by determining how well these goals are achieved.

4.3. OBJECTIVES

Nine objectives were identified that meet multiple goals, acting as a bridge between the mitigation goals and actions, rather than as a subset of a goal. The objectives also are used to help establish priorities. The objectives are as follows:

1. Eliminate or minimize disruption of local government operations caused by natural hazards.
2. Increase resilience of (or protect and maintain) infrastructure and critical facilities.
3. Consider the impacts of natural hazards on future land uses within the planning area.
4. Sustain reliable local emergency operations and facilities during and after a disaster.
5. Educate the public on the risk from natural hazards and increase awareness, preparation, mitigation, response, and recovery activities.

6. Retrofit, relocate or elevate structures in high hazard areas including those known to be repetitively damaged.
7. Improve understanding of the location, causes and potential impacts of natural hazards.
8. Encourage coordination among all jurisdictions, adjoining communities and stakeholders.
9. Develop or improve early warning emergency response systems, communications and evacuation procedures through Code Red.

CHAPTER 5.
PLAN ADOPTION

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

CHAPTER 6.
PLAN MAINTENANCE STRATEGY

A hazard mitigation plan must present a plan maintenance process that includes the following (44CFR Section 201.6(c)(4)):

- A section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan over a 5-year cycle
- 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
- A discussion on how the community will continue public participation in the plan maintenance process.

This chapter details the formal process that will ensure that the Siskiyou County Hazard Mitigation Plan remains an active and relevant document and that the planning partners maintain their eligibility for applicable funding sources. The plan maintenance process includes a schedule for monitoring and evaluating the plan annually and producing an updated plan every five years. This chapter also describes how public participation will be integrated throughout the plan maintenance and implementation process. It also explains how the mitigation strategies outlined in this Plan will be incorporated into existing planning mechanisms and programs, such as comprehensive land-use planning processes, capital improvement planning, and building code enforcement and implementation. The Plan's format allows sections to be reviewed and updated when new data become available, resulting in a plan that will remain current and relevant.

6.1. PLAN IMPLEMENTATION

The effectiveness of the hazard mitigation plan depends on its implementation and incorporation of its action items into partner jurisdictions' existing plans, policies and programs. Together, the action items in the Plan provide a framework for activities that the Partnership can implement over the next 5 years. The planning team and the Steering Committee have established goals and objectives and have prioritized mitigation actions that will be implemented through existing plans, policies, and programs.

Siskiyou County OES will have lead responsibility for overseeing the Plan implementation and maintenance strategy. Plan implementation and evaluation will be a shared responsibility among all planning partnership members and agencies identified as lead agencies in the mitigation action plans (see planning partner annexes in Volume 2 of this plan).

6.2. STEERING COMMITTEE

The Steering Committee is a total volunteer body that oversaw the development of the Plan and made recommendations on key elements of the plan, including the maintenance strategy. It was the Steering Committee's position that an oversight committee with representation similar to the initial Steering Committee should have an active role in the Plan maintenance strategy. Therefore, it is recommended that a steering committee remain a viable body involved in key elements of the Plan maintenance strategy. The new steering committee should strive to include representation from the planning partners, as well as other stakeholders in the planning area.

The principal role of the new steering committee in this plan maintenance strategy will be to review the annual progress report and provide input to OES on possible enhancements to be considered at the next update. Future Plans will be overseen by a steering committee similar to the one that participated in this plan development process, so keeping an interim steering committee intact will provide a head start on future updates. Completion of the progress report is the responsibility of each planning partner, not the responsibility of the steering committee. It will simply be the steering committee's role to review the progress report in an effort to identify issues needing to be addressed by future Plans.

6.3. ANNUAL PROGRESS REPORT

The minimum task of each planning partner will be the evaluation of the progress of its individual action plan during a 12-month performance period. This review will include the following:

- Additions or deletions to the planning partnership
- Summary of any hazard events that occurred during the performance period and the impact these events had on the planning area
- Review of mitigation success stories
- Review of continuing public involvement
- Brief discussion about why targeted strategies were not completed
- Re-evaluation of the action plan to determine if the timeline for identified projects needs to be amended (such as changing a long-term project to a short-term one because of new funding)
- Recommendations for new projects
- Changes in or potential for new funding options (grant opportunities)
- Impact of any other planning programs or initiatives that involve hazard mitigation.

OES will assume the responsibility of initiating the annual progress reporting process. A template to guide the planning partners in preparing a progress report has been created as part of this planning process (see Appendix C). At OES's discretion, a committee as described in Section 6.2 may be convened to provide feedback to the planning partners on items included in the template. Siskiyou County OES will then prepare a formal annual report on the progress of the plan. This report should be used as follows:

- Posted on the Hazard Mitigation Plan on the County website
- Provided to the local media through a press release
- Presented to planning partner governing bodies to inform them of the progress of actions implemented during the reporting period

Uses of the progress report will be at the discretion of each planning partner. Annual progress reporting is not a requirement specified under 44CFR. However, it may enhance the planning partnership's opportunities for funding. While failure to implement this component of the plan maintenance strategy will not jeopardize a planning partner's compliance under the DMA, it may jeopardize its opportunity to partner and leverage funding opportunities with the other partners. Each planning partner was informed of these protocols at the beginning of this planning process (in the "Planning Partner Expectations" package provided at the start of the process), and each partner acknowledged these expectations when with submittal of a letter of intent to participate in this process.

6.4. PLAN

Local hazard mitigation plans must be reviewed, revised if appropriate, and resubmitted for approval in order to remain eligible for benefits under the DMA (44CFR, Section 201.6(d)(3)). The Siskiyou County partnership intends to update the hazard mitigation plan on a 5-year cycle from the date of initial plan adoption. This cycle may be accelerated to less than 5 years based on the following triggers:

- A Presidential Disaster Declaration that impacts the planning area
- A hazard event that causes loss of life
- A comprehensive update of the County or participating city's comprehensive plan

It will not be the intent of future updates to develop a complete new hazard mitigation plan for the planning area. The update will, at a minimum, include the following elements:

- The update process will be convened through a steering committee.
- The hazard risk assessment will be reviewed and, if necessary, updated using best available information and technologies.
- The action plans will be reviewed and revised to account for any initiatives completed, dropped, or changed and to account for changes in the risk assessment or new partnership policies identified under other planning mechanisms (such as the comprehensive plan).
- The draft update will be sent to appropriate agencies and organizations for comment.
- The public will be given an opportunity to comment on the update prior to adoption.
- The partnership governing bodies will adopt their respective portions of the updated plan.

6.5. CONTINUING PUBLIC INVOLVEMENT

The public will continue to be apprised of the plan's progress through the Hazard Mitigation Plan website and by providing copies of annual progress reports to the media. Each planning partner has agreed to provide links to the County hazard mitigation plan website on their individual jurisdictional websites to increase avenues of public access to the plan. Siskiyou County OES has agreed to maintain the hazard mitigation plan website. This site will not only house the final plan, it will become the one-stop shop for information regarding the plan, the partnership and plan implementation. Copies of the plan will be distributed to the Siskiyou County Library system. Upon initiation of future update processes, a new public involvement strategy will be initiated based on guidance from a new steering committee. This strategy will be based on the needs and capabilities of the planning partnership at the time of the update. At a minimum, this strategy will include the use of local media outlets within the planning area. The jurisdiction will provide contact information on their website if the public wishes to have more input. They can contact the program manager for any questions or comments.

6.6. INCORPORATION INTO OTHER PLANNING MECHANISMS

The information on hazard, risk, vulnerability, and mitigation contained in this plan is based on the best science and technology available at the time this plan was prepared. The Siskiyou County General Plan and the general plans of the partner cities are considered to be integral parts of this plan. The County and partner cities, through adoption of general plans and zoning ordinances, have planned for the impact of natural hazards. The plan development process provided the County and the cities with the opportunity to review and expand on policies contained within these planning mechanisms. The planning partners used their comprehensive plans and the hazard mitigation plan as complementary documents that work together to achieve the goal of reducing risk exposure to the citizens of the Siskiyou County. An update to a general plan may trigger an update to the hazard mitigation plan.

All municipal planning partners are committed to maintaining compliance with the provisions of California Assembly Bill 2140 (AB 2140) by creating a linkage between the hazard mitigation plan and their individual general plans by identifying a mitigation initiative and giving that initiative a high priority. Other planning processes and programs to be coordinated with the recommendations of the hazard mitigation plan include the following:

- Partners' emergency response plans
- Capital improvement programs
- Municipal codes
- Community design guidelines
- Water-efficient landscape design guidelines
- Stormwater management programs
- Water system vulnerability assessments
- Master fire protection plans.

Some action items do not need to be implemented through regulation. Instead, these items can be implemented through the creation of new educational programs, continued interagency coordination, or improved public participation. As information becomes available from other planning mechanisms that can enhance this plan, that information will be incorporated via the update process. We will be adopting this plan into the safety elements of the general plan when adopted. Due to insufficient staff and funding to the Siskiyou OES position we were not able to integrate information from the 2012 plan into these planning mechanisms as noted above. It is the intent of the jurisdictions to perform these integrations after the 2019 plan is approved.

PART 2 — RISK ASSESSMENT

CHAPTER 7.
IDENTIFIED HAZARDS AND RISK ASSESSMENT METHODOLOGY

Risk assessment is the process of measuring the potential loss of life, personal injury, economic injury, and property damage resulting from natural hazards. It allows emergency management personnel to establish early response priorities by identifying potential hazards and vulnerable assets. The process focuses on the following elements:

- Hazard identification—Use all available information to determine what types of disasters may affect a jurisdiction, how often they can occur, and their potential severity.
- Vulnerability identification—Determine the impact of natural hazard events on the people, property, environment, economy and lands of the region.
- Cost evaluation—Estimate the cost of potential damage or cost that can be avoided by mitigation.

The risk assessment for this hazard mitigation Plan evaluates the risk of natural hazards prevalent in Siskiyou County and meets requirements of the DMA (44CFR, Section 201.6(c)(2)).

7.1 IDENTIFIED HAZARDS

7.1.1 7Hazards of Concern

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

- Dam failure
- Drought
- Earthquake
- Flood
- Landslide
- Severe weather
- Volcano
- Wildfire.

A complete risk assessment is provided for each of these hazards.

7.1.2 Hazards of Interest

The Steering Committee also identified natural and human-caused hazards that, while not posing enough threat to warrant a complete risk assessment, do have some limited potential to impact the planning area. These "hazards of interest" were not evaluated with a complete risk assessment for this plan, but a profile of all of them is presented in a single chapter at the end of the risk assessment section of the plan. The hazards of interest are as follows:

- Avalanche
- Air quality/smoke pollution
- Energy shortages
- Hazardous materials
- Fish disease
- Noxious weeds.

7.1.3 Climate Change

Climate includes patterns of temperature, precipitation, humidity, wind and seasons. Climate plays a fundamental role in shaping natural ecosystems, and the human economies and cultures that depend on them. "Climate change" refers to changes over a long period of time. It is generally perceived that climate change will have a measurable impact on the occurrence and severity of natural hazards around the world. Impacts include the following:

- Snow cover losses will continue, and declining snowpack will affect snow-dependent water supplies and stream flow levels around the world.
- The risk of drought and the frequency, intensity, and duration of heat waves are expected to increase.
- More extreme precipitation is likely, increasing the risk of flooding.
- The world's average temperature is expected to increase.

Climate change will affect communities in a variety of ways. Impacts could include an increased risk for extreme events such as drought, storms, flooding, and forest fires; more heat-related stress; and the spread of existing or new vector-born disease into a community. In many cases, communities are already facing these problems to some degree. Climate change changes the frequency, intensity, extent, and/or magnitude of the problems.

This hazard mitigation Plan addresses climate change as a secondary impact for each identified hazard of concern. Each chapter addressing one of the hazards of concern includes a section with a qualitative discussion on the probable impacts of climate change for that hazard. While many models are currently being developed to assess the potential impacts of climate change, there are currently none available to support hazard mitigation planning. As these models are developed in the future, this risk assessment may be enhanced to better measure these impacts.

7.2 METHODOLOGY

The risk assessments in Chapter 9 through Chapter 16 describe the risks associated with each identified hazard of concern. Each chapter describes the hazard, the planning area's vulnerabilities, and probable event scenarios. The following steps were used to define the risk of each hazard:

- Identify and profile each hazard—The following information is given for each hazard:
  - Geographic areas most affected by the hazard
  - Event frequency estimates

– Severity estimates

– Warning time likely to be available for response.

Determine exposure to each hazard—Exposure was determined by overlaying hazard maps with an inventory of structures, facilities, and systems to determine which of them would be exposed to each hazard.

Assess the vulnerability of exposed facilities—Vulnerability of exposed structures and infrastructure was determined by interpreting the probability of occurrence of each event and assessing structures, facilities, and systems that are exposed to each hazard. Tools such as GIS and FEMA's hazard-modeling program called HAZUS-MH were used to perform this assessment for the flood, dam failure and earthquake hazards. Outputs similar to those from HAZUS were generated for other hazards, using maps generated by the HAZUS program.

7.3 RISK ASSESSMENT TOOLS

7.3.1 Dam Failure, Earthquake and Flood—HAZUS-MH

Overview

In 1997, FEMA developed the standardized Hazards U.S., or HAZUS, model to estimate losses caused by earthquakes and identify areas that face the highest risk and potential for loss. HAZUS was later expanded into a multi-hazard methodology, HAZUS-MH, with new models for estimating potential losses from hurricanes and floods.

HAZUS-MH is a GIS-based software program used to support risk assessments, mitigation planning, and emergency planning and response. It provides a wide range of inventory data, such as demographics, building stock, critical facility, transportation and utility lifeline, and multiple models to estimate potential losses from natural disasters. The program maps and displays hazard data and the results of damage and economic loss estimates for buildings and infrastructure. Its advantages include the following:

Provides a consistent methodology for assessing risk across geographic and political entities.

Provides a way to save data so that it can readily be updated as population, inventory, and other factors change and as mitigation planning efforts evolve.

Facilitates the review of mitigation plans because it helps to ensure that FEMA methodologies are incorporated.

Supports grant applications by calculating benefits using FEMA definitions and terminology.

Produces hazard data and loss estimates that can be used in communication with local stakeholders.

Is administered by the local government and can be used to manage and update a hazard mitigation plan throughout its implementation.

The version used for this plan was HAZUS-MH MR5, released by FEMA in September 2010.

Levels of Detail for Evaluation

HAZUS-MH provides default data for inventory, vulnerability and hazards; this default data can be supplemented with local data to provide a more refined analysis. The model can carry out three levels of analysis, depending on the format and level of detail of information about the planning area:

Level 1—All of the information needed to produce an estimate of losses is included in the software's default data. This data is derived from national databases and describes in general terms the characteristic parameters of the planning area.

Level 2—More accurate estimates of losses require more detailed information about the planning area. To produce Level 2 estimates of losses, detailed information is required about local geology, hydrology, hydraulics and building inventory, as well as data about utilities and critical facilities. This information is needed in a GIS format.

Level 3—This level of analysis generates the most accurate estimate of losses. It requires detailed engineering and geotechnical information to customize it for the planning area.

Application for This Plan

The following methods were used to assess specific hazards for this plan:

- **Flood**—A Level 2, general building stock analysis was performed. An updated inventory was used in place of the HAZUS-MH defaults for essential facilities, transportation and utilities. Current Siskiyou County DFIRMs were used to delineate flood hazard areas and estimate potential losses from the 100-year flood event. Using the DFIRM floodplain boundaries and a countywide 10-meter digital elevation model, a 100-year flood depth grid was generated and integrated into the model. Flood exposure numbers were generated using Siskiyou County assessor data. The assessor data does not include tax exempt structures, such as federal and local government buildings. Assessor data was the best available data to estimate hazard exposure. Flood hazard vulnerability numbers were generated in HAZUS, using the default census block General Building Stock.

- **Dam Failure**—Dam failure inundation mapping for Siskiyou County was collected where available. This data was imported into HAZUS-MH and a modified Level 2 analysis was run using the flood methodology described above. Using the dam inundation mapping and a countywide 10-meter digital elevation model, a dam failure flood depth grid was generated and integrated into the model. Dam failure exposure numbers were generated using Siskiyou County assessor data. Dam failure vulnerability numbers were generated in HAZUS, using the default census block General Building Stock.

Earthquake—A Level 2 analysis was performed to assess earthquake risk and exposure. Earthquake probabilistic data prepared by the U.S. Geological Survey (USGS) was used for the analysis of this hazard. An updated inventory of essential facilities, transportation and utility features was used in place of the HAZUS-MH defaults. A modified version of the California Department of Conservation National Earthquake Hazard Reduction Program (NEHRP) soils inventory was used. The standard HAZUS analysis for the 100- and 500-year probabilistic events was used to assess earthquake risk in Siskiyou County.

7.3.2 Landslide, Severe Weather, Volcano and Wildfire

For most of the hazards evaluated in this risk assessment, historical data was not adequate to model future losses. However, HAZUS-MH and GIS are able to map hazard areas and calculate exposures if geographic information is available on the locations of the hazards and inventory data. Areas and inventory susceptible to some of the hazards of concern were mapped and exposure was evaluated. For other hazards, a qualitative analysis was conducted using the best available data and professional judgment. County-relevant information was gathered from a variety of sources. Frequency and severity indicators include past events and the expert opinions of geologists, emergency management specialists and others. The primary data source was the Siskiyou County GIS database, augmented with state and federal data sets. Additional data sources for specific hazards were as follows:

- **Landslide—**Historical landslide and probable landslide data were provided by Siskiyou County and incorporated into the plan. Also included in the landslide assessment was geomorphology characteristics provided by the Klamath National Forest. Landslide exposure numbers were generated using Siskiyou County assessor data.
- **Severe Weather**—Severe weather data was downloaded from the Natural Resources Conservation Service and the National Climatic Data Center.
- **Volcano**—Volcanic hazard data was obtained from the USGS Cascade Volcano Observatory.
- **Wildfire**—Information on wildfire hazards areas was provided by California Department of Forestry and Fire Protection. Wildfire exposure numbers were generated using Siskiyou County assessor data.

7.3.3 Drought

The risk assessment methodologies used for this plan focus on damage to structures. Because drought does not impact structures, the risk assessment for drought was more limited and qualitative than the assessment for the other hazards of concern.

7.3.4 Limitations

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

Approximations and simplifications necessary to conduct a study

Incomplete or outdated inventory, demographic or economic parameter data

The unique nature, geographic extent and severity of each hazard

Mitigation measures already employed

The amount of advance notice residents have to prepare for a specific hazard event.

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

CHAPTER 8.
SISKIYOU COUNTY PROFILE

Siskiyou County is located in northern California (see Figure 8-1). It is the 45th most populous of California's 58 counties. Its incorporated cities are Dorris, Dunsmuir, Etna, Fort Jones, Montague, Mount Shasta, Tulelake, Weed and Yreka. Yreka, in the center of the county, is the county seat. Siskiyou County is the fifth largest county in California, covering 6,347 square miles in the Siskiyou Mountain region. The county is bounded to the north by the state of Oregon, to the east by Modoc County, to the south by Shasta and Trinity Counties and to the west by Del Norte and Humboldt Counties.

Figure 8-1. Main Features of Siskiyou County

About 60 percent of the land is managed by state and federal government agencies, including the U.S. Forest Service, the U.S. Bureau of Land Management, the U.S. Fish and Wildlife Service and the California Department of Fish and Game. Much of the land use in the county is resource-based, in the form of forested hills, cropland, range and pasture land.

Much of the county's rural and sparse population is located along major transportation corridors, which also are interspersed with commercial and light industrial operations. Interstate-5, the primary transportation corridor along the West Coast, divides the county east and west. Services, retail trade, wholesale trade, manufacturing and agriculture, forestry and fishing are important base industries in the county. The summer months see a large influx of tourists who take advantage of the County's wide-open spaces for outdoor recreation including hunting, fishing, white-water rafting, and mountain climbing and camping.

8.1 COMMUNITIES

Some of the county's cities and towns are located along major transportation corridors, including Interstate 5, while others are located along small rural highways that connect the scenic valleys:

Yreka, located on Interstate 5 and near State Routes 96 and 3, has the largest population in the county. Yreka was a gold rush boomtown and its downtown district, museum and monuments attract many tourists each year.

Mount Shasta is the County's second largest city.

The City of Dunsmuir is a hub for tourism and once was an important railroad yard.

The city of Montague is home to a historic preservation district, an annual hot air balloon fair and several old-fashioned farms and ranches.

Tulelake, in the eastern corner of the county, is known for its volcanic cinder cones, lava bed landscapes and a wildlife refuge visited by millions of migrating birds.

Weed is named after a lumber mill pioneer, although the timber industry has scaled back. The town's economy is now supported by tourism, the College of the Siskiyous and the Crystal Geyser bottled water company.

The community of Dorris is located in the Butte Valley at the California-Oregon boundary.

Surrounded by ranch lands in the Scott Valley, the City of Etna attracts anglers in search of stillwater rainbow trout.

The Scott River runs through the Town of Fort Jones, which is an historical military post.

Significant unincorporated communities in Siskiyou County include Callahan, Edgewood, Forks of Salmon, Gazelle, Greenview, Grenada, Happy Camp, Hornbrook, Horse Creek, Klamath River, Lake Shastina, Macdoel, McCloud, Sawyers Bar, Scott Bar, Seiad Valley, and Somes Bar.

8.2 HISTORICAL OVERVIEW

The presence of Native Americans in Siskiyou County has been traced back over 7,000 years, and oral histories of local tribes extend even further back. The historical distribution of tribes in the area was as follows:

The area north of Mount Shasta and west into Scott Valley was the territory of the Shasta Indians. The tribe had a vast land base encompassing a substantial proportion of Northern California and Southern Oregon.

The Karuk Tribe lived along the Klamath River and across the Marble and Salmon Mountains in the Scott Valley area. People of the Karuk Tribe lived sustainably within their ancestral lands using land management techniques such as burning. The rivers and surrounding forests sustained the population with fish, game and acorns.

The traditional homelands of the Modocs were east of Mount Shasta and up into Butte Valley and the Klamath Basin. In the late 1800s, the federal government relocated the Modoc people to Oklahoma reservations where the majority of tribe remains.

The Wintu people lived south of Mount Shasta, including most of Shasta and Trinity Counties.

The Achomawi and Klamath native peoples had some historical territory within what is now Siskiyou County.

The first record of non-Indian travel in Siskiyou County was in the winter of 1826-27 when Hudson's Bay Company fur trappers under Peter Ogden, traveled through the area. Ogden noted in his journal that Mount Shasta was equal in height to Mount Hood and that the mountain was named Mount Sastise. Early maps portrayed Mount Shasta with a variety of other names including Mount Pitt, Mount Jackson, and Mount Simpson and also indicated that the mountain stood over 20,000 feet above sea level. For the most part, explorers and fur trappers traveled in the area but did not stay for any extensive length of time.

Gold was discovered in Siskiyou County in 1850 by prospectors on the South Fork of the Salmon River. The Gold Rush brought considerable numbers of gold-seekers to parts of Siskiyou County. Men and women from across America and some from Europe, Australia and Asia came to mine gold, though most were unsuccessful. Many failed gold-seekers stayed in the region, displacing Native American people while establishing small settlements and boomtowns, along with roads, churches, hotels and schools. The town of Yreka was one such settlement, settled in the 1850s while ranching, logging and railroads became an economic force in the county.

Siskiyou County was created on March 22, 1852, from parts of Shasta and Klamath Counties. Yreka was declared the county seat. The county was named after the Siskiyou Mountains; although the origin of the word *siskiyou* is not entirely understood, one suggestion is that it is the Chinook Indian word for "bob-tailed horse." Another version is that the name has French origins from the phrase *six cailloux*, or "six stones," which was given to a ford crossing on the Umpqua River by a party of Hudson's Bay Company trappers, because six large stones or rocks lay in the river where they crossed. Others attribute the name to a local Native American tribe.

8.3 PHYSICAL SETTING

Siskiyou County encompasses 1.2 million acres of ecologically diverse wildland ranging from high desert in the east, to the coniferous forests of the Klamath River drainage with farmland carpeting the interior valleys, and Mt. Shasta as the geographical centerpiece.

8.3.1 Geology

The Siskiyou County region has a complex geologic history of folding, faulting, uplifting, sedimentation, volcanism and erosion. The primary bedrock in Siskiyou County includes igneous, or volcanic, rocks, with an array of surficial alluvial and colluvial deposits. Considerable marble, sandstone and limestone deposits exist throughout the County, many of which have been mined for minerals or road materials. The county features three major geomorphic provinces:

Klamath Mountains—The Klamath Mountains have rugged topography with jagged peaks and ridges that extend 6,000 to 8,000 feet above sea level. In the western Klamath Range, an irregular drainage pattern is incised into the Klamath peneplain, an uplifted plateau. The uplift has left successive benches exposing gold bearing gravels on the canyon walls. This geomorphic province is considered to be a northern extension of the Sierra Nevada.

Cascade Range—The Cascade Range is chain of volcanoes and mountains from Washington, through Oregon and into California. In Siskiyou County, this province is dominated by Mt. Shasta, a glacier covered volcanic peak that rises 14,162 feet above sea level and is the second highest active volcano in the Cascade Range. The broad and relatively flat Medicine Lake Volcano is one of the largest shield volcanoes in the Cascade Range.

Modoc Plateau—The Modoc Plateau is a broad volcanic table that ranges from 4,000 to 6,000 feet above sea level. The plateau consists of a thick accumulation of basaltic lava flows and tuff layers and numerous small volcanic cones. The Modoc Plateau is dissected by several north-south fault lines.

8.3.2 Soils

With a diverse landscape altered by geologic processes, the soils in Siskiyou County range from simple to the most complex. Alluvium and terrace deposits, primarily composed of sand, silt, clay and gravel, are prevalent in the lowlands and flat riverine valleys. The intermountain valleys and foothills contain alluvial soils and terrace deposits. The mountainous areas consist of hearty soils from a variety of lithic parent materials, including sedimentary, metamorphic and igneous rocks. Mapping units in the Natural Resources Conservation Service's (NRCS) soil survey for Siskiyou County, Central Part describe the prevailing soils and include information about parent rock material, soil depth, erosion and slope. The acreage and proportionate extent of the major soil groups is described below:

Duzel-Jilson-Facey Complex—This soil complex is the majority soil, covering 11.4 percent (103,165 acres) of the map. The component is located in steep, mountainous areas with 15 to 50 percent slopes. The parent material is weathered metamorphic rock and is considered well-drained.

Marpa-Kinkel-Boomer, Cool Complex—This soil complex covers over 80,000 acres and is 8.8 percent of the map area. It is located in steep, mountainous areas with 15 to 50 percent slopes. The parent material is weathered metamorphic rock and is considered well-drained.

Kindig-Neuns Gravelly Loams—These gravelly loams cover 46,590 acres, making up about 5 percent of the map area. They are located in very steep mountains with 50 to 80 percent slopes. The parent material is weathered metamorphic rock and is considered well-drained.

Lassen-Kuck Complex, Stony—Covering over 46,000 acres, this complex makes up 5.1 percent of the map area. These formations occur on hills with 2 to 50 percent slopes. The rocky materials are well-drained and come from weathered igneous parent materials.

Lassen-Rock Outcrop-Kuck Complex—This soil complex covers 35,845 acres, or 3.9 percent of the map area. This outcrop and soil complex is located on hills with a range of 2 to 50 percent slopes. The parent material is weathered igneous rock and is considered well-drained.

Soils have varying levels of susceptibility to erosion, but each soil type benefits from conservation management techniques to prevent accelerated erosion. Topsoil erosion often results in reduced crop productivity and may cause sedimentation in nearby streams. Sedimentation fills in stream beds, diminishing water quality and limiting water transportation, and it may damage sensitive riparian habitats.

Soil erosion in Siskiyou County occurs as a result of intensive land use, wind and water erosion. Erosion may be most severe where urbanization, development, recreational activities, logging and intensive agricultural practices take place. Extreme rainfall events, lack of vegetative cover, fragile soils and steep slopes combine to accelerate erosion. Wind erosion can also be a factor for soil losses in some areas. Agricultural crops are subject to the erosive forces of water, and hillside grazing pastures have been strained by reduced root structure due to years of drought conditions. With proper drainage construction and landscaping techniques, these altered soils may return to pre-construction stability and condition.

8.3.3 Surface Water

The County is drained by the Sacramento River in the south, the Klamath River in the north and the Salmon River in the west. The Klamath River winds an irregular course from the Cascade Range through the Klamath Mountains. Numerous watercourses drain the snow-capped peaks of the Cascade Range. Lakes, marshes and slow moving streams meander across the relatively flat Modoc Plateau.

8.3.4 Climate

In general, Siskiyou County's climate is characterized by warm, dry summers and cool, wet winters typical of Mediterranean climates. However, since Siskiyou County is at the northern extreme of the Mediterranean climate zone (above 41° N) and is in a mountainous region, winters tend to be colder than the average Mediterranean region. The geographic diversity of Siskiyou County contributes to a broad range of regional micro-climates. Elevation differences, along with distance from the Pacific Ocean, which is the main source of precipitation, account for most of the variability in Siskiyou County's climate. The alpine areas around Mount Shasta and other mountainous areas receive considerable snow in the winter, which blankets the ski area on the slopes of Mount Shasta. In contrast, the valleys receive a only a light dusting of snow in winter.

Due to the influence of coastal air masses, the western portion of Siskiyou County receives the most moisture and it becomes progressively drier toward the east. High elevation and proximity to the Pacific Ocean results in the Klamath Mountains receiving an average of 40 to 60 inches per year in the valley regions and from 80 to 100 inches per year in the higher elevations. The Shasta Valley lies in the rain shadow of the Klamath Range, so on average the valley receives less than 20 inches each year. As winter storms move eastward with the prevailing westerlies, they reach the Cascade Range, where uplift results in relatively high precipitation (approximately 30 to 60 inches per year). As coastal storms pass over the Coast Range (west of Siskiyou County) and the ranges in the County, much of the moisture precipitates out, so the Modoc Plateau in the eastern county receives little precipitation—about 10 to 20 inches year. Due to the distance from the moderating influence of the Pacific Ocean, the Modoc Plateau has more extreme temperature ranges and much colder winter temperatures. This eastern, interior part of Siskiyou County is better classified as having a steppe climate rather than a Mediterranean climate.

8.4 MAJOR PAST HAZARD EVENTS

Presidential disaster declarations are typically issued for hazard events that cause more damage than state and local governments can handle without assistance from the federal government, although no specific dollar loss threshold has been established for these declarations. A presidential disaster declaration puts federal recovery programs into motion to help disaster victims, businesses and public entities. Some of the programs are matched by state programs. Siskiyou County has experienced eight events since 1964 for which presidential disaster declarations were issued. These events are listed in Table 8-1.

TABLE 8-1.
PRESIDENTIAL DISASTER DECLARATIONS FOR HAZARD EVENTS IN SISKIYOU COUNTY

Year	Date	Incident Description	Disaster Number
2017	01/02	Severe Winter Storms, Flooding, and Debris and Mud Flows	4301
2017	01/23	Severe Winter Storms, Flooding, and Debris and Mud Flows	4308
2010	03/08	Severe Winter Storms, Flooding, and Debris and Mud Flows	1884
2006	02/03	Severe Storms, Flooding, Mudslides, and Landslides	1628
1997	01/04	Severe Storms/Flooding	1155
1995	03/12	Severe Winter Storms, Flooding, Landslides, Mud Flows	1046
1993	02/03	Severe Storm, Winter Storm, Mud & Landslides, Flooding	979
1974	01/25	Severe storms, flooding	412
1970	02/16	Severe storms, flooding	283

1964	12/24	Heavy Rains & Flooding	183

Many natural hazard events do not trigger federal disaster declaration protocol but have significant impacts on their communities. These events are also important to consider in establishing recurrence intervals for hazards of concern.

8.5 CRITICAL FACILITIES AND INFRASTRUCTURE

Critical facilities and infrastructure are those that are essential to the health and welfare of the population. These become especially important after a hazard event. Critical facilities typically include police and fire stations, schools and emergency operations centers. Critical infrastructure can include the roads and bridges that provide ingress and egress and allow emergency vehicles access to those in need, and the utilities that provide water, electricity and communication services to the community. Also included are "Tier II" facilities and railroads, which hold or carry significant amounts of hazardous materials with a potential to impact public health and welfare in a hazard event. As defined for this hazard mitigation Plan, critical facilities include but are not limited to the following:

- Police stations, fire stations, city/county government facilities (including those that house critical information technology and communication infrastructure), vehicle and equipment storage facilities, and emergency operations centers needed for disaster response before, during, and after hazard events
- Public and private utilities and infrastructure vital to maintaining or restoring normal services to areas damaged by hazard events. These facilities include but are not limited to:
  - Public and private water supply infrastructure, water and wastewater treatment facilities and infrastructure, potable water pumping, flow regulation, distribution and storage facilities and infrastructure
  - Public and private power generation (electrical and non-electrical), regulation and distribution facilities and infrastructure
  - Data and server communication facilities
  - Structures that manage or limit the impacts of natural hazards such as regional flood conveyance systems, potable water trunk main interconnect systems and redundant pipes crossing fault lines and reservoirs
  - Major road and rail systems including bridges, airports and marine terminal facilities
- Educational facilities, including K-12 and community college.
- Community gathering places, such as libraries, community centers, senior centers, veterans halls, and the County fairground
- Hospitals, nursing homes, and housing likely to contain occupants who may not be sufficiently mobile to avoid death or injury during a hazard event
- Structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic, and/or water-reactive materials.

Map 8-1 shows the location of critical facilities in unincorporated areas of the county. Critical facilities within the cities participating in this plan are shown in maps for each city provided in Volume 2 of the plan. Due to the sensitivity of this information, a detailed list of facilities is not provided. The list is on file with each planning partner. Table 8-2 and Table 8-3 provide summaries of the general types of critical facilities and infrastructure, respectively, in each municipality and unincorporated county areas. All critical facilities/infrastructure were analyzed in HAZUS to help rank risk and identify mitigation actions. The risk assessment for each hazard qualitatively discusses critical facilities with regard to that hazard. There has been little development in infrastructure that puts the county in higher risk sense the 2012 plan. All buildings were built to code and gone through the proper planning departments and approved.

**TABLE 8-2.
CRITICAL FACILITIES BY JURISDICTION AND CATEGORY**

City	Medical	Government	Protective	Schools	Hazmat	Other	**Total**
Dorris	1	0	1	2	0	0	**4**
Dunsmuir	0	0	2	6	0	1	**9**
Etna	3	12	2	5	0	0	**22**
Fort Jones	1	11	2	5	0	0	**19**
Montague	1	0	1	3	0	0	**5**
Mt Shasta	15	0	3	13	0	0	**31**
Tulelake	1	0	1	4	0	1	**7**
Weed	4	2	2	9	0	0	**17**
Yreka	25	12	5	28	0	2	**72**
Unincorporated	13	33	26	42	0	12	**126**
Total	**64**	**70**	**45**	**117**	**0**	**16**	**312**

**TABLE 8-3.
CRITICAL INFRASTRUCTURE BY JURISDICTION AND CATEGORY**

City	Bridges	Water	Wastewater	Power	Communications	Other	**Total**
Dorris	0	0	0	0	0	0	**0**
Dunsmuir	9	0	0	0	0	0	**9**
Etna	0	0	0	0	0	0	**0**
Fort Jones	2	7	0	1	0	0	**10**
Montague	0	0	0	0	0	0	**0**
Mt Shasta	5	0	0	0	0	0	**5**
Tulelake	0	0	0	0	0	0	**0**
Weed	9	0	0	1	0	0	**10**
Yreka	21	0	0	0	0	0	**21**
Unincorporated	320	7	1	1	0	0	**329**
Total	**366**	**14**	**1**	**3**	**0**	**0**	**384**

8.6 DEMOGRAPHICS

Some populations are at greater risk from hazard events because of decreased resources or physical abilities. Elderly people, for example, may be more likely to require additional assistance. Research has shown that people living near or below the poverty line, the elderly (especially older single men), the disabled, women, children, ethnic minorities and renters all experience, to some degree, more severe effects from disasters than the general population. These vulnerable populations may vary from the general population in risk perception, living conditions, access to information before, during and after a hazard event, capabilities during an event, and access to resources for post-disaster recovery. Indicators of vulnerability—such as disability, age, poverty, and minority race and ethnicity—often overlap spatially and often in the geographically most vulnerable locations. Detailed spatial analysis to locate areas where there are higher concentrations of vulnerable community members would assist the County in extending focused public outreach and education to these most vulnerable citizens.

8.6.1 Siskiyou County Population Characteristics

An understanding the composition of the population and how it has changed in the past and how it may change in the future is needed for making informed decisions about the future. Information about population is a critical part of planning because it directly relates to land needs such as housing, industry, stores, public facilities and services, and transportation. Siskiyou County is the 41st most populous of California's 58 counties. The California Department of Finance estimated Siskiyou County's population at 44,900 as of 2010.

Population changes are useful socio-economic indicators. A growing population generally indicates a growing economy, while a decreasing population signifies economic decline. Figure 8-2 shows the growth rate of Siskiyou County from 2000 to 2010 compared to that of the State of California. Between 2000 and 2010, California's population grew by 10 percent (about 1.0 percent per year) while Siskiyou County's population increased by 1.8 percent (0.18 percent per year).

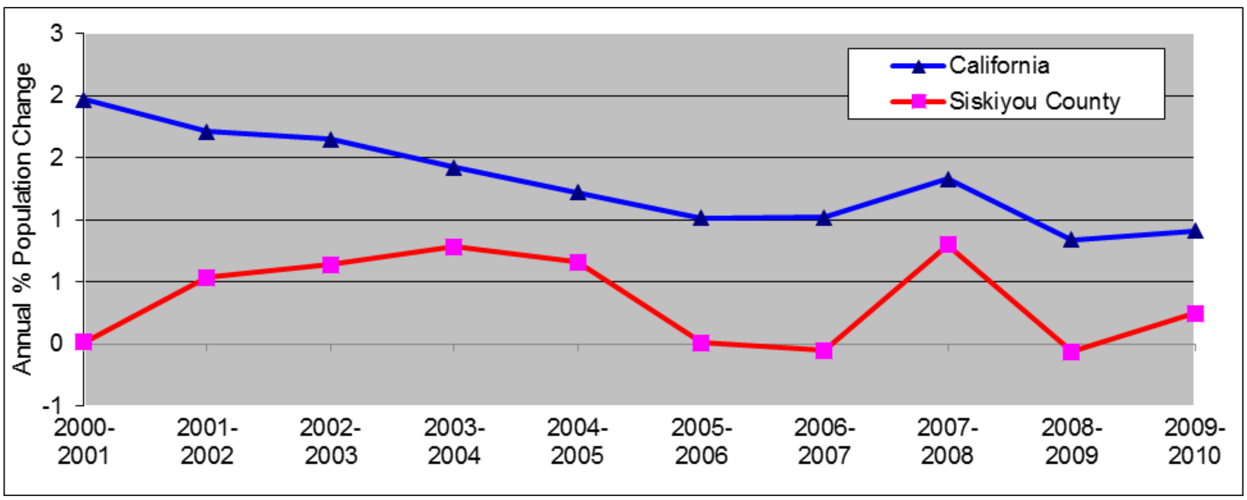


Figure 8-2. California and Siskiyou County Population Growth

Table 8-4 shows the population of incorporated municipalities and the unincorporated area in Siskiyou County from 2000 to 2010. In 2000, about 53 percent of Siskiyou County's residents lived outside incorporated areas. Overall growth in incorporated areas was 129 persons from 2000 to 2010, while the unincorporated areas of the county grew by 470 persons during the same timeframe.

8.6.2 Income

In the United States, individual households are expected to use private resources to prepare for, respond to and recover from disasters to some extent. This means that households living in poverty are automatically disadvantaged when confronting hazards. Additionally, the poor typically occupy more poorly built and inadequately maintained housing. Mobile or modular homes, for example, are more susceptible to damage in earthquakes and floods than other types of housing. In urban areas, the poor often live in older houses and apartment complexes, which are more likely to be made of un-reinforced masonry, a building type that is particularly susceptible to damage during earthquakes.

**TABLE 8-4.
CITY AND COUNTY POPULATION DATA**

	Population										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Dorris	915	919	922	920	922	932	939	933	918	907	903
Dunsmuir	1,830	1,803	1,771	1,729	1,702	1,684	1,650	1623	1600	1581	1574
Etna	769	766	760	748	742	743	737	732	724	716	711
Fort Jones	655	657	647	645	647	648	710	703	694	687	686
Montague	1,457	1,471	1,477	1,472	1,455	1,453	1,443	1434	1417	1402	1397
Mt. Shasta	3,598	3,577	3,537	3,480	3,438	3,435	3,394	3362	3323	3283	3285
Tulelake	1,023	1,020	1,016	1,005	1,000	1,005	1,010	1007	998	993	989
Weed	2,965	2,946	2,896	2,981	2,989	2,988	2,967	2987	2945	2897	2865
Yreka	7,484	7,482	7,448	7,542	7,687	7,750	7,765	7763	7674	7594	7564
Unincorporated	23,919	24,131	24,322	24,220	24,223	24,193	24,156	24,292	24,268	24,346	24,419
Total	**44,691**	**44,865**	**44,918**	**44,877**	**44,952**	**44,996**	**44,900**	**44,836**	**44,561**	**44,406**	**44,393**

Furthermore, residents below the poverty level are less likely to have insurance to compensate for losses incurred from natural disasters. This means that residents below the poverty level have a great deal to lose during an event and are the least prepared to deal with potential losses. The events following Hurricane Katrina in 2005 illustrated that personal household economics significantly impact people's decisions on evacuation. Individuals who cannot afford gas for their cars will likely decide not to evacuate.

Based on U.S. Census Bureau estimates, per capita income in Siskiyou County in 2009 was $22,528, and the median household income was $37,938. It is estimated that about 7 percent of households have an income between $100,000 and $149,999 per year and over 3 percent of the county's household incomes are above $150,000 annually. About 33.8 percent of the households in Siskiyou County make less than $25,000 per year and are therefore below the poverty level. As defined by the Census Bureau's Office of Management and Budget and updated for inflation using the Consumer Price Index, the weighted average poverty threshold for a family of four in 2010 was $24,314; for a family of three, $17,374; for a family of two, $14,218; and for unrelated individuals, $11,139.

8.6.3 Age Distribution

As a group, the elderly are more apt to lack the physical and economic resources necessary for response to hazard events and are more likely to suffer health-related consequences making recovery slower. They are more likely to be vision, hearing, and/or mobility impaired, and more likely to experience mental impairment or dementia. Additionally, the elderly are more likely to live in assisted-living facilities where emergency preparedness occurs at the discretion of facility operators. These facilities are typically identified as "critical facilities" by emergency managers because they require extra notice to implement evacuation. Elderly residents living in their own homes may have more difficulty evacuating their homes and could be stranded in dangerous situations. This population group is more likely to need special medical attention, which may not be readily available during natural disasters due to isolation caused by the event. Specific planning attention for the elderly is an important consideration given the current aging of the American population.

Children under 14 are particularly vulnerable to disaster events because of their young age and dependence on others for basic necessities. Very young children may additionally be vulnerable to injury or sickness; this vulnerability can be worsened during a natural disaster because they may not understand the measures that need to be taken to protect themselves from hazards.

The overall age distribution for Siskiyou County is illustrated in Figure 8-3. Based on U.S. Census data estimates for 2010-2017, 24.7 percent of Siskiyou County's population is 65 or older, compared to the state average of 12.6 percent. According to the 2010 U.S. Census data, 39.7 percent of the County's over-65 population has disabilities of some kind and 7.3 percent have incomes below the poverty line. Children under 18 account for nearly 20.2 percent of individuals who are below the poverty line. It is also estimated that 16.6 percent of the County's population is 14 or younger, compared to the state average of 21.5 percent.

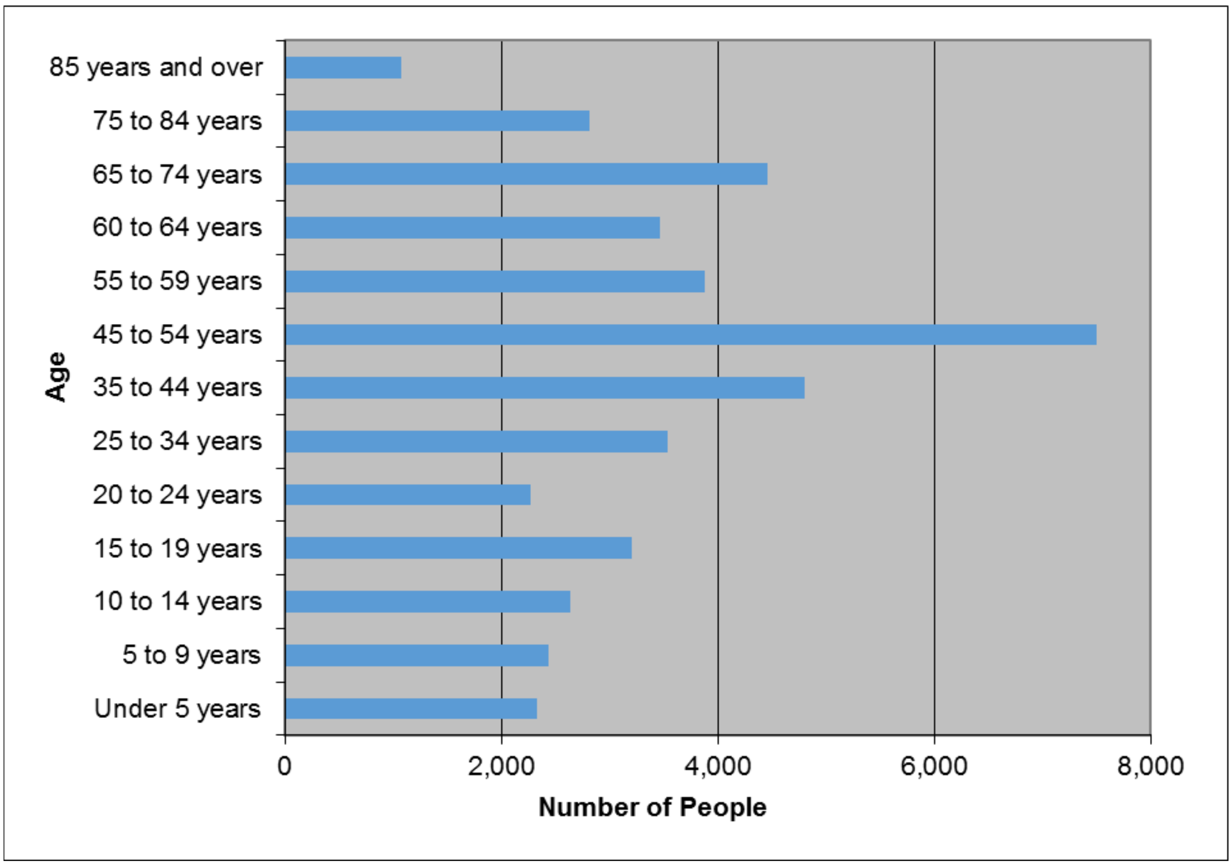


Figure 8-3. Siskiyou County Age Distribution

8.6.4 Race, Ethnicity and Language

Research shows that minorities are less likely to be involved in pre-disaster planning and experience higher mortality rates during a disaster event. Post-disaster recovery can be ineffective and is often characterized by cultural insensitivity. Since higher proportions of ethnic minorities live below the poverty line than the majority white population, poverty can compound vulnerability. According to the U.S. Census, the racial composition of Siskiyou County is predominantly White, at about 86.5percent. The largest minority populations are Hispanic or Latino at 12.6 percent and "some other race" at 5.3 percent. Figure 8-4 shows the racial distribution in Siskiyou County.

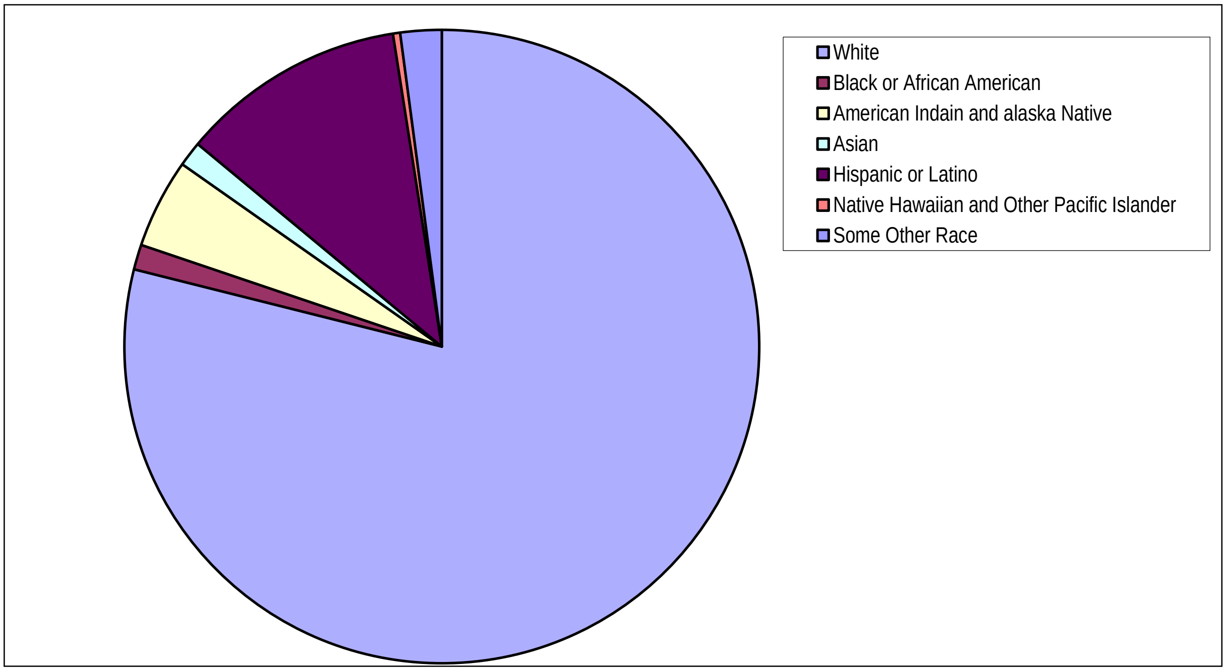


Figure 8-4. Siskiyou County Race Distribution

Siskiyou County has a 5.6-percent foreign-born population. Other than English, the most commonly spoken language in Siskiyou County is Spanish. The census estimates 3.9 percent of the county's residents speak English "less than very well."

8.6.5 Disabled Populations

People living with disabilities are significantly more likely to have difficulty responding to a hazard event than the general population. According to U.S. Census figures, roughly one-fifth of the U.S. population lives with a disability. Disabled populations are increasingly integrated into society. This means that a relatively large segment of the population will require assistance during the 72 hours after a hazard event, the period generally reserved for self-help. Disabilities can vary greatly in severity and permanence, making populations difficult to define and track. There is no "typical" disabled person, which can complicate disaster-planning processes that attempt to incorporate them. Disability is likely to be compounded with other vulnerabilities, such as age, economic disadvantage and ethnicity, all of which mean that housing is more likely to be substandard.

Table 8-5 summarizes the estimates of disabled people in Siskiyou County. According to 2010 U.S. Census data, 20.6 percent of the County's population over the age of 5 has a disability.

**TABLE 8-5.
DISABILITY STATUS OF NON-INSTITUTIONALIZED POPULATION**

Age	Persons with a Disability	Percent of Age Group
Age 5 to 20 years	728	5.2
Age 21 to 64 years	5,260	20.2
Age 65 years and over	3,166	50.2

8.7 ECONOMY

8.7.1 Industry, Businesses and Institutions

Siskiyou County's economy is strongly based in the "educational services, health care and social assistance" industry (23.7 percent), followed by the retail trade industry. The information and wholesale trade industries make up the smallest source of the county's economy. Figure 8-5 shows the breakdown of industry types in Siskiyou County.

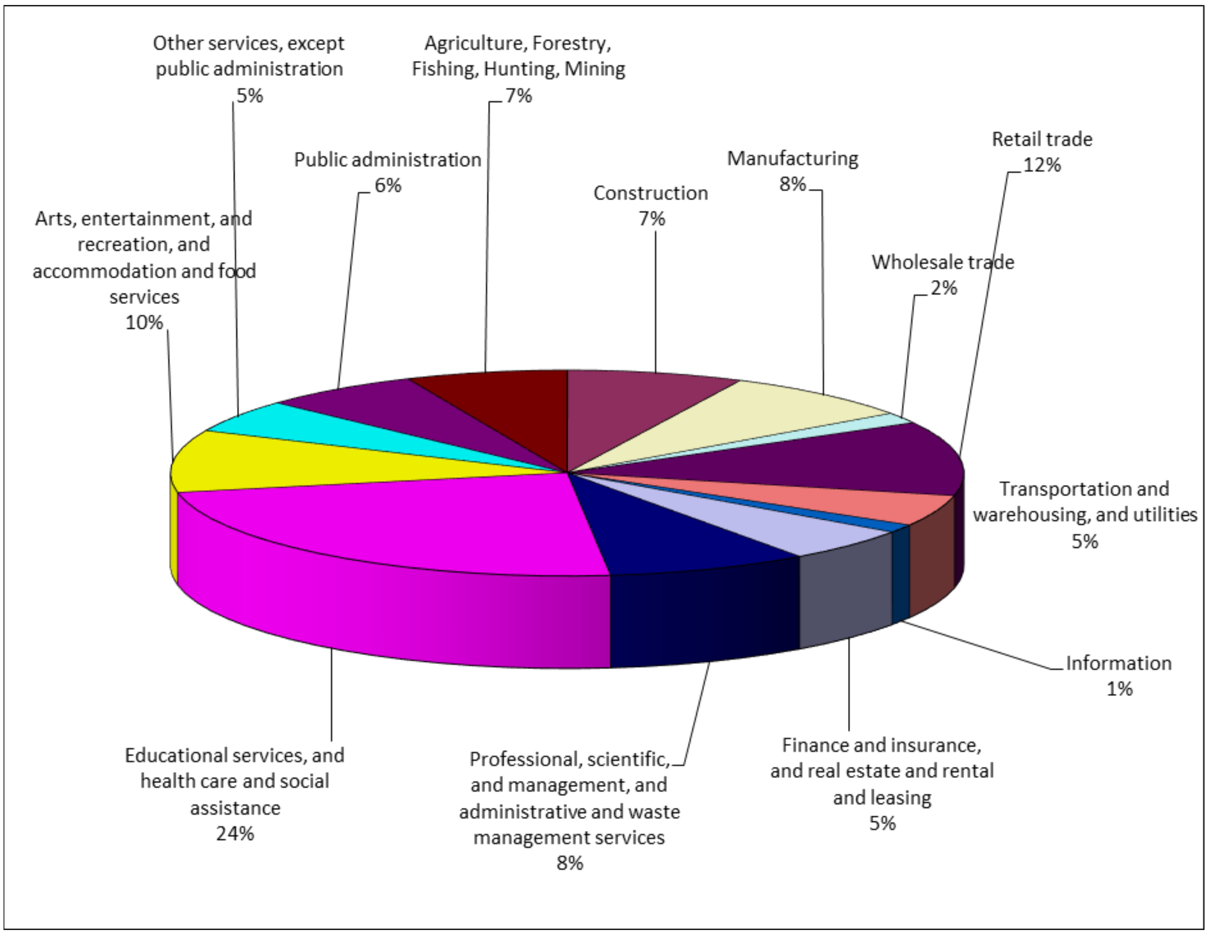


Figure 8-5. Industry in Siskiyou County

The county benefits from a variety of business activity. Major businesses include Siskiyou County government offices, CCDA Waters, LLC, College of the Siskiyous, Fairchild Medical Center, U.S. Forest

Service, Electro-Guard, Inc., Mercy Medical Center, Mt. Shasta Resort, Raley's Supermarket, Roseburg Forest Products, Siskiyou Lake Resort, Sugar Creek Ranch, Timber Products Co., and Wal-Mart.

Major educational and research institutions in the county are College of the Siskiyou's and the U.S. Forest Service.

Streams, mountains, and forestland provide a wide array of recreational opportunities in Siskiyou County. The Salmon and Scott Rivers provide boating, bird/wildlife watching, wild-trout fly fishing and other water recreation activities. The Klamath River is a premier fishing and camping destination. Skiing, river rafting, kayaking, hiking, camping, swimming, climbing, hunting and other outdoor activities abound at Mt. Shasta, Castle Crags State Park, Mt. Eddy, Black Butte, Marble Mountain Wilderness, Lake McCloud, Iron Gate Reservoir, Klamath National Forest, Tule Lake National Wildlife Refuge and waterfalls throughout the county. The Siskiyou National Forest in the Klamath Mountains and the Coastal Range provide additional national park and forestland.

8.7.2 Employment Trends and Occupations

According to the 2005-2009 American Community Survey Estimates, about 53.8 percent of Siskiyou County's population is in the labor force. Of the working-age population group (age 16 years and over), 59.4 percent of men and 49.4 percent of women are in the labor force.

Figure 8-6 compares California's and Siskiyou County's unemployment trends from 2001 through 2010. Siskiyou County's unemployment rate was lowest in 2001, at 8 percent. Unemployment rates again dipped to 8 percent in 2006, but have since been on an upward trend and are expected to continue to rise.

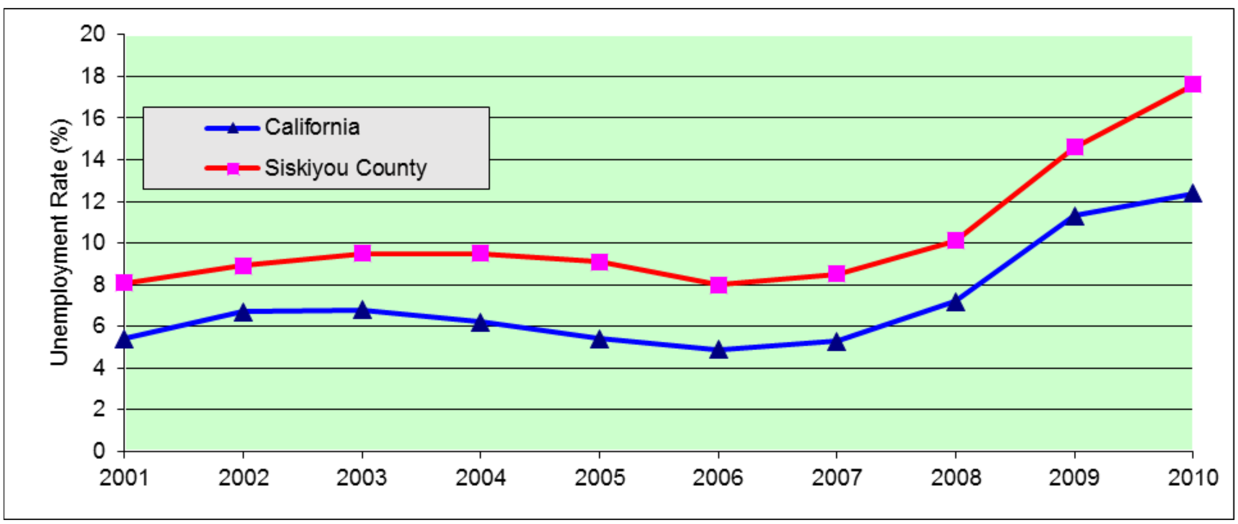


Figure 8-6. California and Siskiyou County Unemployment Rate

Management, professional and related occupations make up 32.6 percent of the jobs in Siskiyou County. The largest employer in the county is Siskiyou County government, where the major occupations are administration, management and professional in nature and include Public Works and the Sherriff's Department. Only about 3.4 percent of the employment in Siskiyou County is in farming, fishing and forestry occupations (see Figure 8-7).

The U.S. Census estimates that 72.1 percent of Siskiyou County workers commute alone (by car, truck or van) to work, and mean travel time to work is 20 minutes (the state average is 27 minutes).

8.8 FUTURE TRENDS IN DEVELOPMENT

The County and its cities have adopted comprehensive or general plans that govern land use decision and policy making their jurisdictions. Decisions on land use will be governed by these programs. This plan will work together with these programs to support wise land use in the future by providing vital information on the risk associated with natural hazards in Siskiyou County.

All municipal planning partners will incorporate by reference the Siskiyou County Hazard Mitigation Plan in their comprehensive or general plans. This will assure that all future trends in development can be established with the benefits of the information on risk and vulnerability to natural hazards identified in this plan. There has been a decrease in population sense 2012 and that has reduced the risk and there has been no significant changes to development that would increase risk in communities.

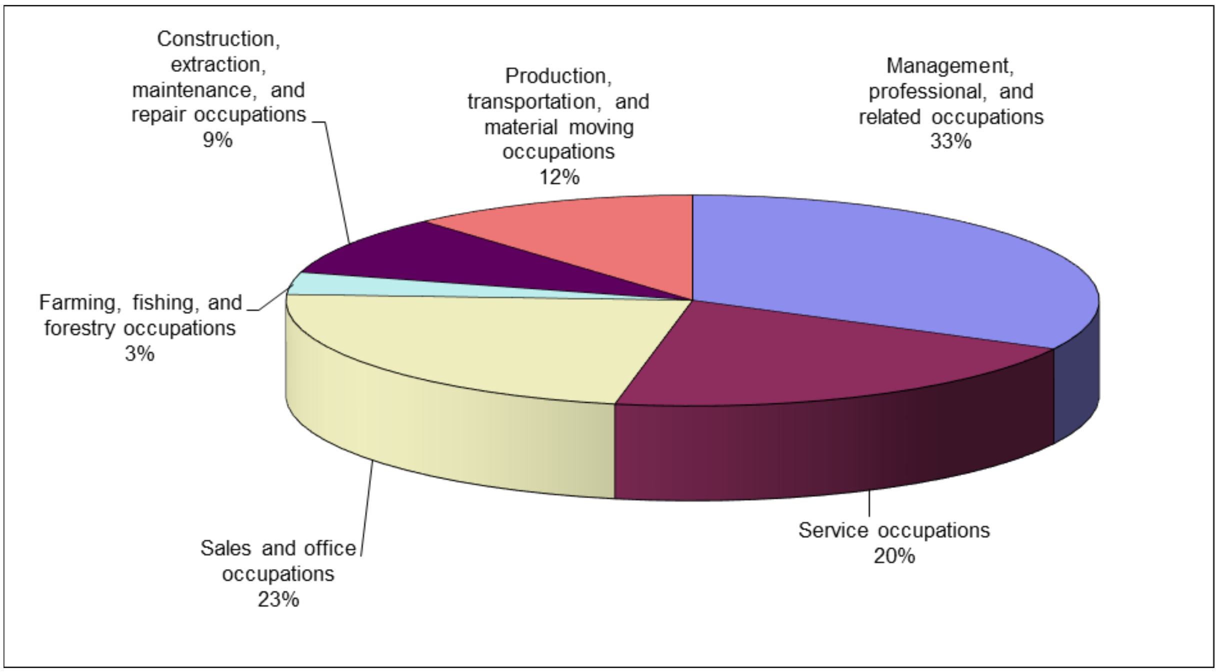


Figure 8-7. Occupations in Siskiyou County

8.9 LAWS AND ORDINANCES

Existing laws, ordinances and plans at the federal, state and local level can support or impact hazard mitigation initiatives identified in this plan. Hazard mitigation plans are required to include a review and incorporation, if appropriate, of existing plans, studies, reports, and technical information as part of the planning process (44CFR, Section 201.6(b)(3)). Pertinent federal and state laws are described below. Each planning partner has individually reviewed existing local plans, studies, reports, and technical information in its jurisdictional annex, presented in Volume 2.

8.9.1 Federal

Disaster Mitigation Act

The Disaster Mitigation Act (DMA) is the current federal legislation addressing hazard mitigation planning. It emphasizes planning for disasters before they occur. It specifically addresses planning at the local level, requiring plans to be in place before Hazard Mitigation Grant Program funds are available to communities. This Plan is designed to meet the requirements of DMA, improving the planning partners' eligibility for future hazard mitigation funds.

Endangered Species Act

The federal Endangered Species Act (ESA) was enacted in 1973 to conserve species facing depletion or extinction and the ecosystems that support them. The act sets forth a process for determining which species are threatened and endangered and requires the conservation of the critical habitat in which those species live. The ESA provides broad protection for species of fish, wildlife and plants that are listed as threatened or endangered. Provisions are made for listing species, as well as for recovery plans and the designation of critical habitat for listed species. The ESA outlines procedures for federal agencies to follow when taking actions that may jeopardize listed species and contains exceptions and exemptions. It is the enabling legislation for the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Criminal and civil penalties are provided for violations of the ESA and the Convention.

Federal agencies must seek to conserve endangered and threatened species and use their authorities in furtherance of the ESA's purposes. The ESA defines three fundamental terms:

Endangered means that a species of fish, animal or plant is "in danger of extinction throughout all or a significant portion of its range." (For salmon and other vertebrate species, this may include subspecies and distinct population segments.)

Threatened means that a species "is likely to become endangered within the foreseeable future." Regulations may be less restrictive for threatened species than for endangered species.

Critical habitat means "specific geographical areas that are…essential for the conservation and management of a listed species, whether occupied by the species or not."

Five sections of the ESA are of critical importance to understanding it:

Section 4: Listing of a Species—The National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries) is responsible for listing marine species; the U.S. Fish and Wildlife Service is responsible for listing terrestrial and freshwater aquatic species. The agencies may initiate reviews for listings, or citizens may petition for them. A listing must be made "solely on the basis of the best scientific and commercial data available." After a listing has been proposed, agencies receive comment and conduct further scientific reviews for 12 to 18 months, after which they must decide if the listing is warranted. Economic impacts cannot be considered in this decision, but it may include an evaluation of the adequacy of local and state protections. Critical habitat for the species may be designated at the time of listing.

Section 7: Consultation—Federal agencies must ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed or proposed species or adversely modify its critical habitat. This includes private and public actions that require a federal permit. Once a final listing is made, non-federal actions are subject to the same review, termed a "consultation." If the listing agency finds that an action will "take" a species, it must propose mitigations or "reasonable and prudent" alternatives to the action; if the proponent rejects these, the action cannot proceed.

Section 9: Prohibition of Take—It is unlawful to "take" an endangered species, including killing or injuring it or modifying its habitat in a way that interferes with essential behavioral patterns, including breeding, feeding or sheltering.

Section 10: Permitted Take—Through voluntary agreements with the federal government that provide protections to an endangered species, a non-federal applicant may commit a take that would otherwise be prohibited as long as it is incidental to an otherwise lawful activity (such as developing land or building a road). These agreements often take the form of a "Habitat Conservation Plan."

Section 11: Citizen Lawsuits—Civil actions initiated by any citizen can require the listing agency to enforce the ESA's prohibition of taking or to meet the requirements of the consultation process.

With the listing of salmon and trout species as threatened or endangered, the ESA has impacted most of the Pacific Coast states. Although some of these areas have been more impacted by the ESA than others due to the known presence of listed species, the entire region has been impacted by mandates, programs and policies based on the presumption of the presence of listed species. Most West Coast jurisdictions must now take into account the impact of their programs on habitat.

The Clean Water Act

The federal Clean Water Act (CWA) employs regulatory and non-regulatory tools to reduce direct pollutant discharges into waterways, finance municipal wastewater treatment facilities, and manage polluted runoff. These tools are employed to achieve the broader goal of restoring and maintaining the chemical, physical, and biological integrity of the nation's surface waters so that they can support "the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water."

Evolution of CWA programs over the last decade has included a shift from a program-by-program, source-by-source, pollutant-by-pollutant approach to more holistic watershed-based strategies. Under the watershed approach, equal emphasis is placed on protecting healthy waters and restoring impaired ones. A full array of issues are addressed, not just those subject to CWA regulatory authority. Involvement of stakeholder groups in the development and implementation of strategies for achieving and maintaining water quality and other environmental goals is a hallmark of this approach.

National Flood Insurance Program

The National Flood Insurance Program (NFIP) provides federally backed flood insurance in exchange for communities enacting floodplain regulations. Participation and good standing under NFIP are prerequisites to grant funding eligibility under the Robert T. Stafford Act. The County and most of the partner cities for this plan participate in the NFIP and have adopted regulations that meet the NFIP requirements. At the time of the preparation of this plan, all participating jurisdictions in the partnership were in good standing with NFIP requirements.

8.9.2 State

California General Planning Law

California state law (Cal. Gov. Code §65300 et seq.) requires that every county and city prepare and adopt a comprehensive long-range plan to serve as a guide for community development. The general plan expresses the community's goals, visions, and policies relative to future public and private land uses. The general plan forms the basis for most local government land use decision-making. It must consist of an integrated and internally consistent set of goals, policies, and implementation measures. It must focus on issues of the greatest concern to the community and be written in a clear and concise manner. Local government actions—such as those relating to land use allocations, annexations, zoning, subdivision, design review, redevelopment and capital improvements—must be consistent with the plan.

California Environmental Quality Act

The California Environmental Quality Act (CEQA) was passed in 1970 to institute a statewide policy of environmental protection. CEQA requires state and local agencies in California to follow a protocol of analysis and public disclosure of the potential environmental impacts of development projects. CEQA makes environmental protection a mandatory part of every California state and local agency's decision-making process.

For any project under CEQA's jurisdiction with potentially significant environmental impacts, agencies must identify mitigation measures and alternatives by preparing an environmental impact report and may approve only projects with no feasible mitigation measures or environmentally superior alternatives.

Assembly Bill 162: Flood Planning

This California State Assembly Bill passed in 2007 requires cities and counties to address flood-related matters in the land use, conservation, and safety and housing elements of their general plans. The land use element must identify and annually review the areas covered by the general plan that are subject to flooding as identified in floodplain mapping by either FEMA or the California Department of Water Resources (DWR). Upon the next revision of the housing element, the conservation element of the general plan must identify rivers, creeks, streams, flood corridors, riparian habitat, and land that may accommodate floodwater for the purposes of groundwater recharge and stormwater management. The safety element must identify information regarding flood hazards including:

- Flood hazard zones
- Maps published by FEMA, DWR, the U.S. Army Corps of Engineers, the Central Valley Flood Protection Board, California Emergency Management Agency, etc.
- Historical data on flooding
- Existing and planned development in flood hazard zones.

The general plan must establish goals, policies and objectives to protect from unreasonable flooding risks including:

- Avoiding or minimizing the risks of flooding new development
- Evaluating whether new development should be located in flood hazard zones
- Identifying construction methods to minimize damage.

Assembly Bill 162 establishes procedures for the determination of available land suitable for urban development, which may exclude lands where FEMA or DWR has determined that the flood management infrastructure is not adequate to avoid the risk of flooding.

Assembly Bill 2140: General Plans: Safety Element

This bill provides that the state may allow for more than 75 percent of public assistance funding under the California Disaster Assistance Act only if the local agency is in a jurisdiction that has adopted a local hazard mitigation plan as part of the safety element of its general plan. The local hazard mitigation plan needs to include elements specified in the legislation. In addition this bill requires California Emergency Management Agency to give federal mitigation funding preference to cities and counties that have adopted such plans. The intent of the bill is to encourage cities and counties to create and adopt hazard mitigation plans.

Assembly Bill 70: Flood Liability

This bill provides that a city or county may be required to contribute a fair and reasonable share to compensate for property damage caused by a flood to the extent that it has increased the state's exposure to liability for property damage by unreasonably approving new development in a previously undeveloped area that is protected by a state flood control project, unless the city or county meets specified requirements.

Assembly Bill 32: The California Global Warming Solutions Act

Assembly Bill 32 establishes a state goal of reducing greenhouse gas emissions to 1990 levels by 2020 (a reduction of approximately 25 percent from forecast emission levels) with further reductions to follow. The law requires the state Air Resources Board to do the following:

- Establish a program to track and report greenhouse gas emissions.
- Approve a scoping plan for achieving the maximum technologically feasible and cost-effective reductions from sources of greenhouse gas emissions.
- Adopt early reduction measures to begin moving forward.
- Adopt, implement and enforce regulations—including market mechanisms such as "cap and-trade" programs—to ensure that the required reductions occur.

The Air Resources Board recently adopted a statewide greenhouse gas emissions limit and an emissions inventory, along with requirements to measure, track, and report greenhouse gas emissions by the industries it determined to be significant sources of greenhouse gas emissions.

Senate Bill 97: Guidelines for Greenhouse Gas Emissions

Senate Bill 97, enacted in 2007, amends the CEQA to clearly establish that greenhouse gas emissions and their effects are appropriate subjects for CEQA analysis. It directs the Governor's Office of Planning and Research to develop draft CEQA guidelines for the mitigation of greenhouse gas emissions or their effects and directs the California Natural Resources Agency to certify and adopt the CEQA guidelines.

California State Building Code

California Code of Regulations Title 24 (CCR Title 24), also known as the California Building Standards Code, is a compilation of building standards from three sources:

- Building standards that have been adopted by state agencies without change from building standards contained in national model codes
- Building standards that have been adopted and adapted from national model code standards to meet California conditions
- Building standards authorized by the California legislature that constitute extensive additions not covered by the model codes, adopted to address particular California concerns.

The state Building Standards Commission is authorized by California Building Standards Law (Health and Safety Code Sections 18901 through 18949.6) to administer the processes related to the adoption, approval, publication, and implementation of California's building codes. These building codes serve as the basis for the design and construction of buildings in California. The national model code standards adopted into Title 24 apply to all occupancies in California except for modifications adopted by state agencies and local governing bodies. Since 1989, the Building Standards Commission has published new editions of Title 24 every three years.

Standardized Emergency Management System

CCR Title 19 establishes the Standardized Emergency Management System (SEMS) to standardize the response to emergencies involving multiple jurisdictions. SEMS is intended to be flexible and adaptable to the needs of all emergency responders in California. It requires emergency response agencies to use basic principles and components of emergency management. Local governments must use SEMS in order to be eligible for state funding of response-related personnel costs under CCR Title 19 (Sections 2920, 2925 and 2930). Individual agencies' roles and responsibilities contained in existing laws or the state emergency plan are not superseded by these regulations.

California State Hazard Mitigation Plan

Under the DMA, California must adopt a federally approved state multi-hazard mitigation plan in order to be eligible for certain disaster assistance and mitigation funding. The intent of the *California State Hazard Mitigation Plan* is to reduce or prevent injury and damage from hazards through the following:

- Documenting statewide hazard mitigation planning in California
- Describing strategies and priorities for future mitigation activities
- Facilitating the integration of local and tribal hazard mitigation planning activities into statewide efforts
- Meeting state and federal statutory and regulatory requirements.

The plan is an annex to the State Emergency Plan, and it identifies past and present mitigation activities, current policies and programs, and future mitigation strategies. The plan will be updated annually to reflect changing conditions and new information, especially information on local planning activities. This plan was helped used to develop our plan along with the annexes. We outlined our strategies and planning efforts based off this plan.

Governor's Executive Order S-13-08

Governor's Executive Order S-13-08 enhances the state's management of climate impacts from sea level rise, increased temperatures, shifting precipitation and extreme weather events. There are four key actions in the executive order:

- Initiate California's first statewide climate change adaptation strategy to assess expected climate change impacts, identify where California is most vulnerable, and recommend adaptation policies by early 2009. This effort will improve coordination within state government so that better planning can more effectively address climate impacts on human health, the environment, the state's water supply and the economy.
- Request that the National Academy of Science establish an expert panel to report on sea level rise impacts in California, to inform state planning and development efforts.
- Issue interim guidance to state agencies for how to plan for sea level rise in designated coastal and floodplain areas for new projects.
- Initiate a report on critical infrastructure projects vulnerable to sea level rise.

8.9.3 Cities and County

Each planning partner has prepared a jurisdiction-specific annex to this plan (see Volume 2). In preparing these annexes, each partner completed a capability assessment that looked at its regulatory, technical and financial capability to carry out proactive hazard mitigation. Refer to these annexes for a review of regulatory codes and ordinances applicable to each planning partner.

CHAPTER 9.

DAM FAILURE

9.1 GENERAL BACKGROUND

9.1.1 Causes of Dam Failure

Dam failures in the United States typically occur in one of four ways (see Figure 9-1):

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

The remaining 6 percent of U.S. dam failures are due to miscellaneous causes. Many dam failures in the United States have been secondary results of other disasters, such as earthquakes, landslides, extreme storms, massive snowmelt, equipment malfunction, structural damage, foundation failures, and sabotage. The most likely disaster-related causes of dam failure in Siskiyou County are earthquakes, excessive rainfall and landslides.

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

DEFINITIONS

Dam—Any artificial barrier, together with appurtenant works, that does or may impound or divert water, and that either (a) is 25 feet or more in height from the natural bed of the stream or watercourse at the downstream toe of the barrier (or from the lowest elevation of the outside limit of the barrier if it is not across a stream channel or watercourse) to the maximum possible water storage elevation; or (b) has an impounding capacity of 50 acre-feet or more. (CA Water Code, Division 3.)

Dam Failure—An uncontrolled release of impounded water due to structural deficiencies in dam.

Emergency Action Plan—A document that identifies potential emergency conditions at a dam and specifies actions to be followed to minimize property damage and loss of life. The plan specifies actions the dam owner should take to alleviate problems at a dam. It contains procedures and information to assist the dam owner in issuing early warning and notification messages to responsible downstream emergency management authorities of the emergency situation. It also contains inundation maps to show emergency management authorities the critical areas for action in case of an emergency. (FEMA 64)

High Hazard Dam—Dams where failure or operational error will probably cause loss of human life. (FEMA 333)

Significant Hazard Dam—Dams where failure or operational error will result in no probable loss of human life but can cause economic loss, environmental damage or disruption of lifeline facilities, or can impact other concerns. Significant hazard dams are often located in rural or agricultural areas but could be located in areas with population and significant infrastructure. (FEMA 333)

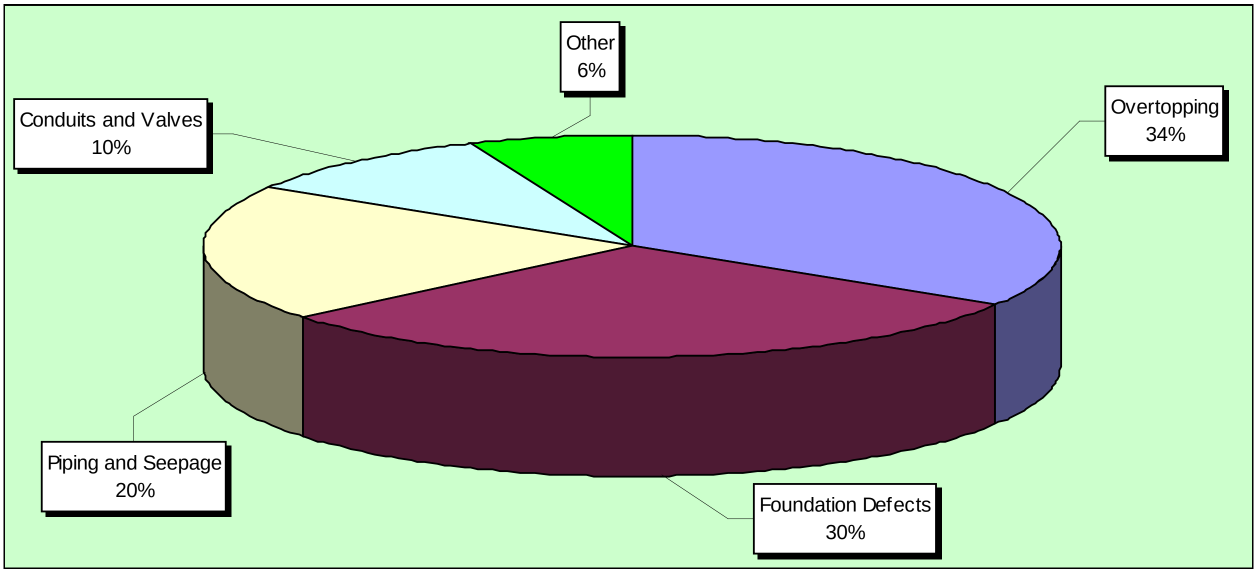


Figure 9-8. Historical Causes of Dam Failure

9.1.2 Regulatory Oversight

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

California Division of Safety of Dams

California's Division of Safety of Dams (a division of the Department of Water Resources) monitors the dam safety program at the state level. When a new dam is proposed, Division staff inspect the site. When an application is received, the Division reviews the plans to ensure that the dam is designed to meet minimum requirements and that the design is appropriate for known geologic conditions. After approval of the application, the Division inspects the construction to ensure that the work is done in accordance with the approved plans. After construction, the Division inspects each dam on an annual basis to ensure that it is performing as intended and is not developing problems. Roughly a third of these inspections include in-depth instrumentation reviews. The Division periodically reviews the stability of dams and their major appurtenances in light of improved design approaches and requirements, as well as new findings regarding earthquake hazards and hydrologic estimates in California (DWR Website, 2007).

U.S. Army Corps of Engineers Dam Safety Program

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

Federal Energy Regulatory Commission Dam Safety Program

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

Potential dam safety problems

Complaints about constructing and operating a project

Safety concerns related to natural disasters

Issues concerning compliance with the terms and conditions of a license.

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

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

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

9.2 HAZARD PROFILE

9.2.1 Past Events

According to the California State Hazard Mitigation Plan, there have been nine dam failures in the state since 1950, none of them in Siskiyou County. Overtopping caused two of the failures, and the others were caused by seepage or leaks. One failure, the 1963 Baldwin Hills Dam Failure, resulted in three deaths because the leak turned into a washout. The historical record indicates that California has had about 45 failures of non-federal dams. The failures occurred for a variety of reasons, the most common being overtopping. Other reasons include shortcomings in the dams or an inadequate assessment of surrounding geomorphologic characteristics.

California’s first notable dam failure was in 1883 in Sierra County, and the most recent failure was in 1965. The most catastrophic event was the failure of William Mulholland’s St. Francis Dam, which failed in 1928 and killed an estimated 450 people. San Francisquito Canyon, which was flooded in the event, was home to hundreds of transients who were not accounted for in the death estimate.

9.2.2 Location

According to California Department of Water Resources Dam Safety Program, there are 22 dams in Siskiyou County, as listed in Table 9-1. Two are operated by federal agencies, and the remainder are under the jurisdiction of the state.

**TABLE 9-6.
DAMS IN SISKIYOU COUNTY**

Name	National ID #	Water Course	Owner	Year Built	Dam Type	Crest Length (feet)	Height (feet)	Storage Capacity (acre-feet)	Drainage area (sq. mi.)
Barton	CA00928	White Slough	Madison Valley Investment Partners	1964	Earth	570	13	160	52
Bass Lake	CA00498	Lit Shasta R trib.	California Department of Fish & Game	1949	ERTH	1110	18	223	108
Box Canyon	CA00889	Sacramento River	Siskiyou County	1969	GRAV	1000	204	26,000	430
Campbell Lake	CA00495	Shackleford Creek	J & J Menke	1929	ERRK	65	19	350	35
Cloak Lake	CA00927	Lit Shasta R trib.	Madison Valley Investment Partners	1955	ERTH	432	13	123	25
Copco #1	CA00323	Klamath River	PacifiCorp	1922	GRAV	415	132	77,000	1000
Copco #2	CA00324	Klamath River	PacifiCorp	1925	GRAV	148	37	55	5
Dwight Hammond	CA00929	Lit Shasta R trib.	Hammond Lake Irrigation Assoc.	1959	ERTH	720	25	348	58
East Boulder	CA82442	E. Boulder Cr	Forest Service	1937	GRAV	63	7	200	0.8
Fiock#2	CA00502	Lit Shasta R trib.	Robert J. Cena	1946	ERTH	890	14	318	40
George Fiock #1	CA00501	Lit Shasta R trib.	The Kuck Brothers	1954	ERTH	725	19	223	38
Greenhorn	CA00826	Greenhorn Creek	City of Yreka	1960	ERTH	1300	28	251	25
Iron Gate	CA00325	Klamath River	PacifiCorp	1962	ERRK	745	188	58,000	1,000
Juanita Lake	CA00040	Musgrave Creek trib.	California Department of Fish & Game	1964	ERTH	907	20	348	55
Kangaroo Lake	CA10217	Rail Creek	Forest Service	1876	ROCK	69	12	168	--
Montague #2	CA01135	Oregon Slough trib.	City of Montague	1978	ERTH	1250	41	160	14
Ray Soule Reservoir	CA00496	Lit Shasta R trib.	Skip Soule	1953	ERTH	1100	10	132	13
Shasta River	CA00244	Shasta River	Montague Water Con District	1928	HYDF	1247	29	50,000	1850
Shelley	CA00926	Webb Gulch	Dr. I. Jack Cowley	1952	ERTH	1700	14	364	27
Steamboat Lake	CA00499	Lit Shasta R trib.	California Department of Fish & Game	1968	ERTH	655	12	2700	304
Suzanne Lake	CA00930	Lit Shasta R trib.	M&M Mariani	1962	ERTH	1966	12	89	17
Trout Lake	CA00500	Lit Shasta R trib.	California Department of Fish & Game	1960	ERTH	650	12	2108	176

9.2.3 Frequency

Dams are constructed with safety features known as “spillways.” Spillways are put in place on dams as a safety measure in the event of the reservoir filling too quickly. Spillway overflow events, often referred to as “design failures,” result in increased flooding potential downstream. The “residual risk” associated with dams is the risk beyond that for which safeguards have been implemented. However, the probability of any type of dam failure is low in today’s regulatory and dam safety oversight environment. Dam failure events usually coincide with events such as earthquakes, landslides and excessive rainfall and snowmelt.

9.2.4 Severity

Dam failure can be catastrophic to all life and property downstream. The U.S. Army Corps of Engineers developed the classification system shown in Table 9-2 for the hazard potential of dam failures. The Corps of Engineers hazard rating system is based only on the potential consequences of a dam failure; it does not take into account the probability of such failures.

TABLE 9-7.
CORPS OF ENGINEERS HAZARD POTENTIAL CLASSIFICATION

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

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

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

9.2.5 Warning Time

Warning time for dam failure depends on the cause of failure. In event of extreme precipitation or massive snowmelt, evacuations can be planned with sufficient time. In the event of a structural failure due to earthquake, there may be no warning time. A dam’s structural type also affects warning time. Earthen dams do not tend to fail instantaneously. Once a breach is initiated, discharging water erodes the breach until the reservoir water is depleted or the breach resists further erosion. Concrete gravity dams also tend to have a partial breach. The time of breach formation ranges from a few minutes to a few hours (U.S. Army Corps of Engineers, 1997). Several planning partners have established protocols for warning and response to imminent dam failure in the flood warning portion of their emergency operations plans. These protocols are tied to the emergency action plans (EAPs) created by the dam owners.

9.3 SECONDARY HAZARDS

Dam failure can cause severe downstream flooding, depending on the magnitude of the failure. Other potential secondary hazards of dam failure are landslides around the reservoir perimeter, bank erosion on the rivers, and destruction of downstream habitat.

9.4 CLIMATE CHANGE IMPACTS

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

Dams are constructed with safety features known as "spillways." Spillway overflow events, often referred to as "design failures," result in increased discharges downstream and increased flooding potential. Although climate change will not increase the probability of catastrophic dam failure, it may increase the probability of design failures.

9.5 EXPOSURE

The Level 2 HAZUS-MH protocol was used to assess the risk and vulnerability to dam failure in the planning area. The model used census data at the block level and dam failure inundation data to estimate potential dam failure impacts. The inundation areas evaluated are for the Iron Gate and JC Boyle Dams on the Klamath River and the Box Canyon Dam on the Sacramento River. These are the only high-risk dams for which flood inundation mapping is available. The JC Boyle Dam is not in Siskiyou County, but it is on the Klamath River in Oregon just upstream of the state border, and its failure would cause inundation within the county. Maps 9-1, 9-2 and 9-3 show the inundation zones for the three dams. Dam failure exposure numbers were generated using Siskiyou County Assessor and parcel data. County assessor data does not include tax exempt structures, such as federal and local government buildings. Where possible, the HAZUS-MH default data was enhanced using local GIS data from county, state and federal sources. All data sources have a level of accuracy acceptable for planning purposes.

9.5.1 Population

The entire population in a dam failure inundation zone is exposed to the risk of a dam failure. The estimated population living in the inundation areas mapped for this risk assessment is 2,045, 4.5 percent of the County's population. Table 9-3 summarizes the at-risk population in the planning area by city.

9.5.2 Property

The HAZUS-MH model estimated that there are 1,024 structures within the mapped dam failure inundation areas in the planning area. Table 9-4 summarizes the estimated value of exposed buildings. The evaluation estimated $122 million worth of building-and-contents exposure to dam failure inundation, representing 2.7 percent of the total assessed value of the planning area.

9.5.3 Critical Facilities

GIS analysis determined that 57 of the planning area's critical facilities (8 percent) are in the mapped inundation areas, as summarized in Table 9-5 and Table 9-6.

**TABLE 9-8.
POPULATION AT RISK FROM DAM FAILURE**

	Affected Population	% of City Population
Dorris	0	0
Dunsmuir	345	21
Etna	0	0
Fort Jones	0	0
Montague	0	0
Mt. Shasta	0	0
Tulelake	0	0
Weed	0	0
Yreka	0	0
Unincorporated	1,700	7
Total[a]	2,045	4.5

a. Represents the total population in the combined inundation areas all dams for all

**TABLE 9-9.
VALUE OF PROPERTY EXPOSED TO DAM FAILURE**

	Number of Buildings Exposed	Value Exposed			% of Total Assessed Value
		Building	Contents	Total	
Dorris	0	0	0	0	0
Dunsmuir	187	$16,066,755	$12,658,921	$28,725,676	21%
Etna	0	0	0	0	0
Fort Jones	0	0	0	0	0
Montague	0	0	0	0	0
Mt. Shasta	0	0	0	0	0
Tulelake	0	0	0	0	0
Weed	0	0	0	0	0
Yreka	0	0	0	0	0
Unincorporated	837	$53,172,611	$40,196,229	$93,368,840	3.50%
Total	**1,024**	**$69,239,366**	**52,855,150**	**$122,094,516**	**2.70%**

**TABLE 9-10.
CRITICAL FACILITIES IN DAM FAILURE INUNDATION AREAS**

	Medical & Health Services	Government Function	Protective Function	Schools	Hazardous Materials	Other Critical Function	**Total**
Dorris	0	0	0	0	0	0	0
Dunsmuir	0	0	0	0	0	1	1
Etna	0	0	0	0	0	0	0
Fort Jones	0	0	0	0	0	0	0
Montague	0	0	0	0	0	0	0
Mt. Shasta	0	0	0	0	0	0	0
Tulelake	0	0	0	0	0	0	0
Weed	0	0	0	0	0	0	0
Yreka	0	0	0	0	0	0	0
Unincorporated	3	5	4	3	0	0	15
Total	**3**	**5**	**4**	**3**	**0**	**1**	**16**

**TABLE 9-11.
CRITICAL INFRASTRUCTURE IN DAM FAILURE INUNDATION AREAS**

	Bridges	Water Supply	Wastewater	Power	Communications	Other Infrastructure	**Total**
Dorris	0	0	0	0	0	0	0
Dunsmuir	4	0	0	0	0	0	4
Etna	0	0	0	0	0	0	0
Fort Jones	0	0	0	0	0	0	0
Montague	0	0	0	0	0	0	0
Mt. Shasta	0	0	0	0	0	0	0
Tulelake	0	0	0	0	0	0	0
Weed	0	0	0	0	0	0	0
Yreka	0	0	0	0	0	0	0
Unincorporated	35	1	1	0	0	0	37
Total	**39**	**1**	**1**	**0**	**0**	**0**	**41**

9.5.4 Environment

The environment would be exposed to a number of risks in the event of dam failure. The inundation could introduce many foreign elements into local waterways. This could destroy downstream habitat and have detrimental effects on many species of animals, especially endangered species such as salmon.

9.6 VULNERABILITY

9.6.1 Population

Vulnerable populations are all populations downstream from dam failures that are incapable of escaping the area within the allowable time frame. This population includes the elderly and young who may be unable to get themselves out of the inundation area. The vulnerable population also includes those who would not have adequate warning from a television or radio emergency warning system. The potential for loss of life is affected by the capacity and number of evacuation routes available to populations living in areas of potential inundation.

9.6.2 Property

Vulnerable properties are those closest to the dam inundation area. These properties would experience the largest, most destructive surge of water. Low-lying areas are also vulnerable since they are where the dam waters would collect. Transportation routes are vulnerable to dam inundation and have the potential to be wiped out, creating isolation issues. This includes all roads, railroads and bridges in the path of the dam inundation. Those that are most vulnerable are those that are already in poor condition and would not be able to withstand a large water surge. Utilities such as overhead power lines, cable and phone lines could also be vulnerable. Loss of these utilities could create additional isolation issues for the inundation areas.

It is estimated that there could be up to $22 million of loss from a dam failure affecting the planning area. This represents 18 percent of the total exposure within the inundation area, or 0.5 percent of the total assessed value of the planning area. Table 9-7 summarizes the loss estimates for dam failure.

TABLE 9-12.
LOSS ESTIMATES FOR DAM FAILURE

City	Building Loss	Contents Loss	**Total Loss**	% of Total Assessed Value
Dorris	0	0	**0**	0
Dunsmuir	$3,576,048	$2,280,691	**$5,856,739**	4.19%
Etna	0	0	**0**	0
Fort Jones	0	0	**0**	0
Montague	0	0	**0**	0
Mt. Shasta	0	0	**0**	0
Tulelake	0	0	**0**	0
Weed	0	0	**0**	0
Yreka	0	0	**0**	0
Unincorporated	$9,343,000	$6,957,000	**$16,300,000**	0.62%
Total	**$12,919,048**	**$9,237,691**	**$22,156,739**	0.50%

9.6.3 Critical Facilities

On average, critical facilities would receive 15.6 percent damage to the structure and 42.3 percent damage to the contents during a dam failure event. The estimated time to restore these facilities to 100 percent of their functionality is 650 days.

9.6.4 Environment

The environment would be vulnerable to a number of risks in the event of dam failure. The inundation could introduce foreign elements into local waterways, resulting in destruction of downstream habitat and detrimental effects on many species of animals, especially endangered species. The extent of the vulnerability of the environment is the same as the exposure of the environment.

9.7 FUTURE TRENDS IN DEVELOPMENT

Land use in the planning area will be directed by general plans adopted under California's General Planning Law. The safety elements of the general plans establish standards and plans for the protection of the community from hazards. Dam failure is currently not addressed as a standalone hazard in the safety elements, but flooding is. The municipal planning partners have established comprehensive policies regarding sound land use in identified flood hazard areas. Most of the areas vulnerable to the more severe impacts from dam failure intersect the mapped flood hazard areas. Flood-related policies in the general plans will help to reduce the risk associated with the dam failure hazard for all future development in the planning area.

9.8 SCENARIO

An earthquake in the region could lead to liquefaction of soils around a dam. This could occur without warning during any time of the day. A human-caused failure such as a terrorist attack also could trigger a catastrophic failure of a dam that impacts the planning area. While the probability of dam failure is very low, the probability of flooding associated with changes to dam operational parameters in response to climate change is higher. Dam designs and operations are developed based on hydrographs with historical record. If these hydrographs experience significant changes over time due to the impacts of climate change, the design and operations may no longer be valid for the changed condition. This could have significant impacts on dams that provide flood control. Specified release rates and impound thresholds may have to be changed. This would result in increased discharges downstream of these facilities, thus increasing the probability and severity of flooding.

9.9 ISSUES

The most significant issue associated with dam failure involves the properties and populations in the inundation zones. Flooding as a result of a dam failure would significantly impact these areas. There is often limited warning time for dam failure. These events are frequently associated with other natural hazard events such as earthquakes, landslides or severe weather, which limits their predictability and compounds the hazard. Important issues associated with dam failure hazards include the following:

- Federally regulated dams have an adequate level of oversight and sophistication in the development of emergency action plans for public notification in the unlikely event of failure. However, the protocol for notification of downstream citizens of imminent failure is performed by the county's emergency plan and the use of Code RED.
- Mapping for federally regulated dams is already required and available; however, mapping for non-federal-regulated dams that estimates inundation depths is needed to better assess the risk associated with dam failure from these facilities.
- Most dam failure mapping required at federal levels requires determination of the probable maximum flood. While the probable maximum flood represents a worst-case scenario, it is generally the event with the lowest probability of occurrence. For non-federal-regulated dams, mapping of dam failure scenarios that are less extreme than the probable maximum flood but have a higher probability of occurrence can be valuable to emergency managers and

community officials downstream of these facilities. This type of mapping can illustrate areas potentially impacted by more frequent events to support emergency response and preparedness.

The concept of residual risk associated with structural flood control projects should be considered in the design of capital projects and the application of land use regulations.

Addressing security concerns and the need to inform the public of the risk associated with dam failure is a challenge for public officials.

The inundation maps are located in each of the Dam’s EAP and can be viewed at any time.

CHAPTER 10.
DROUGHT

10.1 GENERAL BACKGROUND

DEFINITIONS

Drought—The cumulative impacts of several dry years on water users. It can include deficiencies in surface and subsurface water supplies and generally impacts health, well-being, and quality of life.

Hydrological Drought—Deficiencies in surface and subsurface water supplies.

Socioeconomic Drought—Drought impacts health, well-being and quality of life.

Drought is a prolonged period of dryness severe enough to reduce soil moisture, water and snow levels below the minimum necessary for sustaining plant, animal and economic systems. Droughts are a natural part of the climate cycle.

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

Agricultural—Drought threatens crops that rely on natural precipitation.

Water supply—Drought threatens supplies of water for irrigated crops and for communities.

Fire hazard—Drought increases the threat of wildfires from dry conditions.

10.1.1 Drought in California

Most of California's precipitation comes from storms moving across the Pacific Ocean. The path followed by the storms is determined by the position of an atmospheric high pressure belt that normally shifts southward during the winter, allowing low pressure systems to move into the state. On average, 75 percent of California's annual precipitation occurs between November and March, with 50 percent occurring between December and February. If a persistent Pacific high pressure zone takes hold over California mid-winter, there is a tendency for the water year to be dry.

A typical water year produces about 100 inches of rainfall over the North Coast, 50 inches of precipitation (combination of rain and snow) over the Northern Sierra, 18 inches in the Sacramento area, and 15 inches in the Los Angeles area. In extremely dry years, these annual totals can fall to as little as one half, or even one third of these amounts.

Defining when drought begins is a function of the impacts of drought on water users, and includes consideration of the supplies available to local water users as well as the stored water they may have available in surface reservoirs or groundwater basins. Different local water agencies have different criteria for defining drought conditions in their jurisdictions. Some agencies issue drought watch or drought warning announcements to their customers. Determinations of regional or statewide drought conditions are usually based on a combination of hydrologic and water supply factors.

10.2 HAZARD PROFILE

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

10.2.1 Past Events

The California Department of Water Resources has state hydrologic data back to the early 1900s (watersupplyconditions.water.ca.gov or www.water.ca.gov/drought/). The hydrologic data show multi-year droughts from 1912 to 1913, 1918 to 1920 and 1922 to 1924. Since then, three prolonged periods of drought occurred in California, all of which impacted Siskiyou County to some degree:

1929 to 1934 Drought—The 1929 to 1934 drought established the criteria for designing many large Northern California reservoirs. The Sacramento Valley runoff was 55 percent of average for the time period from 1901 to 1996, with only 9.8 million acre-feet received.

1975 to 1977 Drought—California had one of its most severe droughts due to lack of rainfall during the winters of 1976 and 1977. 1977 was the driest period on record in California, with the previous winter recorded as the fourth driest in California's hydrological history. The cumulative impact led to widespread water shortages and severe water conservation measures throughout the state. A federal disaster declaration was declared for some counties, but not for Siskiyou County.

1987-1992 Drought—California received precipitation well below average levels for four consecutive years. While the Central Coast was most affected, the Sierra Nevadas in Northern California and the Central Valley counties were also affected. In 1991, Siskiyou County declared a local drought emergency. By February 1991, all 58 counties in California were suffering from drought conditions, and urban areas as well as rural and agricultural areas were impacted.

2001 Drought—According the California Hazard Mitigation Plan, Siskiyou County was again impacted by drought conditions in 2001, following several consecutive dry years.

2013-2014 Drought – The County had a drought declaration and passed a Resolution for proclaiming a local emergency due to drought conditions and imminent threat to the county. The City of Montague was in extreme peril of possibly losing their water source for the city. They also had a proclaimed emergency for the event.

2018 Drought – The County had to proclaim a local emergency for drought due to dry conditions and lack of precipitation could present problems for drinking and water supplies in the cities and towns as well as the unincorporated areas, and low-income communities heavily dependent on agriculture employment may suffer heightened unemployment and economic hardship. The County found it appropriate response is beyond the capability of the county.

10.2.2 Location

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

The ***Palmer Crop Moisture Index*** measures short-term drought on a weekly scale and is used to quantify drought's impacts on agriculture during the growing season.

The ***Palmer Z Index*** measures short-term drought on a monthly scale. Figure 10-1 shows this index for March 2011.

The ***Palmer Drought Index (PDI)*** measures the duration and intensity of long-term drought-inducing circulation patterns. The intensity of drought during a given month is dependent on current weather patterns plus the cumulative patterns of previous months. The PDI can respond rapidly to changes in weather patterns. Figure 10-2 shows this index for March 2011.

The ***Palmer Hydrological Drought Index (PHDI)*** measures the short and long term drought indicator blend percentiles 25% palmer hydrologic index 20% 24 Month Precipitation 20% 12 Month up to August 11th 2018

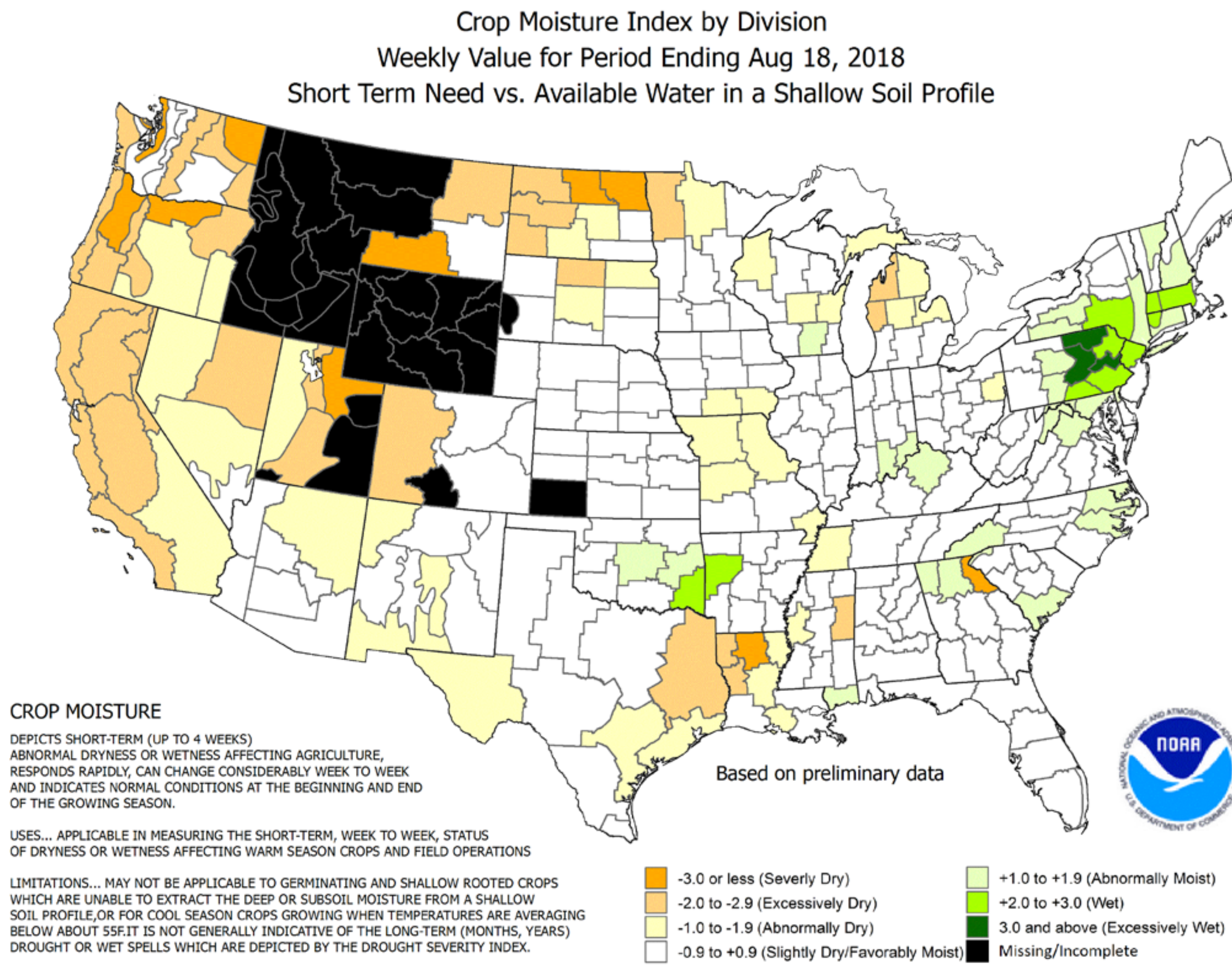


Figure 10-9. Palmer Z Index Short-Term Drought Conditions (August 2018)

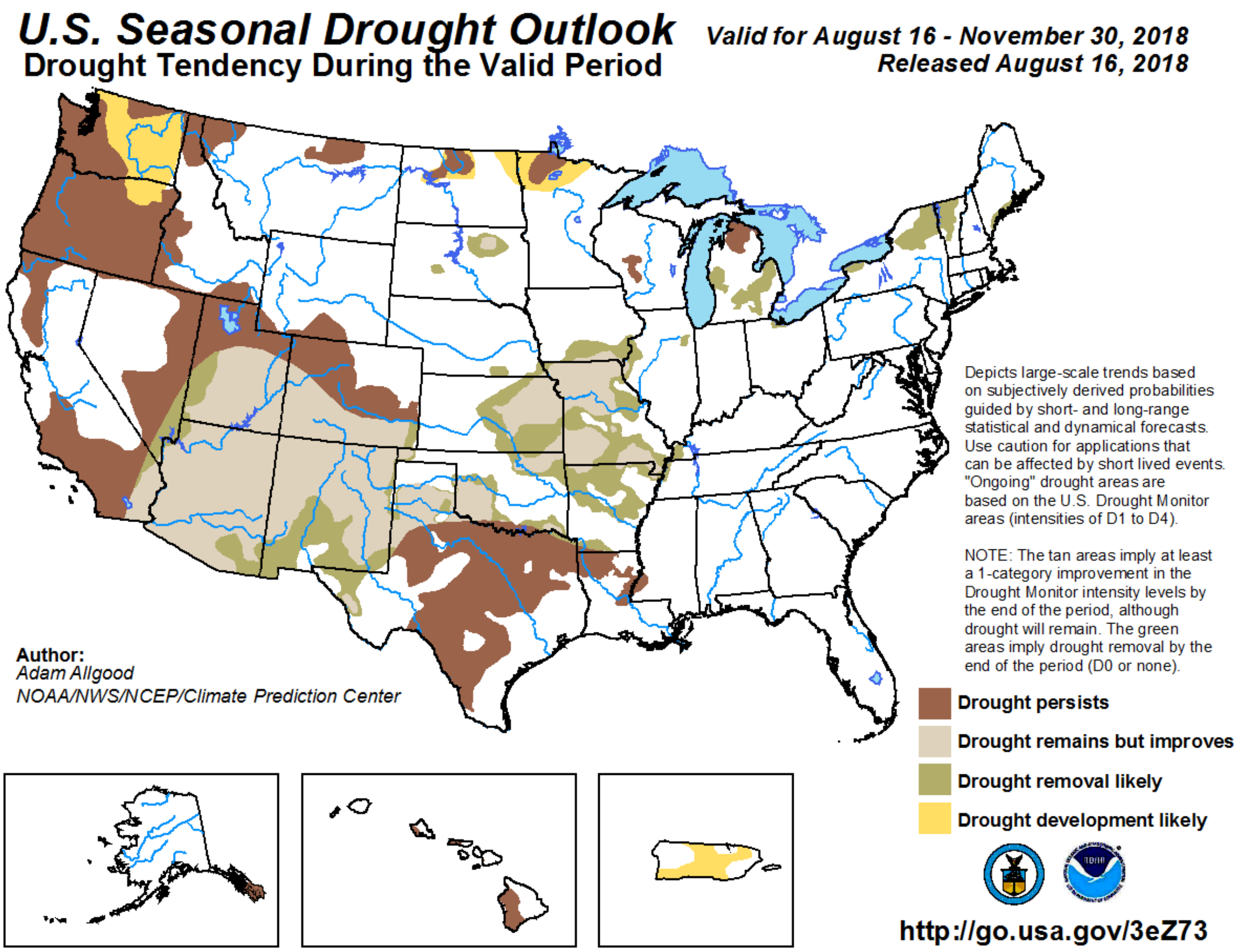
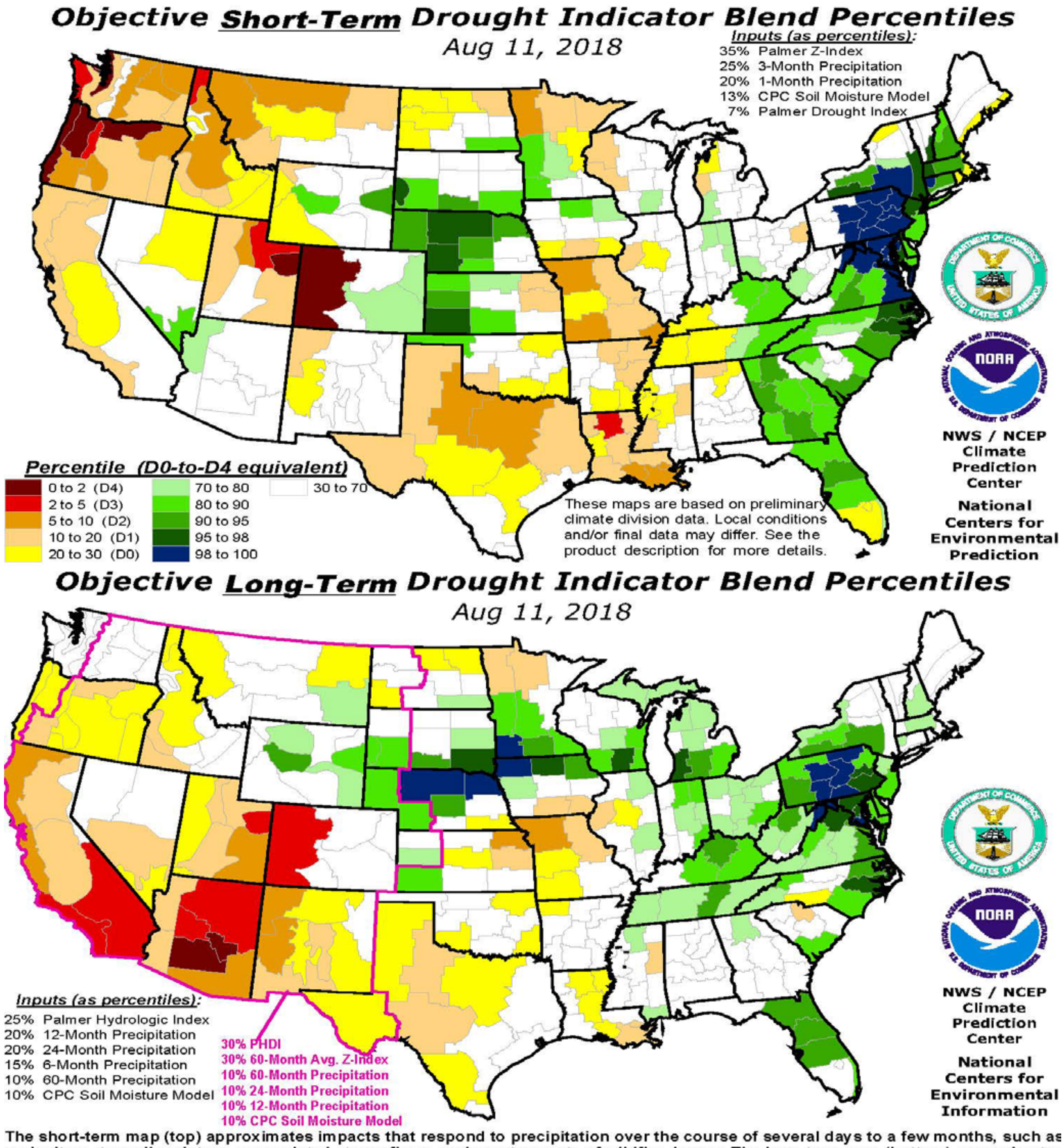


Figure 10-10. Palmer Drought Index Long-Term Drought Conditions (August 2018)



The short-term map (top) approximates impacts that respond to precipitation over the course of several days to a few months, such as agriculture, topsoil moisture, unregulated streamflows, and most aspects of wildfire danger. The long-term map (bottom) approximates impacts that respond to precipitation over the course of several months to a few years, such as reservoir content, groundwater depth, and lake levels. HOWEVER, the relationship between indicators and impacts can vary significantly with location and season. THIS IS PARTICULARLY TRUE OF WATER SUPPLIES, which are additionally affected by source, and management practices.

Figure 10-11. Short and Long term Drought Indicator Blend Percentiles 24 month. August 11th 2018

10.2.3 Frequency

Historical drought data for the Siskiyou County region indicate there have been two significant droughts in the last 20 years. This equates to a drought every 10 years on average, or a 10-percent chance of a drought in any given year.

10.2.4 Severity

The severity of a drought depends on the degree of moisture deficiency, the duration, and the size and location of the affected area. The longer the duration of the drought and the larger the area impacted, the more severe the potential impacts. Droughts are not usually associated with direct impacts on people or property, but they can have significant impacts on agriculture, which can impact people indirectly. When measuring the severity of droughts, analysts typically look at economic impacts on a planning area.

Unlike most disasters, droughts normally occur slowly but last a long time. On average, the nationwide annual impacts of drought are greater than the impacts of any other natural hazard. They are estimated to be between $6 billion and $8 billion annually in the United States and occur primarily in the agriculture, transportation, recreation and tourism, forestry, and energy sectors. Social and environmental impacts are also significant, although it is difficult to put a precise cost on these impacts.

Drought affects groundwater sources, but generally not as quickly as surface water supplies, although groundwater supplies generally take longer to recover. Reduced precipitation during a drought means that groundwater supplies are not replenished at a normal rate. This can lead to a reduction in groundwater levels and problems such as reduced pumping capacity or wells going dry. Shallow wells are more susceptible than deep wells. Reduced replenishment of groundwater affects streams. Much of the flow in streams comes from groundwater, especially during the summer when there is less precipitation and after snowmelt ends. Reduced groundwater levels mean that even less water will enter streams when steam flows are lowest.

A drought impacts all people in affected areas. A drought can result in farmers not being able to plant crops or the failure of planted crops. This results in loss of work for farm workers and those in related food processing jobs. Other water-dependent industries are commonly forced to shut down all or a portion of their facilities, resulting in further layoffs. A drought can harm recreational companies that use water (e.g., swimming pools, water parks, and river rafting companies) as well as landscape and nursery businesses because people will not invest in new plants if water is not available to sustain them.

10.2.5 Warning Time

Droughts are climatic patterns that occur over long periods of time. Only generalized warning can take place due to the numerous variables that scientists have not pieced together well enough to make accurate and precise predictions.

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

Scientists at this time do not know how to predict drought more than a month in advance for most locations. Predicting drought depends on the ability to forecast precipitation and temperature. Anomalies of precipitation and temperature may last from several months to several decades. How long they last depends on interactions between the atmosphere and the oceans, soil moisture and land surface processes, topography, internal dynamics, and the accumulated influence of weather systems on the global scale.

10.3 SECONDARY HAZARDS

The secondary hazard most commonly associated with drought is wildfire. A prolonged lack of precipitation dries out vegetation, which becomes increasingly susceptible to ignition as the duration of the drought extends. Many areas of Siskiyou County are susceptible to drying out during drought and being at risk of wildfire (see Figure 10-5).

Figure 10-12. Dry Hills and Shrub Lands in Northern Siskiyou County

10.4 CLIMATE CHANGE IMPACTS

The long-term effects of climate change on regional water resources are unknown, but global water resources are already experiencing the following stresses without climate change:

- Growing populations
- Increased competition for available water
- Poor water quality
- Environmental claims
- Uncertain reserved water rights
- Groundwater overdraft
- Aging urban water infrastructure.

With a warmer climate, droughts could become more frequent, more severe, and longer-lasting. From 1987 to 1989, losses from drought in the U.S. totaled $39 billion (OTA, 1993). More frequent extreme events such as droughts could end up being more cause for concern than the long-term change in temperature and precipitation averages.

The best advice to water resource managers regarding climate change is to start addressing current stresses on water supplies and build flexibility and robustness into any system. Flexibility helps to ensure a quick response to changing conditions, and robustness helps people prepare for and survive the worst conditions. With this approach to planning, water system managers will be better able to adapt to the impacts of climate change.

10.5 EXPOSURE

All people, property and environments in the Siskiyou County planning area would be exposed to some degree to the impacts of moderate to extreme drought conditions.

10.6 VULNERABILITY

Drought produces a complex web of impacts that spans many sectors of the economy and reaches well beyond the area experiencing physical drought. This complexity exists because water is integral to the ability to produce goods and provide services. Drought can affect a wide range of economic, environmental and social activities. The vulnerability of an activity to the effects of drought usually depends on its water demand, how the demand is met, and what water supplies are available to meet the demand. California’s 2005 Water Plan indicates that water demand in the state will increase through 2030. Although the Department of Water Resources predicts a modest decrease in agricultural water use, the agency anticipates that urban water use will increase by 1.5 to 5.8 million acre-feet per year.

10.6.1 Population

The planning partnership has the ability to minimize any impacts on residents and water consumers in the county should several consecutive dry years occur. No significant life or health impacts are anticipated as a result of drought within the planning area.

10.6.2 Property

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

10.6.3 Critical Facilities

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

10.6.4 Environment

Environmental losses from drought are associated with damage to plants, animals, wildlife habitat, and air and water quality; forest and range fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Some of the effects are short-term and conditions quickly return to normal following the end of the drought. Other environmental effects linger for some time or may even become permanent. Wildlife habitat, for example, may be degraded through the loss of wetlands, lakes and vegetation. However, many species will eventually recover from this temporary aberration. The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity. Although environmental losses are difficult to quantify, growing public awareness and concern for environmental quality has forced public officials to focus greater attention and resources on these effects.

10.6.5 Economic Impact

Economic impact will be largely associated with industries that use water or depend on water for their business. For example, landscaping businesses were affected in the droughts of the past as the demand for service significantly declined because landscaping was not watered. Agricultural industries will be impacted if water usage is restricted for irrigation.

10.7 FUTURE TRENDS IN DEVELOPMENT

Each municipal planning partner in this effort has an established comprehensive plan that includes policies directing land use and dealing with issues of water supply and the protection of water resources. These plans provide the capability at the local municipal level to protect future development from the impacts of drought. All planning partners reviewed their general plans under the capability assessments performed for this effort. Deficiencies identified by these reviews can be identified as mitigation actions to increase the capability to deal with future trends in development.

The California Department of Water Resources is moving forward with aggressive water conservation programs to reduce the state's water demand and consumption. The goal is to reduce per capita water consumption by 20 percent by 2020. Conservation efforts include the following:

- Encouraging increased widespread implementation of cost-effective conservation programs by urban and agricultural water suppliers
- Helping water agencies develop water shortage contingency plans so they are prepared for future dry conditions or supply interruptions
- Implementing programs to conserve water in landscaping and helping irrigation districts, farmers, and managers of large urban landscapes stretch their available water by providing daily information on plant water needs.

10.8 SCENARIO

An extreme multiyear drought more intense than the 1976-1977 and 1987-1992 droughts could impact the region with little warning. Combinations of low precipitation and unusually high temperatures could occur over several consecutive years. Intensified by such conditions, extreme wildfires could break out throughout Siskiyou County, increasing the need for water. Surrounding communities, also in drought conditions, could increase their demand for water supplies relied upon by the planning partnership, causing social and political conflicts. If such conditions persisted for several years, the economy of Siskiyou County could experience setbacks, especially in water dependent industries.

10.9 ISSUES

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

- Identification and development of alternative water supplies, such as drought water banks
- Utilization of groundwater recharge techniques to stabilize the groundwater supply
- The probability of increased drought frequencies and durations due to climate change
- The promotion of active water conservation even during non-drought periods.

CHAPTER 11.
EARTHQUAKE

11.1 GENERAL BACKGROUND

11.1.1 How Earthquakes Happen

An earthquake is the vibration of the earth's surface following a release of energy in the earth's crust. This energy can be generated by a sudden dislocation of the crust or by a volcanic eruption. Most destructive quakes are caused by dislocations of the crust. The crust may first bend and then, when the stress exceeds the strength of the rocks, break and snap to a new position. In the process of breaking, vibrations called "seismic waves" are generated. These waves travel outward from the source of the earthquake at varying speeds.

California is seismically active because of movement of the North American Plate and the Pacific Plate. The movement of these tectonic plates creates stress that can be released as earthquakes.

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

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

Geologists classify faults by their relative hazards. Active faults, which represent the highest hazard, are those that have ruptured to the ground surface during the Holocene period (about the last 11,000 years). Potentially active faults are those that displaced layers of rock from the Quaternary period (the last 1,800,000 years). Determining if a fault is "active" or "potentially active" depends on geologic evidence, which may not be available for every fault. Although there are probably still some unrecognized active faults, nearly all the movement between the two plates, and therefore the majority of the seismic hazards, are on the well-known active faults. However, inactive faults, for which no displacements have been recorded, maintain the potential to reactivate or experience displacement along a branch sometime in the future. Earthquake activity throughout California could cause tectonic movement along currently inactive fault systems.

DEFINITIONS

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

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

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

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

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

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

11.1.2 Earthquake Classifications

Earthquakes are classified according to the amount of energy released as measured by magnitude or intensity scales. Currently the most commonly used scales are the moment magnitude (Mw) scale, and the modified Mercalli intensity scale. Estimates of moment magnitude roughly match the local magnitude scale (ML) commonly called the Richter scale. One advantage of the moment magnitude scale is that, unlike other magnitude scales, it does not saturate at the upper end. That is, there is no value beyond which all large earthquakes have about the same magnitude. For this reason, moment magnitude is now the most often used estimate of large earthquake magnitudes. Table 11-1 presents a classification of earthquakes according to their magnitude. Table 11-2 compares the moment magnitude scale to the modified Mercalli intensity scale.

11.1.3 Ground Motion

Earthquake hazard assessment is also based on expected ground motion. This involves determining the annual probability that certain ground motion accelerations will be exceeded, then summing the annual probabilities over the time period of interest. The most commonly mapped ground motion parameters are the horizontal and vertical peak ground accelerations (PGA) for a given soil or rock type. Instruments called accelerographs record levels of ground motion due to earthquakes at stations throughout a region. These readings are recorded by state and federal agencies that monitor and predict seismic activity.

Maps of PGA values form the basis of seismic zone maps that are included in building codes such as the International Building Code. Building codes that include seismic provisions specify the horizontal force due to lateral acceleration that a building should be able to withstand during an earthquake. PGA values are directly related to these lateral forces that could damage “short period structures” (e.g. single-family dwellings). Longer period response components determine the lateral forces that damage larger structures with longer natural periods (apartment buildings, factories, high-rises, bridges). Table 11-3 lists damage potential by PGA factors compared to the Mercalli scale.

11.1.4 Effect of Soil Types

The impact of an earthquake on structures and infrastructure is largely a function of ground shaking, distance from the source of the quake, and liquefaction, a secondary effect of an earthquake in which soils lose their shear strength and flow or behave as liquid, thereby damaging structures that derive their support from the soil. Liquefaction generally occurs in soft, unconsolidated sedimentary soils. A program called the National Earthquake Hazard Reduction Program (NEHRP) creates maps based on soil characteristics to help identify locations subject to liquefaction. Table 11-4 summarizes NEHRP soil classifications. NEHRP Soils B and C typically can sustain ground shaking without much effect, dependent on the earthquake magnitude. The areas that are commonly most affected by ground shaking have NEHRP Soils D, E and F. In general, these areas are also most susceptible to liquefaction.

11.2 HAZARD PROFILE

Earthquakes can last from a few seconds to over five minutes; they may also occur as a series of tremors over several days. The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Casualties generally result from falling objects and debris, because the shocks shake, damage or demolish buildings and other structures. Disruption of communications, electrical power supplies and gas, sewer and water lines should be expected. Earthquakes may trigger fires, dam failures, landslides or releases of hazardous material, compounding their disastrous effects. Small, local faults produce lower magnitude quakes, but ground shaking can be strong and damage can be significant in areas close to the fault. In contrast, large regional faults can generate earthquakes of great magnitudes but, because of their distance and depth, they may result in only moderate shaking in an area.

TABLE 11-13.
EARTHQUAKE MAGNITUDE CLASSES

Magnitude Class	Magnitude Range (M = magnitude)
Great	M > 8
Major	7 <= M < 7.9
Strong	6 <= M < 6.9
Moderate	5 <= M < 5.9
Light	4 <= M < 4.9
Minor	3 <= M < 3.9
Micro	M < 3

TABLE 11-14.
EARTHQUAKE MAGNITUDE AND INTENSITY

Magnitude (Mw)	Intensity (Modified Mercalli)	Description
1.0—3.0	I	I. Not felt except by a very few under especially favorable conditions
3.0—3.9	II—III	II. Felt only by a few persons at rest, especially on upper floors of buildings. III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it is an earthquake. Standing cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
4.0—4.9	IV—V	IV. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like a heavy truck striking building. Standing cars rocked noticeably.
5.0—5.9	VI—VII	VI. Felt by all; many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight. VII. Damage negligible in buildings of good design and construction; slight in well-built ordinary structures; considerable in poorly built or badly designed structures. Some chimneys broken.
6.0—6.9	VII—IX	VIII. Damage slight in specially designed structures; considerable damage in ordinary buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
7.0 and higher	VIII and higher	X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent. XI. Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly. XII. Damage total. Lines of sight and level are distorted. Objects thrown into the air.

TABLE 11-15.
MERCALLI SCALE AND PEAK GROUND ACCELERATION COMPARISON

Mercalli Scale	Potential Damage	Estimated PGA
I	None	0.017
II-III	None	0.017
IV	None	0.014-0.039
V	Very Light	0.039-0.092
VI	None to Slight; USGS-Light	0.02-0.05
	Unreinforced Masonry-Stair Step Cracks; Damage to Chimneys; Threshold of Damage	0.04-0.18
VII	Slight-Moderate; USGS-Moderate	0.05-0.10
	Unreinforced Masonry-Significant; Cracking of parapets	0.08-0.16
	Masonry may fail; Threshold of Structural Damage	0.10-0.34
VIII	Moderate-Extensive; USGS: Moderate-Heavy	0.10-0.20
	Unreinforced Masonry-Extensive Cracking; fall of parapets and gable ends	0.16-0.65
IX	Extensive-Complete; USGS-Heavy	0.20-0.50
	Structural collapse of some un-reinforced masonry buildings; walls out of plane. Damage to seismically designed structures	0.32-1.24
X	Complete ground failures; USGS- Very Heavy (X+); Structural collapse of most un-reinforced masonry buildings; notable damage to seismically designed structures; ground failure	0.50-1.00

TABLE 11-16.
NEHRP SOIL CLASSIFICATION SYSTEM

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

11.2.1 Past Events

Table 11-5 lists past seismic events that have impacted Siskiyou County.

TABLE 11-17.
HISTORICAL EARTHQUAKES IMPACTING THE PLANNING AREA

Year	Magnitude	Fault/Epicenter	Region Impacted
1828[a]	Unknown	Undetermined	Northern California
1906	7.8	San Francisco	California
1923	7.2	Off coast, Humboldt County, CA	Northern California and coast
1954	6.5	Eureka, CA	Northern California
1980	7.2	Off coast, Humboldt County, CA	Northern California and coast
1993	6.0	Klamath Falls, OR	Southern Oregon, Northern California (particularly Tulelake and Dorris)
1995	6.0	Off coast, Humboldt County, CA	Northern California and coast

a. According to research by Lawrence Buchner, a severe earthquake occurred in Siskiyou County in 1828, although its magnitude is unknown. According to “Old Man Ruffy,” a Karok Indian who died in 1930 at an age of about 110, “The ground went this way and that way. Mountains fell down. Trees fell down, and many big ponds of water (lakes) were formed high up in the mountains.” (Eschscholtzia, 1965).

11.2.2 Location

The impact of an earthquake is largely a function of the following components:

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

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

Shake Maps

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

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

A probabilistic seismic hazard map shows the hazard from earthquakes that geologists and seismologists agree could occur. The maps are expressed in terms of probability of exceeding a certain ground motion, such as the 10-percent probability of exceedance in 50 years. This level of ground shaking has been used for designing buildings in high seismic areas. Maps 11-1 and 11-2 show the estimated ground motion for the 100-year and 500-year probabilistic earthquakes in Siskiyou County.

Earthquake scenario maps describe the expected ground motions and effects of hypothetical large earthquakes for a region. Maps of these scenarios can be used to support all phases of emergency management. The only scenario map available for the Siskiyou County planning area was a Klamath Falls fault scenario. The event mapped was a 6.5-magnitude event with an epicenter 20 miles northeast of Dorris. Map 11-3 shows the potential damage from this event.

NEHRP Soil Maps

NEHRP soil types define the locations that will be significantly impacted by an earthquake. NEHRP Soils B and C typically can sustain low-magnitude ground shaking without much effect. The areas that are most commonly affected by ground shaking have NEHRP Soils D, E and F. Map 12-4 shows NEHRP soil classifications in the county.

Liquefaction Maps

Soil liquefaction maps are useful tools to assess potential damage from earthquakes. When the ground liquefies, sandy or silty materials saturated with water behave like a liquid, causing pipes to leak, roads and airport runways to buckle, and building foundations to be damaged. In general, areas with NEHRP Soils D, E and F are also susceptible to liquefaction. If there is a dry soil crust, excess water will sometimes come to the surface through cracks in the confining layer, bringing liquefied sand with it, creating sand boils. Currently, there are no liquefaction maps available for the Siskiyou County planning area. Creation of this type of data would provide a significant enhancement to the seismic risk assessment of the planning area. Once this data becomes available, the seismic risk assessment for the planning area should be updated.

11.2.3 Frequency

The Northern California Earthquake Data Center (NCEDC) identifies 10 seismic events with a magnitude of 5.0 or higher felt in Siskiyou County between 1984 and 1996 (see Table 11-6). None of these events caused significant damage in the County. This averages to almost 1 seismic event per year. The Northern California area, including Siskiyou County, is in a moderate-risk area, with a majority of the County having a 2-percent probability in a 50-year period of ground shaking from a seismic event exceeding 0.48 percent of gravity (see Figure 11-1).

TABLE 11-18. RECENT EARTHQUAKES MAGNITUDE 5.0 OR GREATER FELT WITHIN SISKIYOU COUNTY					
Date	Time	Latitude	Longitude	Depth (Miles)	Magnitude
1984/09/08	06:16:40.60	44.4480	-114.1530	10	5.38
1984/10/18	15:30:23.60	42.3750	-105.7200	33	5.69
1993/09/21	03:28:55.63	42.316	-122.0670	10.30	5.98
1993/09/21	05:45:38.30	42.2030	-122.1690	5.0	5.98
1993/09/21	06:14:46.76	42.2640	-122.0980	5.0	5.02
1993/12/04	22:15:21.75	42.2730	-122.0250	5.0	5.49
1994/02/03	09:05:03.80	42.7510	-110.9830	5.0	6.18
1994/02/04	02:42:12.10	42.7130	-111.0400	5.0	5.48
1994/06/07	13:30:04.10	44.5100	-114.0480	10.0	5.55
1996/05/03	04:04:22.00	47.7500	-121.8600	4.10	5.32

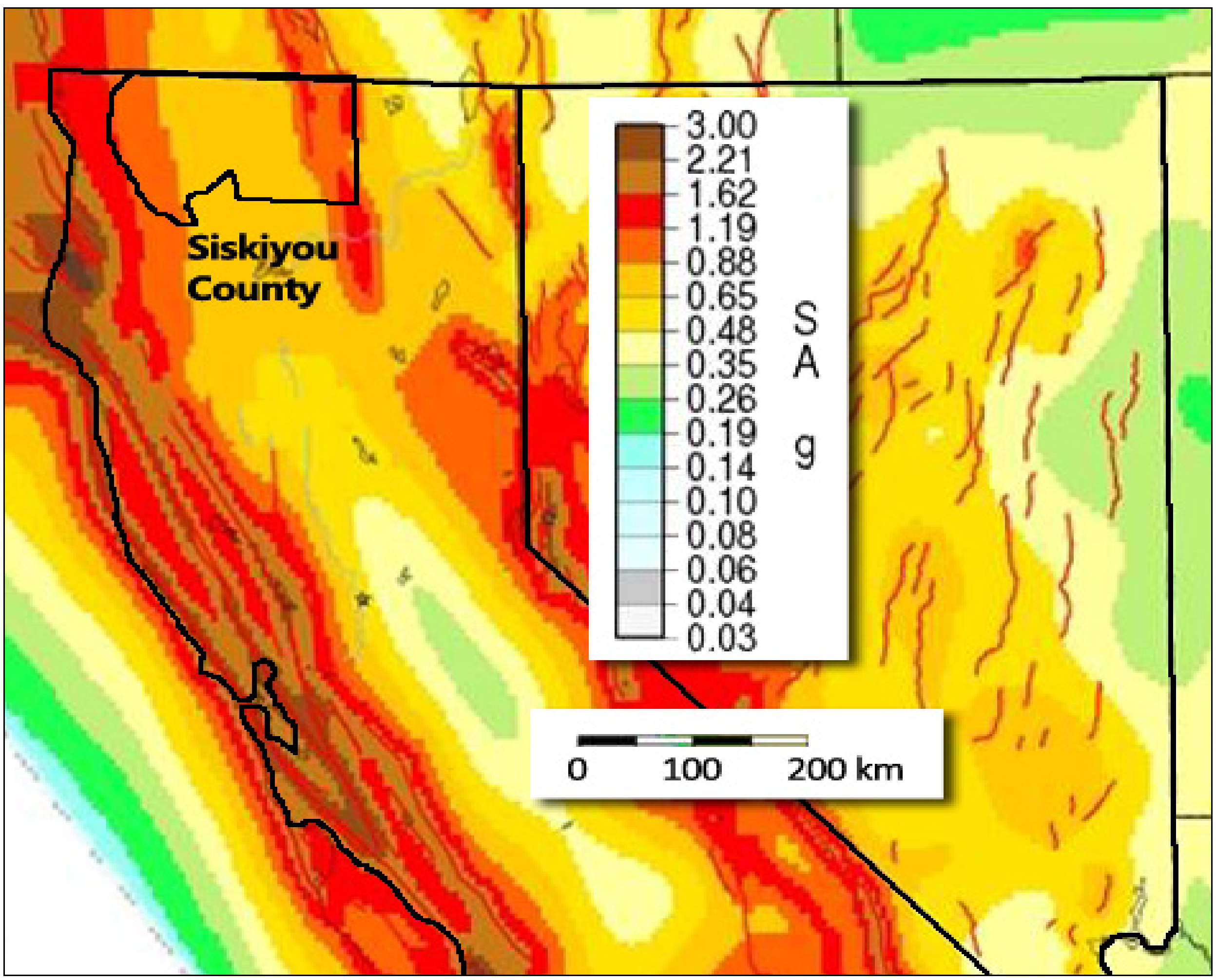


Figure 11-13. PGA with 2-Percent Probability of Exceedance in 50 Years

11.2.4 Severity

The severity of an earthquake can be expressed in terms of intensity or magnitude. Intensity represents the observed effects of ground shaking on people, buildings, and natural features. The USGS has created ground motion maps based on current information about several fault zones. These maps show the PGA that has a certain probability (2 percent or 10 percent) of being exceeded in a 50-year period. The PGA is measured in numbers of g's (the acceleration associated with gravity). Figure 11-1 shows the PGAs with a 2-percent exceedance chance in 50 years in northern California. The region around Siskiyou County is a low to moderate risk area.

Magnitude is related to the amount of seismic energy released at the hypocenter of an earthquake. It is determined by the amplitude of the earthquake waves recorded on instruments. Whereas intensity varies depending on location with respect to the earthquake epicenter, magnitude is represented by a single, instrumentally determined value for each earthquake event.

In simplistic terms, the severity of an earthquake event can be measured in the following terms:

How hard did the ground shake?

How did the ground move? (Horizontally or vertically)

How stable was the soil?

What is the fragility of the built environment in the area of impact?

11.2.5 Warning Time

There is currently no reliable way to predict the day or month that an earthquake will occur at any given location. Research is being done with warning systems that use the low energy waves that precede major earthquakes. These potential warning systems give approximately 40 seconds notice that a major earthquake is about to occur. The warning time is very short but it could allow for someone to get under a desk, step away from a hazardous material they are working with, or shut down a computer system.

11.3 SECONDARY HAZARDS

Earthquakes can cause large and sometimes disastrous landslides and mudslides. River valleys are vulnerable to slope failure, often as a result of loss of cohesion in clay-rich soils. Soil liquefaction occurs when water-saturated sands, silts or gravelly soils are shaken so violently that the individual grains lose contact with one another and float freely in the water, turning the ground into a pudding-like liquid. Building and road foundations lose load-bearing strength and may sink into what was previously solid ground. Unless properly secured, hazardous materials can be released, causing significant damage to the environment and people. Earthen dams and levees are highly susceptible to seismic events and the impacts of their eventual failures can be considered secondary risks for earthquakes.

11.4 CLIMATE CHANGE IMPACTS

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

Secondary impacts of earthquakes could be magnified by climate change. Soils saturated by repetitive storms could experience liquefaction during seismic activity due to the increased saturation. Dams storing increased volumes of water due to changes in the hydrograph could fail during seismic events. There are currently no models available to estimate these impacts.

11.5 EXPOSURE

11.5.1 Population

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

11.5.2 Property

The Siskiyou County Assessor estimates that there are 22,144 buildings in Siskiyou County, with a total assessed value of $4.4 billion (estimates do not include federal and local government buildings.) Since all structures in the planning area are susceptible to earthquake impacts to varying degrees, this total represents the countywide property exposure to seismic events. Most of the buildings (85 percent) are residential.

11.5.3 Critical Facilities and Infrastructure

All critical facilities in Siskiyou County are exposed to the earthquake hazard. Table 8-2 and Table 8-3 list the number of each type of facility by jurisdiction. Hazardous materials releases can occur during an earthquake from fixed facilities or transportation-related incidents. Transportation corridors can be disrupted during an earthquake, leading to the release of materials to the surrounding environment. Facilities holding hazardous materials are of particular concern because of possible isolation of neighborhoods surrounding them. During an earthquake, structures storing these materials could rupture and leak into the surrounding area or an adjacent waterway, having a disastrous effect on the environment.

11.5.4 Environment

Secondary hazards associated with earthquakes will likely have some of the most damaging effects on the environment. Earthquake-induced landslides can significantly impact surrounding habitat. It is also possible for streams to be rerouted after an earthquake. This can change the water quality, possibly damaging habitat and feeding areas. There is a possibility of streams fed by groundwater drying up because of changes in underlying geology.

11.6 VULNERABILITY

Earthquake vulnerability data was generated using a Level 2 HAZUS-MH analysis. Once the location and size of a hypothetical earthquake are identified, HAZUS-MH estimates the intensity of the ground shaking, the number of buildings damaged, the number of casualties, the damage to transportation systems and utilities, the number of people displaced from their homes, and the estimated cost of repair and clean up.

11.6.1 Population

Three population groups are particularly vulnerable to earthquake hazards:

Linguistically Isolated Populations—An estimated 1,650 residents in the planning area census blocks on NEHRP D and E soils do not speak English as their native language. This is about 11 percent of all residents in these census blocks. Problems arise when there is an urgent need to inform non-English speaking residents of an earthquake event. They are vulnerable because of difficulties in understanding hazard-related information from predominantly English-speaking media and An estimated agencies.

Population Below Poverty Level—Approximately 2,240 households in the planning area census blocks on NEHRP D and E soils are listed as being below the poverty level. This is about 35 percent of all households in these census blocks. These households may lack the financial resources to improve their homes to prevent or mitigate earthquake damage. Poorer residents are also less likely to have insurance to compensate for losses in earthquakes.

Population Over 65 Years Old— An estimated 1,230 residents in the planning area census blocks on NEHRP D and E soils are over 65 years old. This is about 8 percent of all residents in these census blocks. This population group is vulnerable because they are more likely to need special medical attention, which may not be available due to isolation caused by earthquakes. Elderly residents also have more difficulty leaving their homes during earthquake events and could be stranded in dangerous situations.

Impacts on persons and households in the planning area were estimated for the 100-year and 500-year earthquakes through the Level 2 HAZUS-MH analysis. Table 11-7 summarizes the results.

TABLE 11-19.
ESTIMATED EARTHQUAKE IMPACT ON PERSON AND HOUSEHOLDS

	Number of Displaced Households	Number of Persons Requiring Short-Term Shelter
100-Year Earthquake	1	1
500-Year Earthquake	23	16

11.6.2 Property

Property losses were estimated through the Level 2 HAZUS-MH analysis for the 100-year and 500-year earthquakes. Although the Klamath scenario shake map did not show sufficient damage potential to warrant modeling in HAZUS, this choice could be changed in the future should liquefaction maps become available for the planning area. The availability of this type of data would significantly enhance any HAZUS modeling. Table 11-8 shows the results for structural loss, representing damage to building structures, and non-structural loss, representing the value of lost contents and inventory, relocation, income loss, rental loss and wage loss. The total of the two types of losses is also shown in the tables. A summary of the property-related loss results is as follows:

For a 100-year probabilistic earthquake, the estimated damage potential is $6.9 million, or 0.16 percent of the total assessed value for the planning area.

For a 500-year probabilistic earthquake, the estimated damage potential is $73.8 million, or 1.68 percent of the total assessed value for the planning area.

TABLE 11-20. EARTHQUAKE BUILDING LOSS POTENTIAL—PROBABILISTIC						
	Estimated Earthquake Loss Value					
	100- Year Probabilistic Earthquake			500- Year Probabilistic Earthquake		
Jurisdiction	Structural	Non-Structural	**Total**	Structural	Non-Structural	**Total**
Yreka and vicinity	$745,307	$164,239	$909,546	$8,064,582	$2,466,300	$10,530,882
Dunsmuir, Weed, Mount Shasta area	$2,548,378	$641,343	$3,189,722	$22,493,749	$6,969,510	$29,463,259
West County including Etna & Fort Jones	$849,563	$186,507	$1,036,070	$7,919,399	$2,352,093	$10,271,491
East County including Dorris, Montague, Tulelake	$1,467,472	$337,700	$1,805,171	$18,179,102	$5,312,783	$23,491,885
Total	**$5,610,721**	**$1,329,78**	**$6,940,50**	**$56,656,831**	**$17,100,686**	**$73,757,517**

The HAZUS-MH analysis also estimated the amount of earthquake-caused debris in the planning area for the 100-year and 500-year earthquakes, as summarized in Table 11-9.

TABLE 11-21. ESTIMATED EARTHQUAKE-CAUSED DEBRIS	
	Debris to Be Removed (tons)
100-Year Earthquake	3,000
500-Year Earthquake	27,000

Building Age

The California State Building Code Council identifies significant milestones in building and seismic code requirements that directly affect the structural integrity of development in California. Using these time periods, the planning team used HAZUS to identify the number of structures within the County by date of construction. Table 11-10 shows the results of this analysis. The number of structures does not reflect the number of total housing units, as many multi-family units and attached housing units are reported as one structure. Figure 11-2 and Figure 11-3 show typical historic buildings within the planning area.

Soft-Story Buildings

A soft-story building is a multi-story building with one or more floors that are “soft” due to structural design. If a building has a floor that is 70-percent less stiff than the floor above it, it is considered a soft-story building. This soft story creates a major weak point in an earthquake. Since soft stories are typically associated with retail spaces and parking garages, they are often on the lower stories of a building. When they collapse, they can take the whole building down with them, causing serious structural damage that may render the structure totally unusable (see Figure 11-4).

TABLE 11-22.
AGE OF STRUCTURES IN SISKIYOU COUNTY

Time Period	Number of Current County Structures Built in Period	Significance of Time Frame
Pre-1940	3,240	Before 1933, there were no explicit earthquake requirements in building codes. State law did not require local governments to have building officials or issue building permits.
1940-1959	4,276	In 1940, the first strong motion recording was made.
1960-1979	6,544	In 1960, the Structural Engineers Association of California published guidelines on recommended earthquake provisions. In 1975, significant improvements were made to lateral force requirements.
1980-1999	5,532	In 1994, the Uniform Building Code was amended to include provisions for seismic safety.
2000-2010	2,552	Seismic code is currently enforced.
2010-2018	4770	Seismic code is currently enforced
Total	**26,914**	

Figure 11-14. The Creamery Building (1912) in Fort Jones

Figure 11-15. Historic Etna Museum (Original Town Hall)

Figure 11-16. Soft-Story Damage from Earthquake

These floors can be especially dangerous in earthquakes, because they cannot cope with the lateral forces caused by the swaying of the building during a quake. As a result, the soft story may fail, causing what is known as a soft story collapse. Soft-story collapse is one of the leading causes of earthquake damage to private residences. Exposure associated with soft story construction in the planning area is not currently known. This type of data will need to be generated to support future risk assessments of the earthquake hazard.

11.6.3 Critical Facilities and Infrastructure

Level of Damage

HAZUS-MH classifies the vulnerability of critical facilities to earthquake damage in five categories: no damage, slight damage, moderate damage, extensive damage, or complete damage. The model was used to assign a vulnerability category to each critical facility in the planning area except hazmat facilities and "other infrastructure" facilities, for which there are no established damage functions. Table 11-11 summarizes the results.

Time to Return to Functionality

HAZUS-MH estimates the time to restore critical facilities to fully functional use. Results are presented as probability of being functional at specified time increments: 1, 3, 7, 14, 30 and 90 days after the event. For example, HAZUS-MH may estimate that a facility has 5 percent chance of being fully functional at Day 3, and a 95-percent chance of being fully functional at Day 90. The analysis of critical facilities in the planning area was performed for the 100-year earthquake event. Table 11-12 summarizes the results.

TABLE 11-23.
CRITICAL FACILITY VULNERABILITY TO 100-YEAR EARTHQUAKE EVENT

Category	No Damage	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage
Medical and Health	10	54	0	0	0
Government Functions	0	70	0	0	0
Protective Functions	27	18	0	0	0
Schools	15	102	0	0	0
Other Critical Functions	36	10	0	0	0
Bridges	366	0	0	0	0
Water supply	14	0	0	0	0
Wastewater	1	0	0	0	0
Total	**469**	**254**	**0**	**0**	**0**

TABLE 11-24.
FUNCTIONALITY OF CRITICAL FACILITIES FOR 100-YEAR EVENT

Category	# of Critical Facilities	Probability of Being Fully Functional (%)					
		at Day 1	at Day 3	at Day 7	at Day 14	at Day 30	at Day 90
Medical and Health	64	40	42	94	96	99	100

TABLE 11-24.
FUNCTIONALITY OF CRITICAL FACILITIES FOR 100-YEAR EVENT

Category	# of Critical Facilities	Probability of Being Fully Functional (%) at Day 1	at Day 3	at Day 7	at Day 14	at Day 30	at Day 90
Government/Shelters	70	40	42	94	96	99	100
Protective Functions	45	41	42	95	96	99	100
Schools	117	41	43	95	96	99	100
Other Critical functions	46	99	100	100	100	100	100
Bridges	366	100	100	100	100	100	100
Water supply	14	98	99	100	100	100	100
Wastewater	1	98	99	100	100	100	100
Total/Average	**723**	**70**	**71**	**97**	**98**	**100**	**100**

11.6.4 Environment

The environment vulnerable to earthquake hazard is the same as the environment exposed to the hazard.

11.7 FUTURE TRENDS IN DEVELOPMENT

Land use in the planning area will be directed by general plans adopted under California's General Planning Law. The safety elements of the general plans establish standards and plans for the protection of the community from hazards including seismic hazards. The information in this plan provides the participating partners a tool to ensure that there is no increase in exposure in areas of high seismic risk. Development in the planning area will be regulated through building standards and performance measures so that the degree of risk will be reduced. The geologic hazard portions of the planning area are heavily regulated under California's General Planning Law. The International Building Code establishes provisions to address seismic risk.

11.8 SCENARIO

With faults limited to the eastern portions of Siskiyou County and into southern Oregon, the potential scenarios for damaging earthquake events are unlikely. However, an earthquake does not have to occur within Siskiyou County to have a significant impact on the people, property and economy of the county.

Any seismic activity of 6.0 or greater on known or unknown faults within the planning area would have significant impacts throughout the county. Potential warning systems could give approximately 40 seconds' notice that a major earthquake is about to occur. This would not provide adequate time for preparation. Earthquakes of this magnitude or higher would lead to massive structural failure of property on NEHRP C, D, E, and F soils. With close to 50 percent of the structures within the County constructed prior seismic safety provisions in the national building codes, the percentage of structures damaged would be high. Levees and revetments built on these poor soils would likely fail, representing a loss of critical infrastructure. These events could cause secondary hazards, including landslides and mudslides that would further damage structures. River valley hydraulic-fill sediment areas are also vulnerable to slope failure, often as a result of loss of cohesion in clay-rich soils. Soil liquefaction would occur in water-saturated sands, silts or gravelly soils.

11.9 ISSUES

Important issues associated with an earthquake include but are not limited to the following:

- More information is needed on the exposure and performance of soft-story construction within the planning area.
- Approximately 50 percent of the planning area's building stock was built prior to 1975, when seismic provisions became uniformly applied through building code applications.
- Based on the modeling of critical facility performance performed for this plan, a high number of facilities in the planning area are expected to have complete or extensive damage from scenario events. These facilities are prime targets for structural retrofits.
- Critical facility owner should be encouraged to create or enhance Continuity of Operations Plans using the information on risk and vulnerability contained in this plan.
- Geotechnical standards should be established that take into account the probable impacts from earthquakes in the design and construction of new or enhanced facilities.
- Any existing earthen levees and revetments are most likely located on soft, unstable soil. These soils are prone to liquefaction, which would severely undermine the integrity of these facilities.
- There are a large number of earthen dams within the planning area. Dam failure warning and evacuation plans and procedures should be reviewed and updated to reflect the dams' risk potential associated with earthquake activity in the region.
- Earthquakes could trigger other natural hazard events such as dam failures and landslides, which could severely impact the county.
- A worst-case scenario would be the occurrence of a large seismic event during a flood or high-water event. Levee failures could happen at multiple locations, exacerbating the impacts of the individual earthquake event.
- The availability of liquefaction maps would significantly enhance the HAZUS seismic model.

CHAPTER 12.

FLOOD

> **DEFINITIONS**
>
> **Flood**—The inundation of normally dry land resulting from the rising and overflowing of a body of water.
>
> **Floodplain**—The land area along the sides of a river that becomes inundated with water during a flood.
>
> **100-Year Floodplain**—The area flooded by a flood that has a 1-percent chance of being equaled or exceeded each year. This is a statistical average only; a 100-year flood can occur more than once in a short period of time. The 1-percent annual chance flood is the standard used by most federal and state agencies.
>
> **Return Period—**The average number of years between occurrences of a hazard (equal to the inverse of the annual likelihood of occurrence).
>
> **Riparian Zone—**The area along the banks of a natural watercourse.

12.1 GENERAL BACKGROUND

A floodplain is the area adjacent to a river, creek or lake that becomes inundated during a flood. Floodplains may be broad, as when a river crosses an extensive flat landscape, or narrow, as when a river is confined in a canyon.

When floodwaters recede after a flood event, they leave behind layers of rock and mud. These gradually build up to create a new floor of the floodplain. Floodplains generally contain unconsolidated sediments (accumulations of sand, gravel, loam, silt, and/or clay), often extending below the bed of the stream. These sediments provide a natural filtering system, with water percolating back into the ground and replenishing groundwater. These are often important aquifers, the water drawn from them being filtered compared to the water in the stream. Fertile, flat reclaimed floodplain lands are commonly used for agriculture, commerce and residential development.

Connections between a river and its floodplain are most apparent during and after major flood events. These areas form a complex physical and biological system that not only supports a variety of natural resources but also provides natural flood and erosion control. When a river is separated from its floodplain with levees and other flood control facilities, natural, built-in benefits can be lost, altered, or significantly reduced.

12.1.1 Measuring Floods and Floodplains

The frequency and severity of flooding are measured using a discharge probability, which is a statistical tool used to define the probability that a certain river discharge (flow) level will be equaled or exceeded within a given year. Flood studies use historical records to determine the probability of occurrence for the different discharge levels. The flood frequency equals 100 divided by the discharge probability. For example, the 100-year discharge has a 1-percent chance of being equaled or exceeded in any given year. The “annual flood” is the greatest flood event expected to occur in a typical year. These measurements reflect statistical averages only; it is possible for two or more floods with a 100-year or higher recurrence interval to occur in a short time period. The same flood can have different recurrence intervals at different points on a river.

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

12.2.2 Floodplain Ecosystems

Floodplains can support ecosystems that are rich in quantity and diversity of plant and animal species. A floodplain can contain 100 or even 1000 times as many species as a river. Wetting of the floodplain soil releases an immediate surge of nutrients: those left over from the last flood, and those that result from the rapid decomposition of organic matter that has accumulated since then. Microscopic organisms thrive and larger species enter a rapid breeding cycle. Opportunistic feeders (particularly birds) move in to take advantage. The production of nutrients peaks and falls away quickly; however the surge of new growth endures for some time. This makes floodplains particularly valuable for agriculture. Species growing in floodplains are markedly different from those that grow outside floodplains. For instance, riparian trees (trees that grow in floodplains) tend to be very tolerant of root disturbance and very quick-growing compared to non-riparian trees.

12.1.3 Effects of Human Activities

Because they border water bodies, floodplains have historically been popular sites to establish settlements. Human activities tend to concentrate in floodplains for a number of reasons: water is readily available; land is fertile and suitable for farming; transportation by water is easily accessible; and land is flatter and easier to develop. But human activity in floodplains frequently interferes with the natural function of floodplains. It can affect the distribution and timing of drainage, thereby increasing flood problems. Human development can create local flooding problems by altering or confining drainage channels. This increases flood potential in two ways: it reduces the stream’s capacity to contain flows, and it increases flow rates or velocities downstream during all stages of a flood event. Human activities can interface effectively with a floodplain as long as steps are taken to mitigate the activities’ adverse impacts on floodplain functions.

12.1.4 Federal Flood Programs

National Flood Insurance Program

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

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

New buildings and those undergoing substantial improvements must, at a minimum, be elevated to protect against damage by the 100-year flood.

New floodplain development must not aggravate existing flood problems or increase damage to other properties.

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

Siskiyou County entered the NFIP on May 17, 1982. Structures permitted or built in the County before then are called “pre-FIRM” structures, and structures built afterwards are called “post-FIRM.” The insurance rate is different for the two types of structures. The effective date for the current countywide FIRM is January 19, 2011. This map is a DFIRM (digital flood insurance rate map).

Six incorporated cities in Siskiyou County also participate in the NFIP. The county and cities are currently in good standing with the provisions of the NFIP. Compliance is monitored by FEMA regional staff and by the California Department of Water Resources under a contract with FEMA. Maintaining compliance under the NFIP is an important component of flood risk reduction. All planning partners that participate in the NFIP have identified initiatives to maintain their compliance and good standing.

The Community Rating System

The CRS is a voluntary program within the NFIP that encourages floodplain management activities that exceed the minimum NFIP requirements. Flood insurance premiums are discounted to reflect the reduced flood risk resulting from community actions meeting the following three goals of the CRS:

- Reduce flood losses.
- Facilitate accurate insurance rating.
- Promote awareness of flood insurance.

For participating communities, flood insurance premium rates are discounted in increments of 5 percent. For example, a Class 1 community would receive a 45 percent premium discount, and a Class 9 community would receive a 5 percent discount. (Class 10 communities are those that do not participate in the CRS; they receive no discount.) The CRS classes for local communities are based on 18 creditable activities in the following categories:

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

Figure 12-1 shows the nationwide number of CRS communities by class as of May 1, 2010, when there were 1,138 communities receiving flood insurance premium discounts under the CRS program.

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

There are no communities in Siskiyou County currently participating in the CRS program. However, many of the mitigation actions identified in Volume 2 of this plan are creditable activities under the CRS program. Therefore successful implementation of this plan offers the potential for the communities to join the program. Most of the flood-prone jurisdictions participating in this plan have included joining the CRS program as a potential mitigation action.

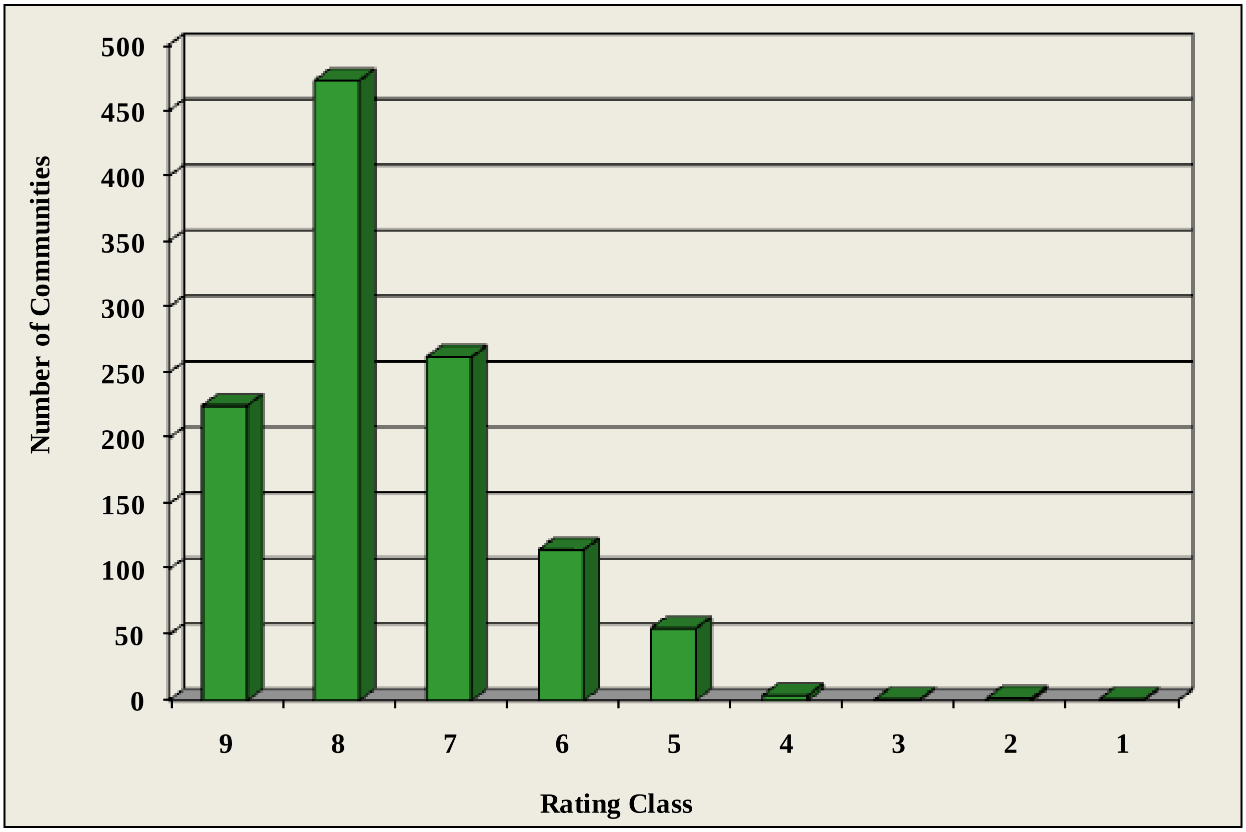


Figure 12-17. CRS Communities by Class Nationwide as of May 1, 2010

12.2 HAZARD PROFILE

Flooding in Siskiyou County is typically caused by high-intensity, short-duration (1 to 3 hours) storms concentrated on stream reaches often with already saturated soils. Two types of flooding are typical:

Flash floods that occur suddenly after a brief but intense downpour. They move rapidly, end suddenly, and can occur in areas not generally associated with flooding (such as subdivisions not adjacent to a water body and areas serviced by underground drainage systems). Although the duration of these events is usually brief, the damage they cause can be severe. Flash floods cannot be predicted accurately and happen whenever there are heavy storms.

Riverine floods described in terms of their extent (including the horizontal area affected and the vertical depth of floodwater) and the related probability of occurrence (expressed as the percentage chance that a flood of a specific extent will occur in any given year).

Siskiyou County is located almost entirely within the mountainous Siskiyou drainage area that courses through high-relief, deeply-cut river canyons with narrow floodplains. Tremendous amounts of water move through these river canyons, and flooding is predominantly confined within the traditional riverine valleys. Locally, some natural or manmade levees separate channels from floodplains and cause independent overland flow paths. Occasionally, railroad, highway or canal embankments form barriers, resulting in ponding or diversion of the flow. Some localized flooding not associated with stream overflow can occur where there are no drainage facilities to control flows or when runoff volumes exceed the design capacity of drainage facilities.

Rain-on-snow events also contribute to Siskiyou County's flood hazards. Rain-on-snow flooding develops when warm rains fall on previously accumulated snow on saturated ground, causing layers of snow to melt and run off in conjunction with the rain. Rain-on-snow induced floods typically occur in late winter or early spring and are generally widespread. Storm fronts with freezing levels above 7,000 feet cause heavy rainfall over large areas of the county. These flood-producing storms typically occur between October and March.

12.2.1 Past Events

Siskiyou County has a long history of flood events. Well-chronicled histories of flooding date to the settlement of the areas in and around the County. Newspaper archives from the Siskiyou Daily News and the Yreka Journal indicate flood events in the following years:

1852	1881	1948-49	1994
1861	1890	1955	1997
1862	1904	1961	2005
1864	1926	1964	2006
1867	1927	1970	2010
1875	1934	1974	2014
2015	2017		

In 1861 and 1961, the Klamath River in the Seiad Valley crested 37.5 feet above the low water mark. In February 1927, the Salmon River rose 45 feet at Somes Bar and the Klamath River rose 51 feet at the mouth of the Salmon River. The 1997 flood caused road failures on national forest lands, resulting in repairs costing over $40 million. The 1955 Christmas flood washed out over 30 bridges in Siskiyou County, and landslides and washouts blocked transportation access in many areas. Some residents were without power and road access for over a month.

Flood frequencies for most of these events cannot be determined, although the floods of 1861 and 1890 were probably the highest known for the period from 1861 to 1927. The flooding in 1964 was the most serious, causing considerable damage along the Klamath River, where bridges were washed out and structures in Happy Camp and the Seiad Valley were flooded.

One of the most recent events, in December 2005-January 2006, was categorized as a 15-year event. Heavy precipitation resulted in widespread soil saturation, causing heavy runoff into stream and creek channels. In most situations, the heavy inundation of water washed out roads, bridges and culverts, and damaged fence lines, eroded stream banks and impacted low-lying agricultural land. Highway 96, the main transportation access for western Siskiyou and northern Humboldt Counties was obstructed by heavy debris slides and water overflows. Access throughout the County was hindered as floodwaters breached swollen creek beds and culverts were unable to handle the flows.

Since 1964, eight presidential-declared flood events in the County have caused in excess of $25 million in property damage. Additional damages include agriculture crop damages. Table 12-1 summarizes flood events in the planning area since 1964. Area-specific flooding summaries are provided in the following sections.

Table 12-25.
Siskiyou County Flood Events

Date	Declaration #	Type of event	Estimated Damage[a]
01/02/2017	4301	Severe Winter Storms, Flooding, Debris and Mudflows	NA
02/01/2017	4308	Severe Winter Storms, Flooding, Debris and Mudflows	NA
10/12/2015	--	Severe Winter Storms, Flooding	NA
02/06/2015		Severe Storms, Flooding	NA
12/14/2014	1884	Severe Winter Storms, Flooding, Debris and Mudflows	NA
03/08/2010		Severe Winter Storms, Flooding, Debris and Mudflows	NA
02/03/2006	1628	Severe Storms, Flooding, Mudslides and Landslides	$7,000,000
1/4/1997	1155	Severe Storms, Flooding	$5,500,000
3/12/1995	1046	Severe Winter Storms, Flooding, Mudslides and Landslides	$11,241,379
2/3/1993	979	Severe Winter Storms, Flooding, Mudslides and	NA
12/11/1992	—	Flooding—Wind—Winter Weather	$1,315
2/16/1992	—	Flooding—Winter Weather	$9,090
1/25/1974	412	Severe Storms, Flooding	NA
1/16/1973	—	Flooding—Severe Storm/Thunder Storm	$86,206
1/12/1973	—	Flooding—Severe Storm/Thunder Storm	$35,714
2/16/1970	283	Severe Storms, Flooding	NA
12/24/1964	183	Heavy Rains, Flooding	$1,785,714

a. Data obtained from Spatial Hazard Events and Losses Database for the United States (SHELDUS)

NA = Information is not available

Dunsmuir Area

Dunsmuir has experienced the six largest floods on the upper Sacramento River since 1911. These occurred, in decreasing order of magnitude, in January 1974, February 1940, January 1914, December 1964, March 1916 and December 1955. Discharge from the 1974 event was estimated to have a recurrence interval of approximately 50 years. The 1964 event was estimated to have a recurrence interval of 15 years. Damage from the 1974 flood in Dunsmuir was estimated to be $4.2 million, with 25 homes destroyed. A bridge connecting downtown constricted flow from the Sacramento River, causing an increase in water surface elevation of approximately 3 feet upstream of the bridge. The backwater effect only extended a short distance upstream because of the steep channel slope. An unnamed creek that enters the City of Dunsmuir near Oak Street and Elinore Way has overflowed and caused widespread shallow flooding of city streets and street-level homes. Although this unnamed creek has a small drainage area, the floodwaters have high velocities due to the steep slopes, and flow paths are unpredictable due to the street pattern and topography.

McCloud Area

A significant flood occurred in the unincorporated area of McCloud between December 1996 and January 1997. Over 11 inches of precipitation fell on a deep snow pack, triggering flooding of Panther and Squaw Valley Creeks. Anecdotal evidence suggests that flooding was the worst to occur in the area in over 50 years. Panther Creek experienced flows heavily laden with sediment, but Squaw Valley Creek experienced relatively clear flows carrying considerable woody debris.

Etna Area

In the City of Etna, flooding has occurred along Etna Creek in 1955, 1964, and 1974. The largest flood occurred in December 1964, with a recurrence interval of 50 years. The January 1974 flood was estimated to have a recurrence interval of 30 years, based on flow records for the Scott River. The principal flood problem on Etna Creek is that the main channel capacity has been blocked by natural dams, shifting most of the flow out onto the floodplain. The dams are caused by debris lodging in the channel, followed by the buildup of cobbles and gravel. Etna Creek's main channel must be cleared of debris, gravel, rocks and vegetation after each major flood event. The overbank flow is mainly on the left-bank floodplain between the creek and the low bank where the majority of the city is located. The overflows vary due to the location of vegetation and obstructions. During past flood events, efforts have been made to divert the creek back into the main channel by building levees of river rock and gravel. These efforts have not been successful.

Fort Jones Area

In the Fort Jones area, five substantial floods have occurred between 1953 and 1974. The largest flood occurred in January 1974, with an estimated recurrence interval of 50 years. During large flood events, the channel capacity of Moffett Creek is exceeded in the vicinity of Marble View Avenue and the overflow spreads out onto the very flat floodplain and continues flowing as a broad, shallow sheet flow. Much of the residential area of Fort Jones is subject to this shallow flooding. Sheet flow tends to pond behind the Scott River Road embankment, where some overtops the road and returns to the channel.

Montague Area

Historical flood data is lacking for Montague, but local residents report that a combination of culverts in place prior to a bridge built over the Oregon Slough in 1965 were inadequate to pass floodwaters. Water was observed ponding upstream until it ran over the road, causing road and embankment erosion. The current bridge is adequate to convey a 100-year flood event. Trees and debris collected behind the Yreka Western Railroad Bridge during the flood of 1964 and the culverts through the embankments could not carry the flow, which resulted in erosion of the embankment. The 1974 flood reached the levee of the old sewage treatment pond, but bank erosion was not evident.

Weed Area

According to local residents and city officials, the largest flood in Weed occurred in January 1974. Flooding also occurred in December 1964. Due to the lack of magnitude and duration data, no frequencies can be determined for these flood events. Overflow from Boles Creek and North Fork Boles Creek caused shallow flooding during the 1974 event as culvert capacities were exceeded. Water from this event also ponded upstream from the US Highway 97 embankment. Local runoff and stormwater issues have caused shallow flooding in the vicinity of the Weed Convalescent Hospital, but no major flooding has occurred from Beaughton Creek.

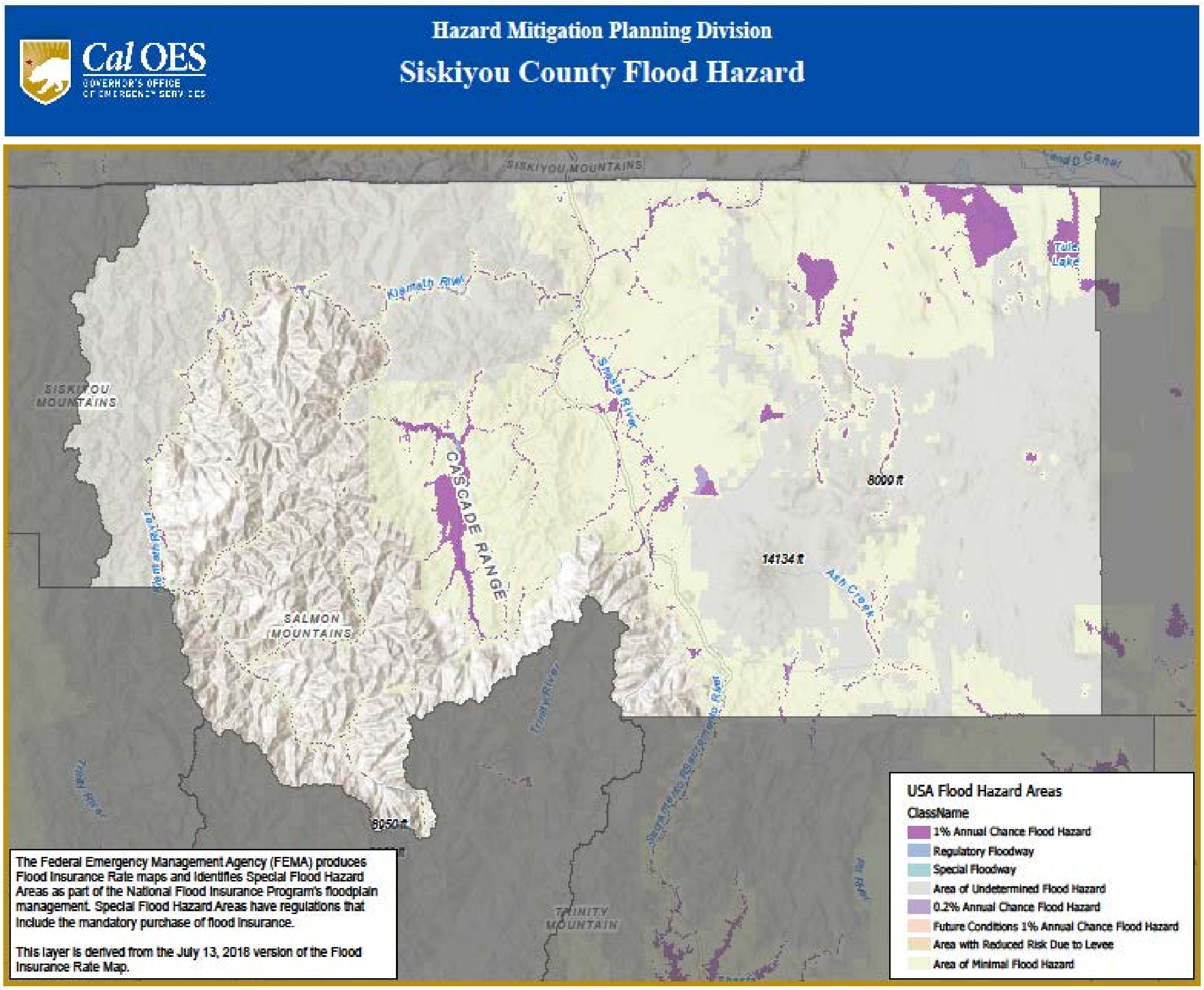
Yreka Area

Flood problems on Yreka Creek have historically consisted of damage to bridges and erosion of stream banks. The erosion has in turn caused problems with structures along the banks. Yreka Creek caused flooding of the buildings along Main Street in 1861 and in 1927 flooding damaged water mains, barns, garages, outbuildings and a newly constructed sewer line. Humbug Gulch has also contributed to flooding along the city streets and in 1964 the stream flooded several houses at Yama, North and Gold Streets.

12.2.2 Location

Major floods in portions of Siskiyou County have been extensively documented by gage records, high water marks, damage surveys and personal accounts. This documentation was the basis for FEMA's January 19, 2011 Siskiyou County FIRMs. The 2011 Flood Insurance Study is the sole source of data used in this risk assessment to map the extent and location of the flood hazard, as shown in Map 12-1.

Map 12-1



12.2.3 Frequency

Siskiyou County experiences episodes of river and small stream flooding nearly every winter. The major floods have resulted from intense winter weather and rainstorms between October and March. Large floods that can cause property damage typically occur every three to seven years. The more urbanized portions of the county annually experience nuisance flooding and groundwater ponding related to storm water drainage issues.

12.2.4 Severity

The principal factors affecting flood damage are flood depth and velocity. The deeper and faster flood flows become, the more damage they can cause. Shallow flooding with high velocities can cause as much damage as deep flooding with slow velocity. This is especially true when a channel migrates over a broad floodplain, redirecting high velocity flows and transporting debris and sediment. Flood severity is often evaluated by examining peak discharges; Table 12-2 lists peak flows used by FEMA to map the floodplains of Siskiyou County.

TABLE 12-26.
SUMMARY OF PEAK DISCHARGES WITHIN SISKIYOU COUNTY

	Discharge (cubic feet/second)			
Source/Location	10-Year	50-Year	100-Year	500-Year
Cottonwood Creek at Henley Horn Brook Rd	4,300	8,000	10,100	16,200
Greenhorn Creek at Yreka	900	1,800	2,200	3,700
Indian Creek from Doolittle Creek confluence	15,000	27,500	34,500	55,500
Klamath River at Elk Creek Confluence	73,000,	164,000	220,000	405,000
Klamath River at Town of Klamath	17,000	59,000	92,000	230,000
Moffett Creek at Ft. Jones	3,400	7,000	8,000	12,000
Sacramento River at Dunsmuir	13,000	22,000	27,000	40,000
Scott River Downstream from Moffett Creek	19,400	39,000	49,000	81,000
Shasta River at Edgewood Rd Bridge	4,800	9,400	11,700	20,000
Yreka Creek at Sewage Treatment Plant	3,000	6,000	8,000	14,000

In the predominantly high relief areas of Siskiyou County, the effects of flooding are often confined to areas immediately adjacent to the waterways. As waterways grow in size, from local drainages up to the primary rivers of the County, so grows the threat of flood and the extent of potential impacts. In some areas, the lack of broad, floodplain topography reduces flood hazards and the scope of flood impact, yet this “channeling” of the water into a narrow confinement does produce major impacts on culverts, bridges and other structures that divert or channel water flows.

A majority of flood related hazards in Siskiyou County are transportation related. Floodwaters do not normally cause road closure due to inundation by water settling in broad floodplains. Roads are typically closed due to varying degrees of erosion-related washout. At the minimum, road shoulders are compromised due to high levels of runoff and rill erosion from intense precipitation. Roads may be reduced to travel in only one direction at a time. At the most severe levels, entire roadways are undercut and eroded due to high river discharges for great distances where roads parallel flooding rivers. In these instances, bridge facilities can be threatened or lost because of debris impacting the bridge structures. In either case, road damage and road closures affect the transportation infrastructure of the County, interrupting the movement of people, supplies, and services while reducing productivity because of increased commute time. Particularly along the Klamath River corridor, communities can become isolated and inaccessible for periods of time. The County’s public safety response is affected as well, slowing the arrival of sheriff deputies and other emergency response personnel.

Flood related erosion can cause damage to homes, businesses, and government structures, including damage to ancillary structures, utilities, and parking facilities. Structural foundation undercutting is the most prevalent form of damage to structures. Structures can also be damaged from trees falling as a result of water-logged soils.

Agriculture is the primary economy in Siskiyou County and is located considerably in flood-prone areas. Irrigation equipment is often damaged and fences can be washed away or mired in debris. Another impact is to perennial crops which can be spoiled with silt and flood debris. Agricultural areas such as the Scott Valley (see Figure 12-2) are subject to shallow flooding that can significantly impact agricultural production. Additionally, fish habitats and riparian zones can be severely impacted—affecting the strength of runs of salmon and steelhead species.

Figure 12-18. The Broad, Flat Scott Valley Is Subject to Shallow Flooding

Electrical power outages often occur as the result of flooding and the interruption of power causes many problems. The effects of lost electricity are elaborated upon in the severe weather chapter of this document. Lost power is usually a precursor to the closure of government offices, or the offices may be subject to reduced schedules. Public schools may also be closed or on a delayed start schedule as well.

12.2.5 Warning Time

Due to the sequential pattern of meteorological conditions needed to cause serious flooding, it is unusual for a flood to occur without warning. Warning times for floods can be between 24 and 48 hours. Flash flooding can be less predictable, but potential hazard areas can be warned in advanced of potential flash flooding danger.

12.3 SECONDARY HAZARDS

The most problematic secondary hazard for flooding is bank erosion, which in some cases can be more harmful than actual flooding. This is especially true in the upper courses of rivers with steep gradients, where floodwaters may pass quickly and without much damage, but scour the banks, edging properties closer to the floodplain or causing them to fall in. Flooding is also responsible for hazards such as landslides when high flows over-saturate soils on steep slopes, causing them to fail. Hazardous materials spills are also a secondary hazard of flooding if storage tanks rupture and spill into streams, rivers or storm sewers.

12.4 CLIMATE CHANGE IMPACTS

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

Historical hydrologic patterns can no longer be solely relied upon to forecast the water future.

Precipitation and runoff patterns are changing, increasing the uncertainty for water supply and quality, flood management and ecosystem functions.

Extreme climatic events will become more frequent, necessitating improvement in flood protection, drought preparedness and emergency response.

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

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

12.5 EXPOSURE

The Level 2 HAZUS-MH protocol was used to assess the exposure to flooding in the planning area. The model used census data at the block level and FEMA floodplain data to estimate potential flooding impacts. Flood exposure numbers were generated using Siskiyou County Assessor and parcel data. County assessor data does not include tax exempt structures, such as federal and local government buildings. Where possible, the HAZUS-MH default data was enhanced using local GIS data from county, state and federal sources. All data sources have a level of accuracy acceptable for planning purposes.

12.5.1 Population

Population counts of those living in the floodplain were generated by analyzing county assessor and parcel data that intersect with the 100-year and 500-year floodplains identified on FIRMs. Using GIS, residential structures on properties that intersect the floodplain were identified, and an estimate of population was calculated by multiplying the residential structures by the average Siskiyou County household size of 2.4 persons per household. Using this approach, it was estimated that the exposed county population is 3,602 within the 100-year floodplain (8 percent of the total county population) and

5,292 within the 500-year floodplain (12 percent of the total). For the unincorporated areas, it is estimated that the exposed population is 2,725 within the 100-year floodplain (6 percent of the total unincorporated county population) and 3,256 within the 500-year floodplain (7 percent of the total)..

12.5.2 Property

Table 12-3 and Table 12-4 summarize the area and number of structures in the floodplain by municipality. The HAZUS-MH model determined that there are 1,908 structures within the 100-year floodplain and 2,921 structures within the 500-year floodplain (not including federal and local government structures). In the 100-year floodplain, about 80 percent of these structures are in unincorporated areas. Eighty percent are residential, and 20 percent are non-residential.

Table 12-5 and Table 12-6 summarize the estimated value of exposed buildings in the 100- and 500-year floodplains within the planning area. This methodology estimated $282 million worth of building-and-contents exposure to the 100-year flood, representing 6.4 percent of the total assessed value of the planning area, and $423 million worth of building-and-contents exposure to the 500-year flood, representing 9.6 percent of the total. Estimates do not include federal and local government structures.

Some land uses are more vulnerable to flooding, such as single-family homes, while others are less vulnerable, such as agricultural land or parks. Many parcels in the 100-year floodplain are zoned for agricultural uses. These are favorable, lower-risk uses for the floodplain. Current, land use information is not available in a format that can support this risk assessment. Data such as buildable lands and/or vacant parcels within the floodplain would be valuable date to support future updates to this risk assessment.

12.5.3 Critical Facilities and Infrastructure

Table 12-7 through Table 12-10 summarize critical facilities and infrastructure in the 100-year and 500-year floodplains. The following sections provide details on exposed critical infrastructure.

Roads

The following major roads in Siskiyou County pass through the 100-year floodplain and thus are exposed to flooding:

Interstate 5	Highway 89
Highway 139	Highway 96
Highway 161	Highway 97
Highway 263	Highway 3

Some of these roads are built above the flood level, and others function as levees to prevent flooding. Still, in severe flood events these roads can be blocked or damaged, preventing access to some areas (see Figure 12-3).

TABLE 12-27.
AREA AND STRUCTURES WITHIN THE 100-YEAR FLOODPLAIN

	Area in Floodplain (acres)	Number of Structures in Floodplain		
		Residential	Non Residential	**Total**
Dorris	0	0	0	**0**

Dunsmuir	90	63	4	**67**
Etna	132	36	6	**42**
Fort Jones	191	168	20	**188**
Montague	36	0	0	**0**
Mt. Shasta	0	0	0	**0**
Tulelake	0	0	0	**0**
Weed	44	7	3	**10**
Yreka	504	78	31	**109**
Unincorporated	134,091	1,136	356	**1,492**
Total	**135,089**	**1,488**	**420**	**1,908**

TABLE 12-28.
AREA AND STRUCTURES WITHIN THE 500-YEAR FLOODPLAIN

	Area in Floodplain (acres)	Number of Structures in Floodplain		
		Residential	Non Residential	**Total**
Dorris	0	0	0	**0**
Dunsmuir	123	156	9	**165**
Etna	163	45	8	**186**
Fort Jones	216	196	32	**228**
Montague	85	37	3	**40**
Mt. Shasta	0	0	0	**0**
Tulelake	0	0	0	**0**
Weed	206	18	15	**33**
Yreka	710	399	150	**549**
Unincorporated	136,854	1,353	367	**1,720**
Total	**138,357**	**2,204**	**584**	**2,921**

TABLE 12-29.
VALUE OF EXPOSED BUILDINGS WITHIN 100-YEAR FLOODPLAIN

	Estimated Flood Exposure ($)			% of Total Assessed Value
	Structure	Contents	**Total**	
Dorris	0	0	0	0.00%
Dunsmuir	4,298,969	3,050,039	7,349,008	5.40%
Etna	3,299,153	2,436,106	5,735,259	9.40%
Fort Jones	13,064,504	9,848,571	22,913,075	46.20%
Montague	0	0	0	0.00%

Mt. Shasta	0	0	0	0.00%
Tulelake	0	0	0	0.00%
Weed	833,206	683,316	1,516,522	0.60%
Yreka	14,928,754	12,966,402	27,895,156	3.90%
Unincorporated	121,342,268	95,069,836	216,412,104	8.30%
Total	**157,766,854**	**124,054,268**	**281,821,122**	**6.40%**

TABLE 12-30.
VALUE OF EXPOSED BUILDINGS WITHIN 500-YEAR FLOODPLAIN

	Estimated Flood Exposure ($)			% of Total Assessed Value
	Structure	Contents	Total	
Dorris	0	0	0	0.00%
Dunsmuir	11,493,500	8,181,237	19,674,737	14.40%
Etna	4,712,438	3,564,856	8,277,294	13.50%
Fort Jones	16,589,425	12,681,693	29,271,118	59.00%
Montague	2,411,448	1,731,608	4,143,056	5.80%
Mt. Shasta	0	0	0	0.00%
Tulelake	0	0	0	0.00%
Weed	4,673,045	4,353,719	9,026,764	3.90%
Yreka	59,441,062	49,438,150	108,879,212	15.10%
Unincorporated	137,264,641	106,765,395	244,030,036	9.30%
Total	**236,585,559**	**186,716,657**	**423,302,216**	**9.60%**

TABLE 12-31.
CRITICAL FACILITIES IN THE 100-YEAR FLOODPLAIN

Jurisdiction	Medical and Health Services	Government Function	Protective	Hazardous Materials	Schools	Other	**Total**
Dorris	0	0	0	0	0	0	**0**
Dunsmuir	0	0	0	0	0	1	**1**
Etna	0	0	0	0	0	0	**0**
Fort Jones	0	7	0	0	2	1	**13**
Montague	0	0	0	0	0	0	**0**
Mt. Shasta	0	0	0	0	0	0	**0**
Tulelake	0	0	0	0	0	0	**0**
Weed	0	0	0	0	0	0	**0**
Yreka	0	2	0	0	2	1	**5**

TABLE 12-31.
CRITICAL FACILITIES IN THE 100-YEAR FLOODPLAIN

Jurisdiction	Medical and Health Services	Government Function	Protective	Hazardous Materials	Schools	Other	**Total**
Unincorporated	4	16	3	0	7	10	**40**
Total	**4**	**25**	**3**	**0**	**11**	**13**	**59**

TABLE 12-32.
CRITICAL FACILITIES IN THE 500-YEAR FLOODPLAIN

Jurisdiction	Medical and Health Services	Government Function	Protective	Hazardous Materials	Schools	Other	**Total**
Dorris	0	0	0	0	0	0	**0**
Dunsmuir	0	0	0	0	0	1	**1**
Etna	0	0	0	0	0	0	**0**
Fort Jones	0	7	1	0	2	0	**13**
Montague	0	0	0	0	0	0	**0**
Mt. Shasta	0	0	0	0	0	0	**0**
Tulelake	0	0	0	0	0	0	**0**
Weed	1	0	0	0	0	0	**1**
Yreka	7	2	3	0	4	1	**17**
Unincorporated	6	21	5	0	8	10	**50**
Total	**14**	**30**	**9**	**0**	**14**	**12**	**82**

TABLE 12-33.
CRITICAL INFRASTRUCTURE IN THE 100-YEAR FLOODPLAIN

Jurisdiction	Bridges	Water Supply	Wastewater	Power	Communications	Other	Total
Dorris	0	0	0	0	0	0	0
Dunsmuir	3	0	0	0	0	0	**3**
Etna	0	0	0	0	0	0	**0**
Fort Jones	2	5	0	0	0	1	**8**
Montague	0	0	0	0	0	0	**0**
Mt. Shasta	0	0	0	0	0	0	**0**
Tulelake	0	0	0	0	0	0	**0**
Weed	2	0	0	0	0	0	**2**
Yreka	9	0	0	0	0	0	**9**

TABLE 12-33.
CRITICAL INFRASTRUCTURE IN THE 100-YEAR FLOODPLAIN

Jurisdiction	Bridges	Water Supply	Wastewater	Power	Communications	Other	Total
Unincorporated	105	0	1	0	0	0	**106**
Total	**121**	**5**	**1**	**0**	**0**	**1**	**128**

TABLE 12-34.
CRITICAL INFRASTRUCTURE IN THE 500-YEAR FLOODPLAIN

Jurisdiction	Bridges	Water Supply	Wastewater	Power	Communications	Other	**Total**
Dorris	0	0	0	0	0	0	**0**
Dunsmuir	3	0	0	0	0	0	**3**
Etna	0	0	0	0	0	0	**0**
Fort Jones	2	5	0	0	0	0	**7**
Montague	0	0	0	0	0	0	**0**
Mt. Shasta	0	0	0	0	0	0	**0**
Tulelake	0	0	0	0	0	0	**0**
Weed	2	0	0	0	0	0	**2**
Yreka	9	0	0	0	0	0	**9**
Unincorporated	105	0	1	0	0	0	**106**
Total	**121**	**5**	**1**	**0**	**0**	**0**	**127**

Figure 12-19. Horse Creek Road, January 4, 2006

Bridges

Flooding events can significantly impact road bridges. These are important because often they provide the only ingress and egress to some neighborhoods. An analysis showed that there are 121 bridges that are in or cross over the 100-year floodplain and 106 bridges in the 500-year floodplain.

Water and Sewer Infrastructure

Water and sewer systems can be affected by flooding. Floodwaters can back up drainage systems, causing localized flooding. Culverts can be blocked by debris from flood events, also causing localized urban flooding. Floodwaters can get into drinking water supplies, causing contamination. Sewer systems can be backed up, causing wastewater to spill into homes, neighborhoods, rivers and streams.

Levees

Siskiyou County has several miles of earthen levees and revetments, some of which are managed by the Siskiyou County Flood Control District; the exact length of the levees is undetermined. There are also levees on many smaller rivers, streams and creeks that protect small areas of land. Many of the levees are older and were built under earlier flood management goals. Many of these older levees are exposed to scouring and failure due to old age and construction methods.

12.5.4 Environment

Flooding is a natural event, and floodplains provide many natural and beneficial functions. Nonetheless, with human development factored in, flooding can impact the environment in negative ways. Migrating fish can wash into roads or over dikes into flooded fields, with no possibility of escape. Pollution from roads, such as oil, and hazardous materials can wash into rivers and streams. During floods, these can settle onto normally dry soils, polluting them for agricultural uses. Human development such as bridge abutments and levees, and logjams from timber harvesting can increase stream bank erosion, causing rivers and streams to migrate into non-natural courses.

12.6 VULNERABILITY

Many of the areas exposed to flooding may not experience serious flooding or flood damage. This section describes vulnerabilities in terms of population, property, infrastructure and environment.

12.6.1 Population

A geographic analysis of demographics, using the HAZUS-MH model and data from the U.S. Census Bureau and Dun & Bradstreet, identified populations vulnerable to the flood hazard as follows:

- **Economically Disadvantaged Populations**—It is estimated that 15 percent of the people within the 100-year floodplain are economically disadvantaged, defined as having household incomes of $10,000 or less.
- **Population over 65 Years Old**—It is estimated that 8 percent of the population in the census blocks that intersect the 100-year floodplain are over 65 years old. Approximately 10 percent of the over-65 population in the floodplain also have incomes considered to be economically disadvantaged and are considered to be extremely vulnerable.
- **Population under 16 Years Old**—It is estimated that 5 percent of the population within census blocks located in or near the 100-year floodplain are under 16 years of age.

HAZUS estimated that a 100-year flood could displace up to 3,577 people, with 1,868 of those people needing short-term shelter.

12.6.2 Property

HAZUS-MH calculates losses to structures from flooding by looking at depth of flooding and type of structure. Using historical flood insurance claim data, HAZUS-MH estimates the percentage of damage to structures and their contents by applying established damage functions to an inventory. For this analysis, local data on facilities was used instead of the default inventory data provided with HAZUS-MH.

The analysis is summarized in Table 12-11 for the 100-year flood event. It is estimated that there would be $83 million of flood loss from a 100-year flood event in the planning area. This represents 28 percent of the total exposure to the 100-year flood and 1.9 percent of the total assessed value for the county.

National Flood Insurance Program

Table 12-12 lists flood insurance statistics that help identify vulnerability in Siskiyou County. Seven jurisdictions in the planning area participate in the NFIP, with 525 flood insurance policies providing over $99 million in insurance coverage. According to FEMA statistics, 69 flood insurance claims were made between January 1, 1978 and July 31, 2011, for a total of $523,791, an average of $7,591 per claim.

Properties constructed after a FIRM has been adopted are eligible for reduced flood insurance rates. Such structures are less vulnerable to flooding since they were constructed after regulations and codes were adopted to decrease vulnerability. Properties built before a FIRM is adopted are more vulnerable to flooding because they do not meet code or are located in hazardous areas. The first FIRMs in Siskiyou County were available in 1979 in the City of Dunsmuir.

**TABLE 12-35.
ESTIMATED FLOOD LOSS FOR THE 100-YEAR FLOOD EVENT**

	Estimated Flood Loss			% of Total Assessed Value
	Structural	Contents	Total	
Dorris	0	0	0	0
Dunsmuir	513,000	297,000	810,000	0.59%
Etna	701,000	847,000	1,548,000	2.53%
Fort Jones	1,098,000	1,348,000	2,446,000	4.93%
Montague	0	0	0	0.00%
Mt. Shasta	0	0	0	0.00%
Tulelake	0	0	0	0.00%
Weed	918,000	1,130,000	2,048,000	0.88%
Yreka	2,412,000	4,829,000	7,241,000	1.00%
Unincorporated	34,481,000	34,133,000	68,614,000	2.62%
Total	**40,204,000**	**42,735,000**	**82,939,000**	**1.89%**

**TABLE 12-36.
FLOOD INSURANCE STATISTICS FOR SISKIYOU COUNTY**

	Date of Entry Initial FIRM Effective Date	# of Flood Insurance Policies as of 7/02/2019	Insurance in Force	Total Annual Premium	Claims, 1/1/1978 – 7/02/2019	
					Number	Value
Dunsmuir	12/4/1979	33	$5,860,100	$31,849	21	$148,051
Etna	3/4/1980	17	$3,230,200	$9,380	1	$0
Fort Jones	4/15/1980	71	$11,446,600	$45,121	6	$4,213
Montague	9/17/1980	0	0	0	0	$0
Weed	1/20/1982	4	$686,500	$3,590	0	$0
Yreka	11/18/1981	64	$13,376,200	$72,841	3	$0
Unincorporated	5/17/1982	336	$65,070,700	$258,150	38	$371,527
Total		**525**	**$99,670,300**	**$420,931**	**69**	**$523,791**

The following information from flood insurance statistics is relevant to reducing flood risk:

The use of flood insurance in Siskiyou County is below the national average. Only 27.5 percent of insurable buildings in the county are covered by flood insurance. According to an NFIP study, about 49 percent of single-family homes in special flood hazard areas are covered by flood insurance nationwide.

The average claim paid in the planning area represents about 5 percent of the 2010 average assessed value of structures in the floodplain.

The percentage of policies and claims outside a mapped floodplain suggests that not all of the flood risk in the planning area is reflected in current mapping. Based on information from the

NFIP, 79.8 percent of policies in the planning area are on structures within an identified SFHA, and 20.2 percent are for structures outside such areas.

Repetitive Loss

A repetitive loss property is defined by FEMA as an NFIP-insured property that has experienced any of the following since 1978, regardless of any changes in ownership:

Four or more paid losses in excess of $1,000

Two paid losses in excess of $1,000 within any rolling 10-year period

Three or more paid losses that equal or exceed the current value of the insured property.

Repetitive loss properties make up only 1 to 2 percent of flood insurance policies in force nationally, yet they account for 40 percent of the nation's flood insurance claim payments. In 1998, FEMA reported that the NFIP's 75,000 repetitive loss structures have already cost $2.8 billion in flood insurance payments and that numerous other flood-prone structures remain in the floodplain at high risk. The government has instituted programs encouraging communities to identify and mitigate the causes of repetitive losses. A recent report on repetitive losses by the National Wildlife Federation found that 20 percent of these properties are outside any mapped 100-year floodplain. The key identifiers for repetitive loss properties are the existence of flood insurance policies and claims paid by the policies.

FEMA-sponsored programs, such as the CRS, require participating communities to identify repetitive loss areas. A repetitive loss area is the portion of a floodplain holding structures that FEMA has identified as meeting the definition of repetitive loss. Identifying repetitive loss areas helps to identify structures that are at risk but are not on FEMA's list of repetitive loss structures because no flood insurance policy was in force at the time of loss. Map 12-2 shows the repetitive loss areas in Siskiyou County. FEMA's list of repetitive loss properties identifies Siskiyou County planning area as of July 2, 2019. The breakdown by jurisdiction is presented in Table 12-13.

Jurisdiction	Participating	#NFIP-Insured RL Properties
Dorris	N	n/a
Dunsmuir	Y	0
Etna	Y	0
Fort Jones	Y	0
Montague	Y	0
Mt. Shasta	N	n/a
Tulelake	N	n/a
Weed	Y	0
Yreka	Y	0
Unincorporated	Y	0

None of the properties on the repetitive loss list are outside the County's special flood hazard area. They likely were flooded by flood events typical for the floodplain reflected in the current mapping. The dates of loss coincide with major flood events that have impacted the planning area. Therefore it can be concluded that the overall cause of repetitive flooding is the same as has been identified for the river basins in which each repetitive loss area is found. It can also be concluded that the entire mapped floodplain can be and is subject to repetitive flooding. Therefore the Planning Team has defined the repetitive loss area to be contiguous with the currently mapped and regulated 100-year floodplain.

12.6.3 Critical Facilities and Infrastructure

HAZUS-MH was used to estimate the flood loss potential to critical facilities. Using depth/damage function curves to estimate the percent of damage to the building and contents of critical facilities, HAZUS-MH correlates these estimates into an estimate of functional down-time (the estimated time it will take to restore a facility to 100 percent of its functionality). This helps to gauge how long the planning area could have limited usage of facilities deemed critical to flood response and recovery. On average, critical facilities would receive 12.4 percent damage to the structure and 31.8 percent damage to the contents during a 100-year flood event. The estimated time to restore these facilities to 100 percent of their functionality is 515 days.

12.6.4 Environment

The environment vulnerable to flood hazard is the same as the environment exposed to the hazard. Loss estimation platforms such as HAZUS-MH are not currently equipped to measure environmental impacts of flood hazards. The best gauge of vulnerability of the environment would be a review of damage from past flood events. Loss data that segregates damage to the environment was not available at the time of this plan. Capturing this data from future events could be beneficial in measuring the vulnerability of the environment for future updates.

12.7 FUTURE TRENDS

The county has experienced slow growth over the past decade, from a population of 44,301 in 2000 to 43606 in 2016. Economic problems in the past three years have impacted growth in the County, with some areas experiencing negative growth. Siskiyou County and its planning partners are optimistic that marginal, sustained growth will return to the county as the state and national economies strengthen.

The County and its planning partners are equipped to handle future growth within flood hazard areas. All municipal planning partners have general plans that address frequently flooded areas in their safety elements. All partners have committed to linking their general plans to this hazard mitigation plan. This will create an opportunity for wise land use decisions as future growth impacts flood hazard areas.

All municipal planning partners participating in the NFIP recognize the incentive to adopt consistent, appropriate, higher regulatory standards in communities with the highest degree of flood risk. All municipal planning partners have committed to maintaining their good standing under the NFIP through initiatives identified in this plan. Communities participating or considering participation in the CRS program will be able to refine this commitment using CRS programs and templates as a guide.

12.8 SCENARIO

The primary water courses in Siskiyou County have the potential to flood at irregular intervals, generally in response to a succession of intense winter rainstorms. Storm patterns of warm, moist air usually occur between October and March. A series of such weather events can cause severe flooding in the planning area. The worst-case scenario is a series of storms that flood numerous drainage basins in a short time. This could overwhelm the response and floodplain management capability within the planning area. Major roads could be blocked, preventing critical access for many residents and critical functions. High in-channel flows could cause water courses to scour, possibly washing out roads and creating more isolation problems. In the case of multi-basin flooding, the County would not be able to make repairs quickly enough to restore critical facilities and infrastructure.

12.9 ISSUES

The planning team has identified the following flood-related issues relevant to the planning area:

The accuracy of the existing flood hazard mapping produced by FEMA in reflecting the true flood risk within the planning area is questionable. This is most prevalent in areas protected by levees not accredited by the FEMA mapping process.

The extent of the protection provided by flood control facilities (dams, dikes and levees) is not known due to the lack of an established national policy on flood protection standards.

Land use information in a format that is compatible for HAZUS applications would significantly enhance the risk assessment for the flood hazard.

Older levees are subject to failure or do not meet current building practices for flood protection.

The risk associated with the flood hazard overlaps the risk associated with other hazards such as earthquake, landslide and fishing losses. This provides an opportunity to seek mitigation alternatives with multiple objectives that can reduce risk for multiple hazards.

There is no degree of consistency of land-use practices and regulatory floodplain management scope within the planning area.

Changes in the climate could impact flood conditions in Siskiyou County.

More information is needed on flood risk to support the concept of risk-based analysis of capital projects.

There needs to be a sustained effort to gather historical damage data, such as high water marks on structures and damage reports, to measure the cost-effectiveness of future mitigation projects.

Ongoing flood hazard mitigation will require funding from multiple sources.

There needs to be a coordinated hazard mitigation effort between jurisdictions affected by flood hazards in the county.

Floodplain residents need to continue to be educated about flood preparedness and the resources available during and after floods.

The concept of residual risk should be considered in the design of future capital flood control projects and should be communicated with residents living in the floodplain.

The promotion of flood insurance as a means of protecting private property owners from the economic impacts of frequent flood events should continue.

Existing floodplain-compatible uses such as agricultural and open space need to be maintained. There is constant pressure to convert these existing uses to more intense uses within the planning area during times of moderate to high growth.

The economy affects a jurisdiction’s ability to manage its floodplains. Budget cuts and personnel losses can strain resources needed to support floodplain management.

CHAPTER 13.
LANDSLIDES AND OTHER EARTH MOVEMENTS

13.1. GENERAL BACKGROUND

A landslide is a mass of rock, earth or debris moving down a slope. Landslides may be minor or very large, and can move at slow to very high speeds. They can be initiated by storms, earthquakes, fires, volcanic eruptions or human modification of the land.

Mudslides (or mudflows or debris flows) are rivers of rock, earth, organic matter and other soil materials saturated with water. They develop in the soil overlying bedrock on sloping surfaces when water rapidly accumulates in the ground, such as during heavy rainfall or rapid snowmelt. Water pressure in the pore spaces of the material increases to the point that the internal strength of the soil is drastically weakened. The soil's reduced resistance can then easily be overcome by gravity, changing the earth into a flowing river of mud or "slurry." A debris flow or mudflow can move rapidly down slopes or through channels, and can strike with little or no warning at avalanche speeds. The slurry can travel miles from its source, growing as it descends, picking up trees, boulders, cars and anything else in its path. Although these slides behave as fluids, they pack many times the hydraulic force of water due to the mass of material included in them. Locally, they can be some of the most destructive events in nature.

DEFINITIONS

Landslide—The sliding movement of masses of loosened rock and soil down a hillside or slope. Such failures occur when the strength of the soils forming the slope is exceeded by the pressure, such as weight or saturation, acting upon them.

Mass Movement—A collective term for landslides, debris flows, falls and sinkholes.

Mudslide (or Mudflow or Debris Flow)— A river of rock, earth, organic matter and other materials saturated with water.

All mass movements are caused by a combination of geological and climate conditions, as well as the encroaching influence of urbanization. Vulnerable natural conditions are affected by human residential, agricultural, commercial and industrial development and the infrastructure that supports it.

13.2. HAZARD PROFILE

Landslides are caused by one or a combination of the following factors: change in slope of the terrain, increased load on the land, shocks and vibrations, change in water content, groundwater movement, frost action, weathering of rocks, and removing or changing the type of vegetation covering slopes. In general, landslide hazard areas are where the land has characteristics that contribute to the risk of the downhill movement of material, such as the following:

- A slope greater than 33 percent
- A history of landslide activity or movement during the last 10,000 years
- Stream or wave activity, which has caused erosion, undercut a bank or cut into a bank to cause the surrounding land to be unstable
- The presence or potential for snow avalanches
- The presence of an alluvial fan, indicating vulnerability to the flow of debris or sediments
- The presence of impermeable soils, such as silt or clay, which are mixed with granular soils such as sand and gravel.

Flows and slides are commonly categorized by the form of initial ground failure. Figure 13-1 through Figure 13-4 show common types of slides. The most common is the shallow colluvial slide, occurring particularly in response to intense, short-duration storms. The largest and most destructive are deep-seated slides, although they are less common than other types.

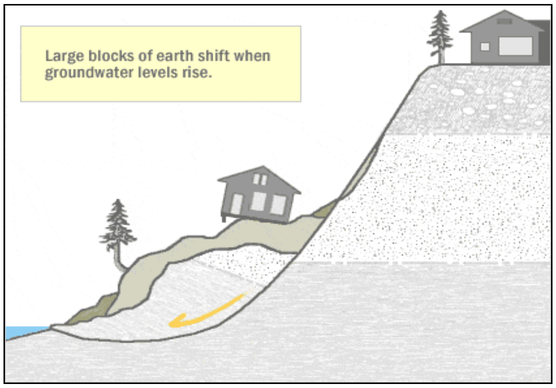


Figure 13-1. Deep Seated Slide

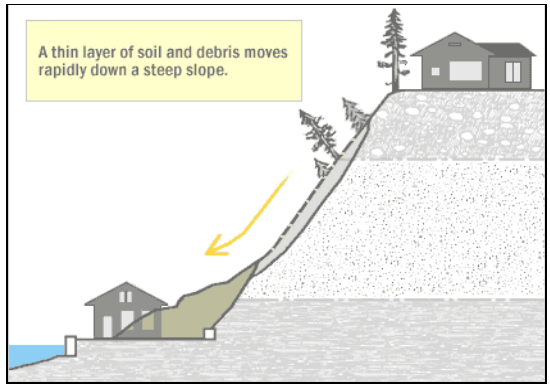


Figure 13-2. Shallow Colluvial Slide

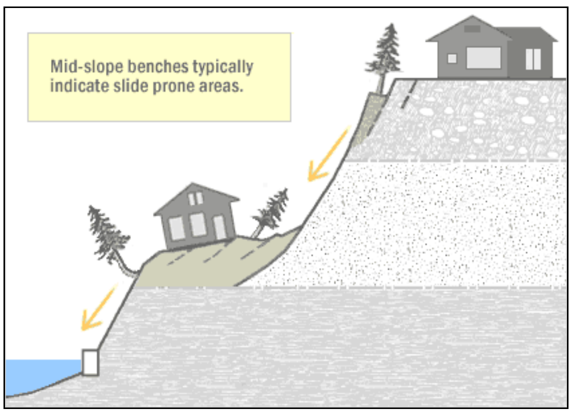


Figure 13-3. Bench Slide

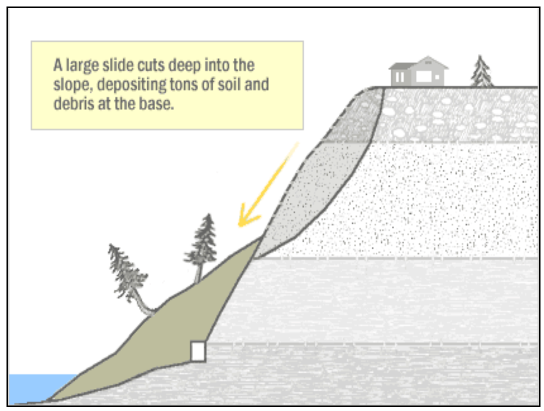
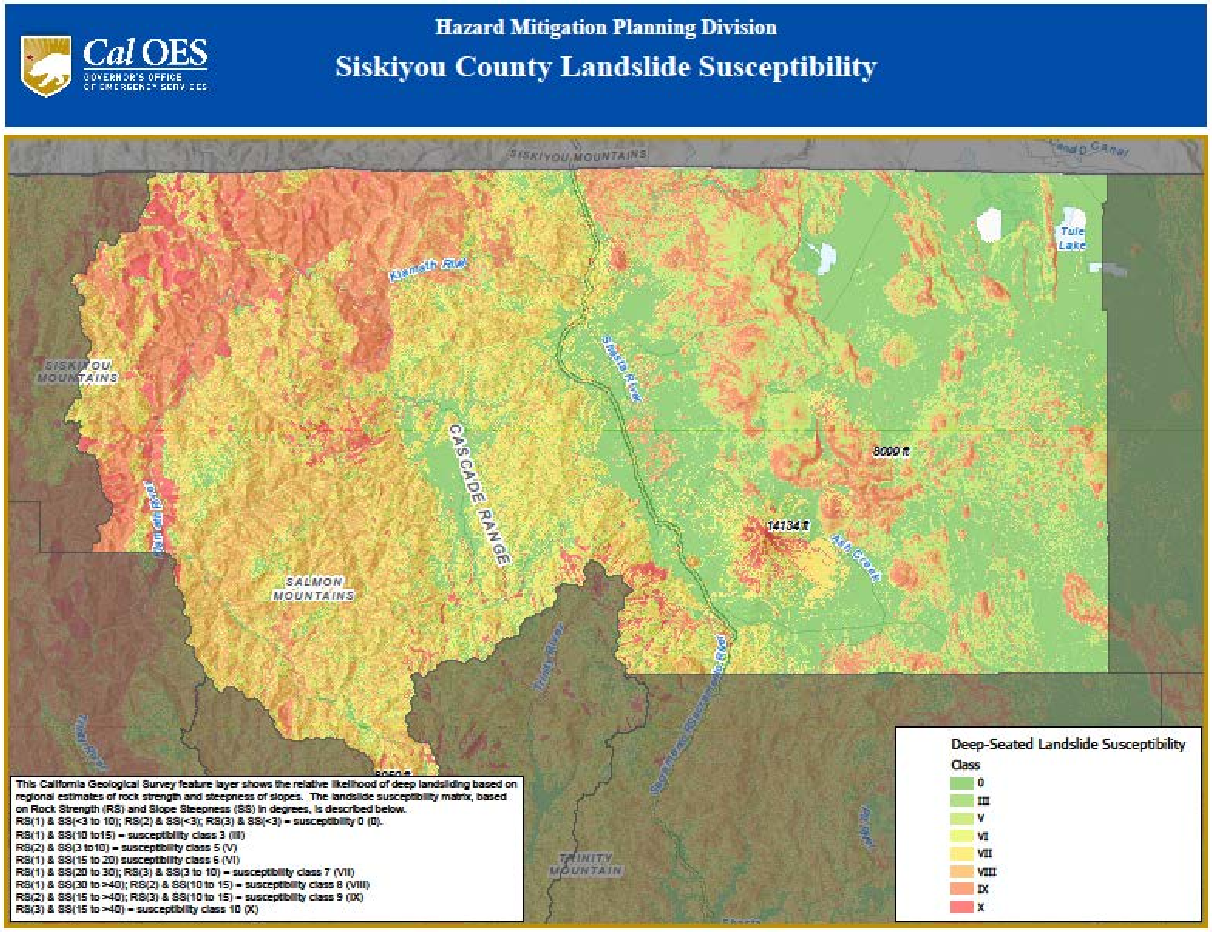


Figure 13-4. Large Slide

Slides and earth flows can pose serious hazard to property in hillside terrain. They tend to move slowly and thus rarely threaten life directly. When they move—in response to such changes as increased water content, earthquake shaking, addition of load, or removal of downslope support—they deform and tilt the ground surface. The result can be destruction of foundations, offset of roads, breaking of underground pipes, or overriding of downslope property and structures. Figure 13-5 shows Siskiyou County landslide susceptibility throughout the county.



Map 13-5

13.2.1 Past Events

The Spatial Hazard Events and Losses Database for the United States (SHELDUS) lists two landslide events in Siskiyou County since 1960: landslide incidents in 1969 resulted in $2.4 million in property damage and one fatality; a mudslide in December 1992 caused about $2,700 in damage. In February 1993, a presidential disaster was declared for mud and landslides affecting the County. Several areas, including Siskiyou County, were impacted by El Nino winter storms resulting in landslides and mudflows from February to April 1995. Mudslides and landslides again impacted the County from December 2005 to January 2006, resulting in disaster declaration DR-1628.

Siskiyou County was most recently included in disaster declaration DR-1884, for a severe winter storm was followed by flooding, debris and mudflows between January 17 and February 6, 2010. The Karuk Tribe, in particular, was impacted by the storm and applied for a Public Assistance (PA) grant to repair Itroop Road in Happy Camp. A 150-foot section of roadway failed after floodwaters and mud flows caused part of the road surface to slide and split open. The road is used by local residents and tribal members going to and from their homes and is the only access for emergency vehicles into the Happy Camp neighborhood. In addition to plans to repair the road, additional drainage is planned to mitigate future flooding and landslides.

In January of 2017 we had back to back disasters resulting in two declared disasters DR-4301 and DR-4308. Had numerous landslides and road closures in the Happy Camp area along with washing out part of the Salmon River Road.

13.2.2 Location

The best available predictor of where slides and earth flows might occur is the location of past movements. Past landslides can be recognized by their distinctive topographic shapes, which can remain in place for thousands of years (see Figure 13-5). Landslides recognizable in this fashion range from a few acres to several square miles. Most show no evidence of recent movement and are not currently active. A small proportion of them may become active in any given year, with movements concentrated within all or part of the landslide masses or around their edges. Dormant mass movement sites can be reactivated by earthquakes or by exceptionally wet weather. Also, because they consist of broken materials and frequently involve disruption of groundwater flow, these dormant sites are vulnerable to construction-triggered sliding.

Figure 13-5. California State Route 3—Fort Jones Road Rock Slide Area

Mudslides due to warm weather have historically impacted communities near Mt. Shasta. Map 13-1 shows identified landslide hazard areas within the county based on historical landslide occurrences, as well as areas that could be expected to slide based on slope and soil makeup. Areas shown as “probable” slide areas were delineated based on slope and soil type. The parameters for these areas are slopes equal to or exceeding 15 percent and Type C, D or E soil types as identified under the National Earthquake Hazards Reduction Program (NEHRP). The County’s mapping of landslide hazards focused on developed portions of the county where there are population centers. Map 13-2 shows the geomorphological characteristics of historical landslides in the sparsely populated Klamath National Forest within the planning area.

13.2.3 Frequency

Landslides are often triggered by other natural hazards such as earthquakes, heavy rain, floods or wildfires, so landslide frequency is often related to the frequency of these other hazards. In Siskiyou County, landslides typically occur during and after major storms, so the potential for landslides largely coincides with the potential for sequential severe storms that saturate steep, vulnerable soils. Landslide events occurred during winter storms of 1993, 1995, 2006, 2010, 2014 and 2017. According to SHELDUS records, the planning area has been impacted by severe storms at least once every few years since 1960. Until better data is generated specifically for landslide hazards, this severe storm frequency is appropriate for the purpose of ranking risk associated with the landslide hazard.

In general, landslides are most likely during periods of higher than average rainfall. The ground must be saturated prior to the onset of a major storm for significant landsliding to occur. Most local landslides occur in January or late winter after the water table has risen during the wet months of November and December.

Landslides follow a pattern of occurrence that typically repeats during heavy winter storms, generally coinciding with El Nino climate events in the Pacific Ocean. Every few years, warm equatorial waters are driven northward, bringing moisture-laden air that results in more frequent and severe winter storms in California. The added weight of rain-saturated slopes and the weakening of slopes caused by the pressure that groundwater exerts on porous hillside materials can trigger slope failure. Improved forecasting of El Nino events now provides advanced warning to better prepare for and respond to potential slope failures.

13.2.4 Severity

Landslides destroy property and infrastructure and can take the lives of people. Slope failures in the United States result in an average of 25 lives lost per year and an annual cost to society of about $1.5 billion. According to FEMA, the December 2005 to January 2006 storms caused in excess of $35 million in property damage across multiple counties due to landslides, mudslides and debris flows. This was about half of all damage caused by the storm. The landslides caused by the storm also caused tens of millions of dollars of damage to road infrastructure.

13.2.5 Warning Time

Mass movements can occur suddenly or slowly. The velocity of movement may range from a slow creep of inches per year to many feet per second, depending on slope angle, material and water content. Some methods used to monitor mass movements can provide an idea of the type of movement and the amount of time prior to failure. It is also possible to determine what areas are at risk during general time periods. Assessing the geology, vegetation and amount of predicted precipitation for an area can help in these predictions. However, there is no practical warning system for individual landslides. The current standard operating procedure is to monitor situations on a case-by-case basis, and respond after the event has occurred. Generally accepted warning signs for landslide activity include:

- Springs, seeps, or saturated ground in areas that have not typically been wet before
- New cracks or unusual bulges in the ground, street pavements or sidewalks
- Soil moving away from foundations
- Ancillary structures such as decks and patios tilting and/or moving relative to the main house
- Tilting or cracking of concrete floors and foundations
- Broken water lines and other underground utilities

- Leaning telephone poles, trees, retaining walls or fences
- Offset fence lines
- Sunken or down-dropped road beds
- Rapid increase in creek water levels, possibly accompanied by increased turbidity (soil content)
- Sudden decrease in creek water levels though rain is still falling or just recently stopped
- Sticking doors and windows, and visible open spaces indicating jambs and frames out of plumb
- A faint rumbling sound that increases in volume as the landslide nears
- Unusual sounds, such as trees cracking or boulders knocking together.

13.3. SECONDARY HAZARDS

Landslides can cause several types of secondary effects, such as blocking access to roads, which can isolate residents and businesses and delay commercial, public and private transportation. This could result in economic losses for businesses. Other potential problems resulting from landslides are power and communication failures. Vegetation or poles on slopes can be knocked over, resulting in possible losses to power and communication lines. Landslides also have the potential of destabilizing the foundation of structures, which may result in monetary loss for residents. They also can damage rivers or streams, potentially harming water quality, fisheries and spawning habitat.

13.4. CLIMATE CHANGE IMPACTS

Climate change may impact storm patterns, increasing the probability of more frequent, intense storms with varying duration. Increase in global temperature could affect the snowpack and its ability to hold and store water. Warming temperatures also could increase the occurrence and duration of droughts, which would increase the probability of wildfire, reducing the vegetation that helps to support steep slopes. All of these factors would increase the probability for landslide occurrences.

13.5. EXPOSURE

13.5.1 Population

Population exposed to the landslide hazard was estimated using the structure count of residential buildings within the landslide risk area and applying the census value of 2.4 persons per household for Siskiyou County. Using this approach, the estimated population living in the landslide risk area is 250 and the population living in the probable landslide risk area is 5. The population exposed to landslides identified in the Klamath National Forest geomorphic landslide hazard data set is 8 people.

13.5.2 Property

Table 13-1 shows the number and assessed value of structures exposed to all landslide risk in the planning area. There are 118 structures exposed to the landslide hazard, with an estimated value of $17.2 million. The majority of the exposed structures are residential.

TABLE 13-1.
SISKIYOU COUNTY STRUCTURES IN ALL LANDSLIDE RISK AREAS

	Buildings Exposed	Assessed Value			% of AV
		Structure	Contents	Total	
Dorris	0	0	0	0	0
Dunsmuir	12	$534,457	$374,120	$908,577	0.62%
Etna	0	0	0	0	0
Fort Jones	0	0	0	0	0
Montague	0	0	0	0	0
Mt. Shasta	0	0	0	0	0
Tulelake	0	0	0	0	0
Weed	0	0	0	0	0
Yreka	0	0	0	0	0
Unincorporated	106	$9,077,101	$7,203,839	$16,280,940	0.67%
Total	**118**	**$9,611,558**	**$7,577,959**	**$17,189,517**	**0.39%**

13.5.3 Critical Facilities and Infrastructure

Table 13-2 summarizes the critical facilities exposed to the landslide hazard. No loss estimation of these facilities was performed due to the lack of established damage functions for the landslide hazard. A significant amount of infrastructure can be exposed to mass movements:

- **Roads**—Access to major roads is crucial to life-safety after a disaster event and to response and recovery operations. Landslides can block egress and ingress on roads, causing isolation for neighborhoods, traffic problems and delays for public and private transportation. This can result in economic losses for businesses.
- **Bridges**—Landslides can significantly impact road bridges. Mass movements can knock out bridge abutments or significantly weaken the soil supporting them, making them hazardous for use.
- **Power Lines**—Power lines are generally elevated above steep slopes; but the towers supporting them can be subject to landslides. A landslide could trigger failure of the soil underneath a tower, causing it to collapse and ripping down the lines. Power and communication failures due to landslides can create problems for vulnerable populations and businesses.

13.5.4 Environment

Environmental problems as a result of mass movements can be numerous. Landslides that impact streams may adversely affect fish and wildlife habitat, as well as water quality. Hillsides that provide wildlife habitat can be lost for prolong periods of time due to landslides.

**TABLE 13-2.
CRITICAL FACILITIES EXPOSED TO LANDSLIDE HAZARDS**

	Number of Exposed Critical Facilities in Risk Area
Medical and Health Services	0
Government/Shelter	1
Protective Function	0
Schools	0
Hazmat	0
Other Critical Function	0
Bridges	3
Water	0
Waste Water	0
Total	**4**

13.6. VULNERABILITY

13.6.1 Population

Due to the nature of census block group data, it is difficult to determine demographics of populations vulnerable to mass movements. In general, all of the estimated 250 persons exposed to higher risk landslide areas are considered to be vulnerable. Tourists traveling in landslide prone areas increase the number of lives endangered by this hazard, as do homes built on view property atop or below bluffs and on steep slopes subject to mass movement.

13.6.2 Property

Although complete historical documentation of the landslide threat in Siskiyou County is lacking, the landslides of 1969, 1993, 1995, 2005, 2010, 2014 and 2017 suggest a significant vulnerability to such hazards. The millions of dollars in damage countywide attributable to mass movement during those storms affected private property and public infrastructure and facilities.

Loss estimations for the landslide hazard are not based on modeling utilizing damage functions, because no such damage functions have been generated. Instead, loss estimates were developed representing 10 percent, 30 percent and 50 percent of the assessed value of exposed structures. This allows emergency managers to select a range of economic impact based on an estimate of the percent of damage to the general building stock. Damage in excess of 50 percent is considered to be substantial by most building codes and typically requires total reconstruction of the structure. Table 13-3 shows the general building stock loss estimates in landslide risk areas.

TABLE 13-3.
ESTIMATED BUILDING LOSSES IN THE LANDSLIDE RISK AREAS

Jurisdiction	Building Count	Assessed Value	10% Damage	30% Damage	50% Damage
Dorris	0	0	0	0	$0
Dunsmuir	12	$534,457	$53,446	$160,337	$267,229
Etna	0	0	0	0	$0
Fort Jones	0	0	0	0	$0
Montague	0	0	0	0	$0
Mt. Shasta	0	0	0	0	$0
Tulelake	0	0	0	0	$0
Weed	0	0	0	0	$0
Yreka	0	0	0	0	$0
Unincorporated	106	$9,077,101	$907,710	$2,723,130	$4,538,551
Total	**118**	**$9,611,558**	**$961,156**	**$2,883,467**	**$4,805,779**

13.6.3 Critical Facilities and Infrastructure

There are at least 4 critical facilities exposed to the landslide hazard to some degree. A more in-depth analysis of the mitigation measures taken by these facilities to prevent damage from mass movements should be done to determine if they could withstand impacts of a mass movement.

Several types of infrastructure are exposed to mass movements, including transportation, water and sewer and power infrastructure. Highly susceptible areas of the county include mountain and coastal roads and transportation infrastructure. At this time all infrastructure and transportation corridors identified as exposed to the landslide hazard are considered vulnerable until more information becomes available.

13.6.4 Environment

The environment vulnerable to landslide hazard is the same as the environment exposed to the hazard.

13.7. FUTURE TRENDS IN DEVELOPMENT

The county has experienced moderate growth over the past 10 years, averaging a 0.18-percent annual increase in population from 2000 through 2017. However, economic problems in the past three years impacted growth in the County, with some area experiencing negative growth. Siskiyou County and its planning partners are optimistic that marginal, sustained growth will return to the county as the state and national economies strengthen.

The County and its planning partners are equipped to handle future growth within landslide hazard areas. All municipal planning partners have general plans that address landslide risk areas in their safety elements. All partners have committed to linking their general plans to this hazard mitigation Plan. This will create an opportunity for wise land use decisions as future growth impacts landslide hazard areas.

Additionally, the State of California has adopted the International Building Code (IBC) by reference in its California Building Standards Code. The IBC includes provisions for geotechnical analyses in steep slope areas that have soil types considered susceptible to landslide hazards. These provisions assure that new construction is built to standards that reduce the vulnerability to landslide risk.

13.8. SCENARIO

Major landslides in Siskiyou County occur as a result of soil conditions that have been affected by severe storms, groundwater or human development. The worst-case scenario for landslide hazards in the planning area would generally correspond to a severe storm that had heavy rain and caused flooding. Landslides are most likely during late winter when the water table is high. After heavy rains from November to December, soils become saturated with water. As water seeps downward through upper soils that may consist of permeable sands and gravels and accumulates on impermeable silt, it will cause weakness and destabilization in the slope. A short intense storm could cause saturated soil to move, resulting in landslides. As rains continue, the groundwater table rises, adding to the weakening of the slope. Gravity, poor drainage, a rising groundwater table and poor soil exacerbate hazardous conditions.

Mass movements are becoming more of a concern as development moves outside of city centers and into areas less developed in terms of infrastructure. Most mass movements would be isolated events affecting specific areas. It is probable that private and public property, including infrastructure, will be affected. Mass movements could affect bridges that pass over landslide prone ravines and knock out rail service through the county. Road obstructions caused by mass movements would create isolation problems for residents and businesses in sparsely developed areas. Property owners exposed to steep slopes may suffer damage to property or structures. Landslides carrying vegetation such as shrubs and trees may cause a break in utility lines, cutting off power and communication access to residents.

Continued heavy rains and flooding will complicate the problem further. As emergency response resources are applied to problems with flooding, it is possible they will be unavailable to assist with landslides occurring all over Siskiyou County.

13.9. ISSUES

Important issues associated with landslides in Siskiyou County include the following:

- There are existing homes in landslide risk areas throughout the County. The degree of vulnerability of these structures depends on the codes and standards the structures were constructed to. Information to this level of detail is not currently available.
- Future development could lead to more homes in landslide risk areas.
- Mapping and assessment of landslide hazards are constantly evolving. As new data and science become available, assessments of landslide risk should be re-evaluated.
- The impact of climate change on landslides is uncertain. If climate change impacts atmospheric conditions, then exposure to landslide risks is likely to increase.
- Landslides may cause negative environmental consequences, including water quality degradation.
- The risk associated with the landslide hazard overlaps the risk associated with other hazards such as earthquake, flood and wildfire. This provides an opportunity to seek mitigation alternatives with multiple objectives that can reduce risk for multiple hazards.

CHAPTER 14.
SEVERE WEATHER

14.1. GENERAL BACKGROUND

Severe weather refers to any dangerous meteorological phenomena with the potential to cause damage, serious social disruption, or loss of human life. It includes thunderstorms, downbursts, tornadoes, waterspouts, snowstorms, ice storms, and dust storms.

Severe weather can be categorized into two groups: those that form over wide geographic areas are classified as general severe weather; those with a more limited geographic area are classified as localized severe weather. Severe weather, technically, is not the same as extreme weather, which refers to unusual weather events are at the extremes of the historical distribution for a given area.

Three types of severe weather events typically impact Siskiyou County: thunderstorms, damaging winds, and cold waves. These types of severe weather are described in the following sections. Flooding issues associated with severe weather are discussed in Chapter 12.

14.1.1 Thunderstorms

A thunderstorm is a rain event that includes thunder and lightning. A thunderstorm is classified as “severe” when it contains one or more of the following: hail with a diameter of three-quarter inch or greater, winds gusting in excess of 50 knots (57.5 mph), or tornado.

Three factors cause thunderstorms to form: moisture, rising unstable air (air that keeps rising when disturbed), and a lifting mechanism to provide the disturbance. The sun heats the surface of the earth, which warms the air above it. If this warm surface air is forced to rise (hills or mountains can cause rising motion, as can the interaction of warm air and cold air or wet air and dry air) it will continue to rise as long as it weighs less and stays warmer than the air around it. As the air rises, it transfers heat from the surface of the earth to the upper levels of the atmosphere (the process of convection). The water vapor it contains begins to cool and it condenses into a cloud. The cloud eventually grows upward into areas where the temperature is below freezing. Some of the water vapor turns to ice and some of it turns into water droplets. Both have electrical charges. Ice

DEFINITIONS

Freezing Rain—The result of rain occurring when the temperature is below the freezing point. The rain freezes on impact, resulting in a layer of glaze ice up to an inch thick. In a severe ice storm, an evergreen tree 60 feet high and 30 feet wide can be burdened with up to six tons of ice, creating a threat to power and telephone lines and transportation routes.

Severe Local Storm—”Microscale” atmospheric systems, including tornadoes, thunderstorms, windstorms, ice storms and snowstorms. These storms may cause a great deal of destruction and even death, but their impact is generally confined to a small area. Typical impacts are on transportation infrastructure and utilities.

Thunderstorm—A storm featuring heavy rains, strong winds, thunder and lightning, typically about 15 miles in diameter and lasting about 30 minutes. Hail and tornadoes are also dangers associated with thunderstorms. Lightning is a serious threat to human life. Heavy rains over a small area in a short time can lead to flash flooding.

Tornado—Funnel clouds that generate winds up to 500 miles per hour. They can affect an area up to three-quarters of a mile wide, with a path of varying length. Tornadoes can come from lines of cumulonimbus clouds or from a single storm cloud. They are measured using the Fujita Scale, ranging from F0 to F5.

Windstorm—A storm featuring violent winds. Southwesterly winds are associated with strong storms moving onto the coast from the Pacific Ocean. Southern winds parallel to the coastal mountains are the strongest and most destructive winds. Windstorms tend to damage ridgelines that face into the winds.

Winter Storm—A storm having significant snowfall, ice, and/or freezing rain; the quantity of precipitation varies by elevation.

particles usually have positive charges, and rain droplets usually have negative charges. When the charges build up enough, they are discharged in a bolt of lightning, which causes the sound waves we hear as thunder. Thunderstorms have three stages (see Figure 14-1):

- The *developing stage* of a thunderstorm is marked by a cumulus cloud that is being pushed upward by a rising column of air (updraft). The cumulus cloud soon looks like a tower (called towering cumulus) as the updraft continues to develop. There is little to no rain during this stage but occasional lightning. The developing stage lasts about 10 minutes.
- The thunderstorm enters the *mature stage* when the updraft continues to feed the storm, but precipitation begins to fall out of the storm, and a downdraft begins (a column of air pushing downward). When the downdraft and rain-cooled air spread out along the ground, they form a gust front, or a line of gusty winds. The mature stage is the most likely time for hail, heavy rain, frequent lightning, strong winds, and tornadoes. The storm occasionally has a black or dark green appearance.
- Eventually, a large amount of precipitation is produced and the updraft is overcome by the downdraft beginning the *dissipating stage*. At the ground, the gust front moves out a long distance from the storm and cuts off the warm moist air that was feeding the thunderstorm. Rainfall decreases in intensity, but lightning remains a danger.

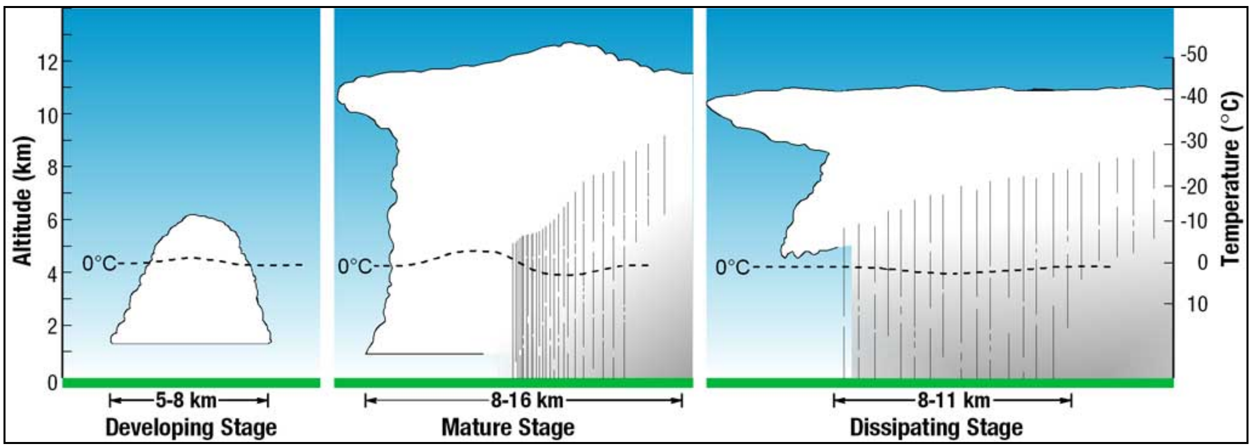


Figure 14-1. The Thunderstorm Life Cycle

There are four types of thunderstorms:

- **Single-Cell Thunderstorms—**Single-cell thunderstorms usually last 20 to 30 minutes. A true single-cell storm is rare, because the gust front of one cell often triggers the growth of another. Most single-cell storms are not usually severe, but a single-cell storm can produce a brief severe weather event. When this happens, it is called a pulse severe storm.
- **Multi-Cell Cluster Storm—**A multi-cell cluster is the most common type of thunderstorm. The multi-cell cluster consists of a group of cells, moving as one unit, with each cell in a different phase of the thunderstorm life cycle. Mature cells are usually found at the center of the cluster and dissipating cells at the downwind edge. Multi-cell cluster storms can produce moderate-size hail, flash floods and weak tornadoes. Each cell in a multi-cell cluster lasts only about 20 minutes; the multi-cell cluster itself may persist for several hours. This type of storm is usually more intense than a single cell storm.
- **Multi-Cell Squall Line—**A multi-cell line storm, or squall line, consists of a long line of storms with a continuous well-developed gust front at the leading edge. The line of storms can be solid, or there can be gaps and breaks in the line. Squall lines can produce hail up to

golf-ball size, heavy rainfall, and weak tornadoes, but they are best known as the producers of strong downdrafts. Occasionally, a strong downburst will accelerate a portion of the squall line ahead of the rest of the line. This produces what is called a bow echo. Bow echoes can develop with isolated cells as well as squall lines. Bow echoes are easily detected on radar but are difficult to observe visually.

- **Super-Cell Storm—**A super-cell is a highly organized thunderstorm that poses a high threat to life and property. It is similar to a single-cell storm in that it has one main updraft, but the updraft is extremely strong, reaching speeds of 150 to 175 miles per hour. Super-cells are rare. The main characteristic that sets them apart from other thunderstorms is the presence of rotation. The rotating updraft of a super-cell (called a mesocyclone when visible on radar) helps the super-cell to produce extreme weather events, such as giant hail (more than 2 inches in diameter), strong downbursts of 80 miles an hour or more, and strong to violent tornadoes. Thunderstorms cover the entire planning area.

14.1.2 Damaging Winds

Damaging winds are classified as those exceeding 60 mph. Damage from such winds accounts for half of all severe weather reports in the lower 48 states and is more common than damage from tornadoes. Wind speeds can reach up to 100 mph and can produce a damage path extending for hundreds of miles. These winds cover the entire planning area. There are seven types of damaging winds:

- **Straight-line winds**—Any thunderstorm wind that is not associated with rotation; this term is used mainly to differentiate from tornado winds. Most thunderstorms produce some straight-line winds as a result of outflow generated by the thunderstorm downdraft.
- **Downdrafts**—A small-scale column of air that rapidly sinks toward the ground.
- **Downbursts**—A strong downdraft with horizontal dimensions larger than 2.5 miles resulting in an outward burst or damaging winds on or near the ground. Downburst winds may begin as a microburst and spread out over a wider area, sometimes producing damage similar to a strong tornado. Although usually associated with thunderstorms, downbursts can occur with showers too weak to produce thunder.
- **Microbursts**—A small concentrated downburst that produces an outward burst of damaging winds at the surface. Microbursts are generally less than 2.5 miles across and short-lived, lasting only 5 to 10 minutes, with maximum wind speeds up to 168 mph. There are two kinds of microbursts: wet and dry. A wet microburst is accompanied by heavy precipitation at the surface. Dry microbursts, common in places like the high plains and the intermountain west, occur with little or no precipitation reaching the ground.
- **Gust front—**A gust front is the leading edge of rain-cooled air that clashes with warmer thunderstorm inflow. Gust fronts are characterized by a wind shift, temperature drop, and gusty winds out ahead of a thunderstorm. Sometimes the winds push up air above them, forming a shelf cloud or detached roll cloud.
- **Derecho**—A derecho is a widespread thunderstorm wind caused when new thunderstorms form along the leading edge of an outflow boundary (the boundary formed by horizontal spreading of thunderstorm-cooled air). The word “derecho” is of Spanish origin and means “straight ahead.” Thunderstorms feed on the boundary and continue to reproduce. Derechos typically occur in summer when complexes of thunderstorms form over plains, producing heavy rain and severe wind. The damaging winds can last a long time and cover a large area.

- **Bow Echo**—A bow echo is a linear wind front bent outward in a bow shape. Damaging straight-line winds often occur near the center of a bow echo. Bow echoes can be 200 miles long, last for several hours, and produce extensive wind damage at the ground.

14.1.3 Cold Waves

As defined by the National Weather Service, a cold wave is a rapid fall in temperature within a 24-hour period, requiring substantially increased protection for agriculture, industry, commerce and social activities. Cold waves are formed by large cool air masses accumulating over a region, caused by movements of air streams. Criteria for defining a cold wave are the rate at which the temperature falls and the minimum to which it falls. The minimum-temperature criterion varies with geographic region and time of year.

A cold wave can cause death and injury to livestock and wildlife. Exposure to cold mandates greater caloric intake for all animals, including humans, and if a cold wave is accompanied by heavy and persistent snow, grazing animals may be unable to reach necessary food and water, and die of hypothermia or starvation. Cold waves often necessitate the purchase of fodder for livestock at considerable cost to farmers. Human populations can be inflicted with frostbite when exposed for extended periods of time to cold, which may result in the loss of limbs or damage to internal organs.

Extreme winter cold often causes poorly insulated water pipes to freeze. Even some poorly protected indoor plumbing may rupture as frozen water expands, causing property damage. Fires become more hazardous during extreme cold because broken water mains may make water supplies unreliable, making firefighting more difficult.

Cold waves that bring unexpected freezes and frosts during the growing season in mid-latitude zones can kill plants during the early and most vulnerable stages of growth. This results in crop failure as plants are killed before they can be harvested. Such cold waves have caused famines. Cold waves can also cause soil particles to harden and freeze, making it harder for plants and vegetation to grow. During several summers in 1810s, numerous crops failed due to unusual cold snaps after volcanic eruptions reduced incoming sunlight. These are cover the entire planning area. The average low in Siskiyou county is 27 degrees Fahrenheit anything below this is considered extreme cold.

A cold front can trigger heavy snowfall, which presents numerous hazards:

- Significant damage may occur when heavy, wet snow, with a snow-water ratio of between 6:1 and 12:1, applies a weight in excess of 10 pounds per square foot onto trees or electricity lines.
- An avalanche can occur with a sudden thermal or mechanical impact on snow that has accumulated on a mountain, which causes the snow to rush downhill suddenly. Preceding an avalanche is a phenomenon known as an avalanche wind caused by the approaching avalanche, which adds to its destructive potential.
- Large amounts of snow that accumulate on top of man-made structures can lead to structural failure.
- During snowmelt, acidic precipitation that accumulated in the snow pack is released, harming marine life.

14.2. HAZARD PROFILE

14.2.1 Past Events

Table 14-1 summarizes severe weather events in Siskiyou County since 1990, as recorded by the National Oceanic and Atmospheric Administration (NOAA).

**TABLE 14-1.
SEVERE WEATHER EVENTS IMPACTING PLANNING AREA SINCE 1990**

Date	Type	Deaths or Injuries	Property Damage
9/23/1990	Thunderstorm/Wind	0	$82,000
Description: Storm produced sustained winds up to 61 mph.			
01/13/1993	Winter Storm	0	$350,000
Description: Severe winter weather impacted most of California including the planning area. Damages within the county were sufficient to trigger a presidential disaster declaration.			
1/15/1999	High Wind	0	None reported
Description: The Weed Remote Automated Weather Station (RAWS) reported a peak gust of 52 mph. A High Wind Warning was issued for CAZ081 (Central Siskiyou County) at 15/1451 PST and cancelled at 16/1330. Although no stations in the zone verified, the Weed RAWS came close with two gusts over 50 mph. The Van Bremmer RAWS, in an adjacent zone at 5310 feet, reported a gust to 62 mph at 15/1945 PST.			
10/15/1999	Extreme Cold	0	Non reported
Description: A Frost Warning was issued for central and western Siskiyou county. Reported low temperatures were in the 30s, so frost probably did occur this morning. Mt. Hebron (CAZ084) reported a low of 19 degrees (15 degrees below normal). This met the freeze warning criteria for the zone, but the very low temperatures did not appear to be widespread.			
10/27/1999	High Wind	0	None reported
Description: Spotter SY57 at Weed reported winds 40 MPH gusting to 68 MPH at 0510 PDT. A wind advisory was issued for this zone at 1018 PDT on 10/27 and cancelled at 2048 PDT on 10/27. The above report was the only one that met High Wind Warning criteria.			
12/9/1999	Heavy Snow	0	None reported
Description: Spotter SY49 northeast of Mt. Shasta City reported 5 inches of new snow. A Heavy Snow Warning was issued for the Mt. Shasta City area (CAZ082) at 1649 PST on 12/8 and cancelled at 0924 PST on 12/9. The criteria for heavy snow in that zone is 5 inches in 12 hours or 7 inches in 24 hours. This appears to have verified.			
3/27/2000	High Wind	0	Minimal
Description: A member of the general public reported the following incident in Happy Camp. At around 1630 on 03/27/00, a rotating dust cloud moved across the roof of a hardware store in Happy Camp. The winds in the cloud stripped off the metal roof of the store and rolled it into a big ball. The store then closed for the day. The dust cloud then continued about 100 yards down Highway 96 before dissipating. The winds observed were significant, but not excessive.			
5/31/2000	Extreme Cold	0	Crop Damage
Description: A major freeze occurred on the morning of 05/31/00 with no warning issued. The Klamath Falls Herald and News reported extensive damage to area crops, especially sugar beets. Beet damage ranged from moderate to a total loss. Attempts were made to have the area declared a Federal Disaster area. Reported low temperatures were in the 20s.			
1/10/2001	High Wind	0	None reported
Description: Spotter SY39 near Black Butte reported estimated winds south 40 to 50 mph. The wind event above was covered with a Wind Advisory in this area, even though the spotter reported winds met warning criteria.			

TABLE 14-1.
SEVERE WEATHER EVENTS IMPACTING PLANNING AREA SINCE 1990

Date	Type	Deaths or Injuries	Property Damage
1/1/2001	Heavy Snow	0	None reported
Description: A California Department of Water Resources measuring device reported 13 inches of snow between 1200 and 2400 on 01/10. A Winter Storm Warning was issued for zone CAZ082 for heavy snow at 0455 PST on 01/10/01 and expired at 0449 PST on 01/11/01.			
11/19/2001	High Wind	0	None Reported
Description: The Weed RAWS reported a max sustained wind of 40 mph and a peak gust of 59 mph at 1445 PST on 11/19/01. One other Weed observation verified the warning. A High Wind Warning was issued for CAZ081 effective at the above times.			
11/28/2001	Winter Storm/High wind	0	None reported
Description: Spotter SY84 at 2800 feet reported 4 inches of new snow. Spotter SY12 at 3000 feet reported wind 35-45 mph gusting to 60 mph.			
12/13/2001	Winter Storm	0	0
Description: Spotter SY39 reported near blizzard conditions with south winds 30 to 35 mph and heavy snow.			
3/9/2002	High Wind	0	0
Description: The RAWS at Weed Airport recorded a sustained wind of 43 mph. A High Wind Warning was issued for the Shasta Valley around Weed at 2102 PST on 03/08 and expired at 09/1845 PST. The above observations verified the warning. The Weed RAWS highest sustained and highest peak wind are listed above, but several other observations from the same sensor also met high wind warning criteria.			
3/10/2002	Heavy snow	0	0
Description: Mt. Shasta Ski Park reported 11 inches of snow overnight. A Heavy Snow Warning was issued for California zones CAZ080/082 at 0540 PST on 03/09/02 and expired at 1445 PST on 03/10/02. The above report was the only one received that verified the warning.			
12/14/2002	Winter Storm	0	0
Description: A Winter Storm Warning was issued for zones CAZ080/082 effective at the above times. No verifying reports were received. However, Sand Flat at 6750 feet recorded 10 inches between 1500 PST and 2200 PST, so it is likely that snow was sufficient to verify a warning in parts of the warning area.			
7/23/2003	Thunderstorm/Wind	0	$200,000
Description: A thunderstorm developed over the Scott Valley around this time. While radar reports did not indicate that this storm was severe, a wet microburst propagated from it, bringing estimated 80+ mph winds to the area near the Greenview airport. A subsequent NWS Storm Survey discovered damaged structures and trees, the largest of which were compromised by wood rot. Greenview airport recorded a peak gust of 54 mph with the event. Interviews with residents yielded numerous reports of golf ball sized hail and hourly rainfall totals exceeding 1.50 inches.			
9/3/2003	Lightning	0	None reported
Description: A Red Flag Warning was issued for all of southern Oregon due to a line of thunderstorms approaching from the south containing dry lightning. The line weakened before arrival, but a number of strikes did occur over northern California. However, verification was marginal as the lightning strikes may have not been widespread enough to verify the Red Flag Warning.			
01/01/2004	Blizzard	0	None reported
Description: The Weed RAWS recorded wind gusts 44-53 mph on nearly every observation in this time interval. This, combined with the heavy snow reported by spotters, indicates that blizzard conditions likely did occur during this time interval. An extraordinary winter storm struck Oregon and Northern California on January 1, 2004. A multitude of warnings and advisories were issued to cover this event.			

TABLE 14-1.
SEVERE WEATHER EVENTS IMPACTING PLANNING AREA SINCE 1990

Date	Type	Deaths or Injuries	Property Damage
7/26/2006	Thunderstorm/Wind	0	None reported
Description: Spotter SY32 in Happy Camp reported strong winds with light rain, 1.5 inch thick branches were broken off of trees. A Severe Thunderstorm warning was issued for West Central Siskiyou County			
8/6/2006	Hail	0	None reported
Description: Spotter SY135 7 W Montague reported .75 inch hail with a thunderstorm. A Severe Thunderstorm Warning was issued for northeast Siskiyou County			
2/21/2007	Heavy Snow	0	None reported
Description: An unusually cold late winter storm moved into Southern Oregon and Northern California during this interval. Numerous Heavy Snow Warnings were issued for this system along with a number of Snow Advisories. At 3500 feet reported 12 inches of snow in 24 hours.			
7/6/2007	Thunderstorm/Wind	0	Unknown
Description: The Klamath Falls Herald and News reported extensive wind, rain, and hail damage to crops around Butte Valley and Tulelake. Crop damage included 1400 acres of strawberry root stock and several alfalfa and potato fields. Monsoonal moisture combined with strong surface heating made for scattered afternoon and evening thunderstorms on this date. A few of the thunderstorms achieved severe status.			
1/27/2008	Blizzard	0	None reported
Description: Yet another winter storm brought another round of heavy snow to Northern California and Southern Oregon. The snow level dropped to sea level during this event...bringing snow to areas that rarely get any snow. In Northern California, a Winter Storm Warning was issued for California zone CAZ082/083 above 3,000 feet. A spotter in Dorris at 4300 feet reported west winds 30 to 40 mph with visibilities 50 yards.			
11/21/2009	Heavy	0	None Reported
Description: A strong cold front followed by strong cold air advection lowered snow levels between 2000-3000 feet which allowed for 6 to 6.5 inches of snow to be observed within a 12 hour period.			
12/11/2009	Extreme Cold/wind Chill	0	None reported
Description: A frigid Arctic air mass moved into Oregon December 5th and remained over the area through December 12th, when it finally abated as a Pacific system approached the area. Low temperatures in this zone during this interval were generally in the teens. On the coldest nights...the 9th and the 10th, the coldest stations dipped into the single digits. Temperatures warmed on the 11th but remained well below normal...and became more seasonable on the 12th. Numerous broken pipes and other cold-related damage was reported during this interval			
3/8/2010	Severe Winter storm	0	In excess of $200,000
Description: a series of heavy snowstorms impacted the planning area during March. The resulting accumulation of snowfall caused sufficient damages to trigger a presidential disaster declaration for the planning area.			
12/14/2014	Winter Storm	0	None Reported
Description: a series of heavy snow and rain storms impacted the planning area.			
01/02/2017	Winter Storm	0	None Reported
Description: a series of heavy snow and rain storms impacted the planning area			
02/01/2017	Winter Storm	0	None Reported
Description: a series of heavy snow and rain storms impacted the planning area			

14.2.2 Location

Severe weather events have the potential to happen anywhere in the planning area. Communities in low-lying areas next to streams or lakes are more susceptible to flooding. Wind events are most damaging to areas that are heavily wooded.

14.2.3 Frequency

The severe weather events for Siskiyou County shown in Table 14-1 are often related to high winds associated with winter storms and thunderstorms. The planning area can expect to experience exposure to some type of severe weather event at least annually.

14.2.4 Severity

The most common problems associated with severe storms are immobility and loss of utilities. Fatalities are uncommon, but can occur. Roads may become impassable due to flooding, downed trees, ice or snow, or a landslide. Power lines may be downed due to high winds or ice accumulation, and services such as water or phone may not be able to operate without power. Lightning can cause severe damage and injury.

Windstorms can be a frequent problem in the planning area and have been known to cause damage to utilities. The predicted wind speed given in wind warnings issued by the National Weather Service is for a one-minute average; gusts may be 25 to 30 percent higher.

Tornadoes are potentially the most dangerous of local storms, but they are not common in the planning area. If a major tornado were to strike within the populated areas of the county, damage could be widespread. Businesses could be forced to close for an extended period or permanently, fatalities could be high, many people could be homeless for an extended period, and routine services such as telephone or power could be disrupted. Buildings may be damaged or destroyed. California ranks 32nd among states for frequency of tornadoes, 44th for the frequency of tornados per square mile, 36th for injuries, and 31st for cost of damage. The state has no reported deaths from tornadoes.

14.2.5 Warning Time

Meteorologists can often predict the likelihood of a severe storm. This can give several days of warning time. However, meteorologists cannot predict the exact time of onset or severity of the storm. Some storms may come on more quickly and have only a few hours of warning time.

14.3. SECONDARY HAZARDS

The most significant secondary hazards associated with severe local storms are floods, falling and downed trees, landslides and downed power lines. Rapidly melting snow combined with heavy rain can overwhelm both natural and man-made drainage systems, causing overflow and property destruction. Landslides occur when the soil on slopes becomes oversaturated and fails.

14.4. CLIMATE CHANGE IMPACTS

Climate change presents a significant challenge for risk management associated with severe weather. The frequency of severe weather events has increased steadily over the last century. The number of weather-related disasters during the 1990s was four times that of the 1950s, and cost 14 times as much in economic losses. Historical data shows that the probability for severe weather events increases in a warmer climate (see Figure 14-2). The changing hydrograph caused by climate change could have a significant impact on the intensity, duration and frequency of storm events. All of these impacts could have significant economic consequences.

14.5. EXPOSURE

14.5.1 Population

A lack of data separating severe weather damage from flooding and landslide damage prevented a detailed analysis for exposure and vulnerability. However, it can be assumed that the entire planning area is exposed to some extent to severe weather events. Certain areas are more exposed due to geographic location and local weather patterns. Populations living at higher elevations with large stands of trees or power lines may be more susceptible to wind damage and black out, while populations in low-lying areas are at risk for possible flooding.

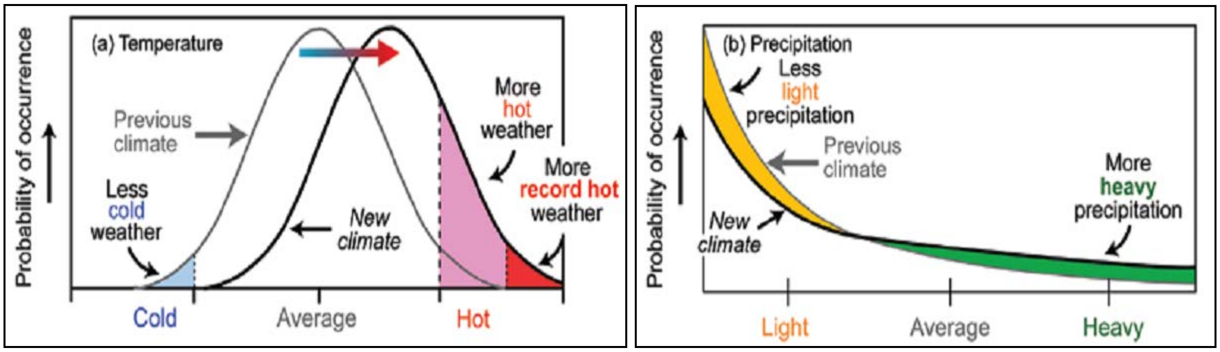


Figure 14-2. Severe Weather Probabilities in Warmer Climates

14.5.2 Property

According to the Siskiyou County Assessor, there are 22,144 buildings within the census tracts that define the planning area. Most of these buildings are residential. Many of the older residential structures were built without the influence of a structure building code that have provisions for wind loads and could therefore be more susceptible to wind damages. All of these buildings are considered to be exposed to the severe weather hazard, but structures in poor condition or in particularly vulnerable locations (located on hilltops or exposed open areas) may risk the most damage. The frequency and degree of damage will depend on specific locations.

14.5.3 Critical Facilities and Infrastructure

All critical facilities exposed to flooding (Chapter 12) are also likely exposed to severe weather. Additional facilities on higher ground may also be exposed to wind damage or damage from falling trees. The most common problems associated with severe weather are loss of utilities. Downed power lines can cause blackouts, leaving large areas isolated. Phone, water and sewer systems may not function. Roads may become impassable due to ice or snow or from secondary hazards such as landslides.

14.5.4 Environment

The environment is highly exposed to severe weather events. Natural habitats such as streams and trees are exposed to the elements during a severe storm and risk major damage and destruction. Prolonged rains can saturate soils and lead to slope failure. Flooding events caused by severe weather or snowmelt can produce river channel migration or damage riparian habitat. Storm surges can erode beachfront bluffs and redistribute sediment loads.

14.6. VULNERABILITY

14.6.1 Population

Vulnerable populations are the elderly, low income or linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are isolated from major roads. Power outages can be life threatening to those dependent on electricity for life support. Isolation of these populations is a significant concern. These populations face isolation and exposure during severe weather events and could suffer more secondary effects of the hazard.

14.6.2 Property

All property is vulnerable during severe weather events, but properties in poor condition or in particularly vulnerable locations may risk the most damage. Those in higher elevations and on ridges may be more prone to wind damage. Those that are located under or near overhead lines or near large trees may be vulnerable to falling ice or may be damaged in the event of a collapse.

Loss estimations for the severe weather hazard are not based on damage functions, because no such damage functions have been generated. Instead, loss estimates were developed representing 10 percent, 30 percent and 50 percent of the assessed value of exposed structures. This allows emergency managers to select a range of potential economic impact based on an estimate of the percent of damage to the general building stock. Damage in excess of 50 percent is considered to be substantial by most building codes and typically requires total reconstruction of the structure. Table 14-2 lists the loss estimates to the general building stock.

**TABLE 14-2.
BUILDINGS VULNERABLE TO SEVERE WEATHER HAZARD**

City	# Assessed	10% Damage	30% Damage	50% Damage
Dunsmuir	933	$77,740,175	$7,774,018	$23,322,053
Etna	361	$34,279,872	$3,427,987	$10,283,962
Fort Jones	355	$27,813,125	$2,781,313	$8,343,938
Montague	558	$41,485,718	$4,148,572	$12,445,715
Mt. Shasta	1,599	$243,034,523	$24,303,452	$72,910,357
Tulelake	384	$16,921,384	$1,692,138	$5,076,415
Weed	1,003	$125,492,838	$12,549,284	$37,647,851
Yreka	2,797	$394,536,909	$39,453,691	$118,361,073
Unincorporated	13,721	$1,490,464,662	$149,046,466	$447,139,399
Total	**22,144**	**$2,472,179,650**	**$247,217,965**	**$741,653,895**

14.6.3 Critical Facilities and Infrastructure

Incapacity and loss of roads are the primary transportation failures resulting from severe weather, mostly associated with secondary hazards. Landslides caused by heavy prolonged rains can block roads are. High winds can cause significant damage to trees and power lines, blocking roads with debris, incapacitating transportation, isolating population, and disrupting ingress and egress. Snowstorms in higher elevations can significantly impact the transportation system and the availability of public safety services. Of particular concern are roads providing access to isolated areas and to the elderly.

Prolonged obstruction of major routes due to landslides, snow, debris or floodwaters can disrupt the shipment of goods and other commerce. Large, prolonged storms can have negative economic impacts for an entire region.

Severe windstorms, downed trees, and ice can create serious impacts on power and above-ground communication lines. Freezing of power and communication lines can cause them to break, disrupting electricity and communication. Loss of electricity and phone connection would leave certain populations isolated because residents would be unable to call for assistance.

14.6.4 Environment

The vulnerability of the environment to severe weather is the same as the exposure.

14.7. FUTURE TRENDS IN DEVELOPMENT

All future development will be affected by severe storms. The ability to withstand impacts lies in sound land use practices and consistent enforcement of codes and regulations for new construction. The planning partners have adopted the International Building Code in response to California mandates. This code is equipped to deal with the impacts of severe weather events. Land use policies identified in general plans within the planning area also address many of the secondary impacts (flood and landslide) of the severe weather hazard. With these tools, the planning partnership is well equipped to deal with future growth and the associated impacts of severe weather.

14.8. SCENARIO

Severe weather events are frequent in the planning area. The altitude and geography of the county make it susceptible to snow accumulation and extreme cold in winter and thunderstorms and high wind events in spring and summer. A worst-case event would involve prolonged high winds during a winter storm accompanied by large amounts of snow. Such an event would have both short-term and longer-term effects. Initially, schools and roads would be closed due to power outages caused by high winds, snow accumulation and downed tree obstructions. In more rural areas, some subdivisions could experience limited ingress and egress. Prolonged rain could produce flooding due to rain-on-snow effects, overtopped culverts with ponded water on roads, and landslides on steep slopes. Flooding and landslides could further obstruct roads and bridges, further isolating residents.

A second “worst-case-scenario” would involve multiple wildfires triggered by thunderstorm activity during the hot and dry summer months. Multiple events would tax county resources and make it difficult to contain the fires.

14.9. ISSUES

Important issues associated with a severe weather in the Siskiyou County planning area include the following:

- Older building stock in the planning area is built to low code standards or none at all. These structures could be highly vulnerable to severe weather events such as windstorms and heavy snow loads.
- Above-ground utility infrastructure is susceptible to snow accumulation and high winds
- Redundancy of power supply must be evaluated.

- The capacity for backup power generation is limited.
- Isolated population centers.
- Road closures (both rural roads to isolated communities and Interstate-5)

CHAPTER 15.
VOLCANO

15.1. GENERAL BACKGROUND

A volcano is a vent in the earth's crust through which magma, rock fragments, gases and ash are ejected from the earth's interior. Over time, accumulation of these erupted products on the earth's surface creates a volcanic mountain. Figure 15-1 illustrates how volcanoes formed in the Cascade Range.

A wide variety of hazards are related to volcanoes. The hazards are distinguished by the different ways in which volcanic materials and other debris flow from the volcano. The molten rock that erupts from a volcano (lava) forms a hill or mountain around the vent. The lava may flow out as a viscous liquid, or it may explode from the vent as solid or liquid particles. Ash and fragmented rock material can become airborne and travel far from the erupting volcano to affect distant areas.

Volcanoes can lie dormant for centuries between eruptions. When they erupt, high-speed avalanches of hot ash and rock (called pyroclastic flows), lava flows, and landslides can devastate areas 10 or more miles away. Huge mudflows of volcanic ash and debris called lahars can inundate valleys more than 50 miles downstream. Ash from explosive eruptions, called tephra, can disrupt human activities hundreds of miles downwind, and drifting clouds of fine ash can cause severe damage to the engines of jet aircraft hundreds or thousands of miles away.

DEFINITIONS

Lahar—A rapidly flowing mixture of water and rock debris that originates from a volcano. While lahars are most commonly associated with eruptions, heavy rains, and debris accumulation, earthquakes may also trigger them.

Lava Flow—The least hazardous threat posed by volcanoes. Cascades volcanoes are normally associated with slow moving andesite or dacite lava.

Stratovolcano—Typically steep-sided, symmetrical cones of large dimension built of alternating layers of lava flows, volcanic ash, cinders, blocks, and bombs, rising as much as 8,000 feet above their bases.

Tephra—Ash and fragmented rock material ejected by a volcanic explosion

Volcano—A vent in the planetary crust from which magma (molten or hot rock) and gas from the earth's core erupts.

15.1.1 Volcanos of Siskiyou County

Mount Shasta in Siskiyou County (see Figure 15-2) is a massive compound stratovolcano composed of overlapping cones centered at four or more main vents. It was constructed over a period of more than 100,000 years. Each cone-building period produced pyroxene-andesite lava flows, block-and-ash flows, and mudflows originating mainly at the central vents. Construction of each cone was followed by eruption of domes and pyroclastic flows of more silicic rock at central vents, and of domes, cinder cones, and lava flows at vents on the flanks of the cones.

Mount Shasta's main peak rises to an elevation of 14,162 feet, dominating the landscape of northern California. Shastina is a large subsidiary cone that rises to 12,329 feet on the west flank of the compound volcano. The largest stratovolcano of the Cascade chain at approximately 84 cubic miles, Mount Shasta compares in volume to such massive stratovolcanoes as Mt. Fuji in Japan and Cotopaxi in Ecuador. The mountain hosts five glaciers, including the Whitney Glacier, the largest in California.

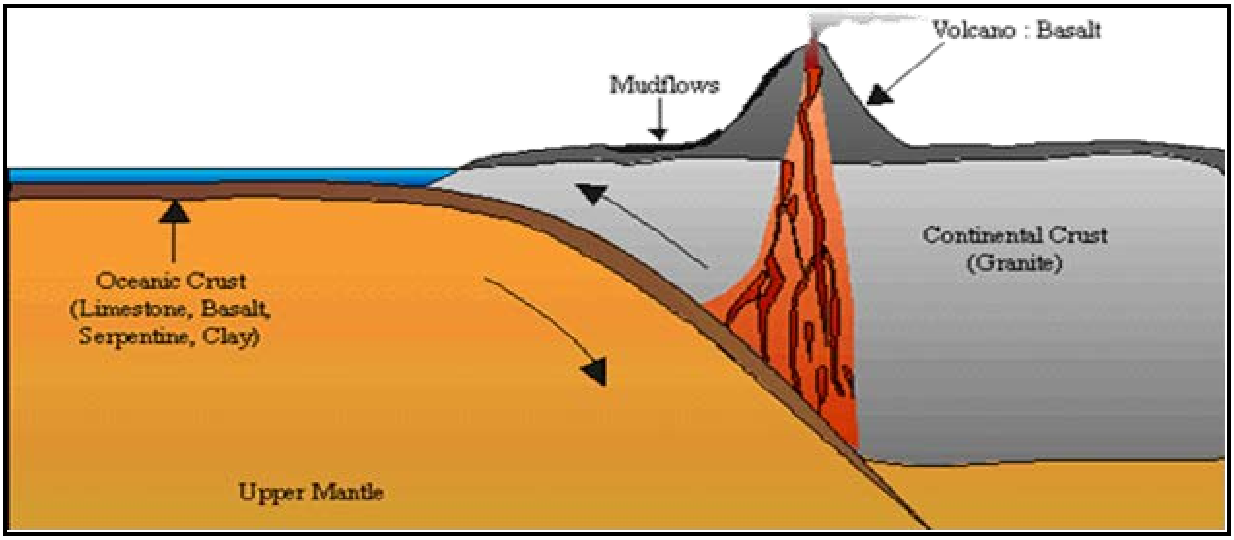


Figure 15-1. The Formation of Cascade Volcanoes

Source: USGS

Figure 15-2. Mount Shasta

Four major cone-building episodes built most of the stratovolcano around separate central vents. The main bulk of the cones built in each of these episodes appears to have accumulated in a short time, lasting perhaps only a few hundred or a few thousand years, during which numerous lava eruptions occurred, mainly from the central vent; the final major eruptions from each of the central craters produced dacite domes and dense-fragment pyroclastic flows. After each episode of rapid cone building, the volcano underwent significant erosion while less frequent eruptions occurred, both from the central vent and from numerous flank vents. The flank eruptions typically produced cinder cones, small monogenetic lava cones, or domes, the latter commonly accompanied by pyroclastic flows. Pyroclastic flows are particularly conspicuous on the west flank of Shastina and its major flank vent, Black Butte.

The Mount Shasta magmatic system has evolved more or less continuously for at least 590,000 years, but the ancestral cone was virtually destroyed by an enormous volcanic sector avalanche and landslide around 300,000 years ago. Only a small remnant of this older edifice remains on the west side of the stratovolcano. Shasta Valley to the north is largely floored by the debris of the sector collapse, likely representing a considerable fraction of the volume of the ancestral cone.

The Sargents Ridge cone, oldest of the four major edifices that formed the present compound volcano after the major sector collapse, is younger than approximately 250,000 years, has undergone two major glaciations, and is exposed mainly on the south side of Mount Shasta. The next younger cone, Misery Hill, is younger than approximately 130,000 years, has been sculpted in one major glaciation, and forms much of the upper part of the mountain. The two younger cones are Holocene: Shastina, west of the cluster of other central vents, was formed mainly between 9,700 and 9,400 years ago; the Hotlum cone, which forms the summit and the north and northwest slopes of Shasta, may overlap Shastina in age, but most of the Hotlum cone is probably younger.

Mount Shasta has continued to erupt at least once every 600 to 800 years for the past 10,000 years. Its most recent eruption probably was in 1786. Evidence for this eruption, recorded from sea by the explorer La Perouse, is somewhat ambiguous, but his description could only have referred to Mount Shasta. A small craterlike depression in the summit dome, containing several small groups of fumaroles and an acidic hot spring, might have formed during that eruption; lithic ash preserved on the slopes of the volcano and widely to the east yields charcoal dates of about 200 years.

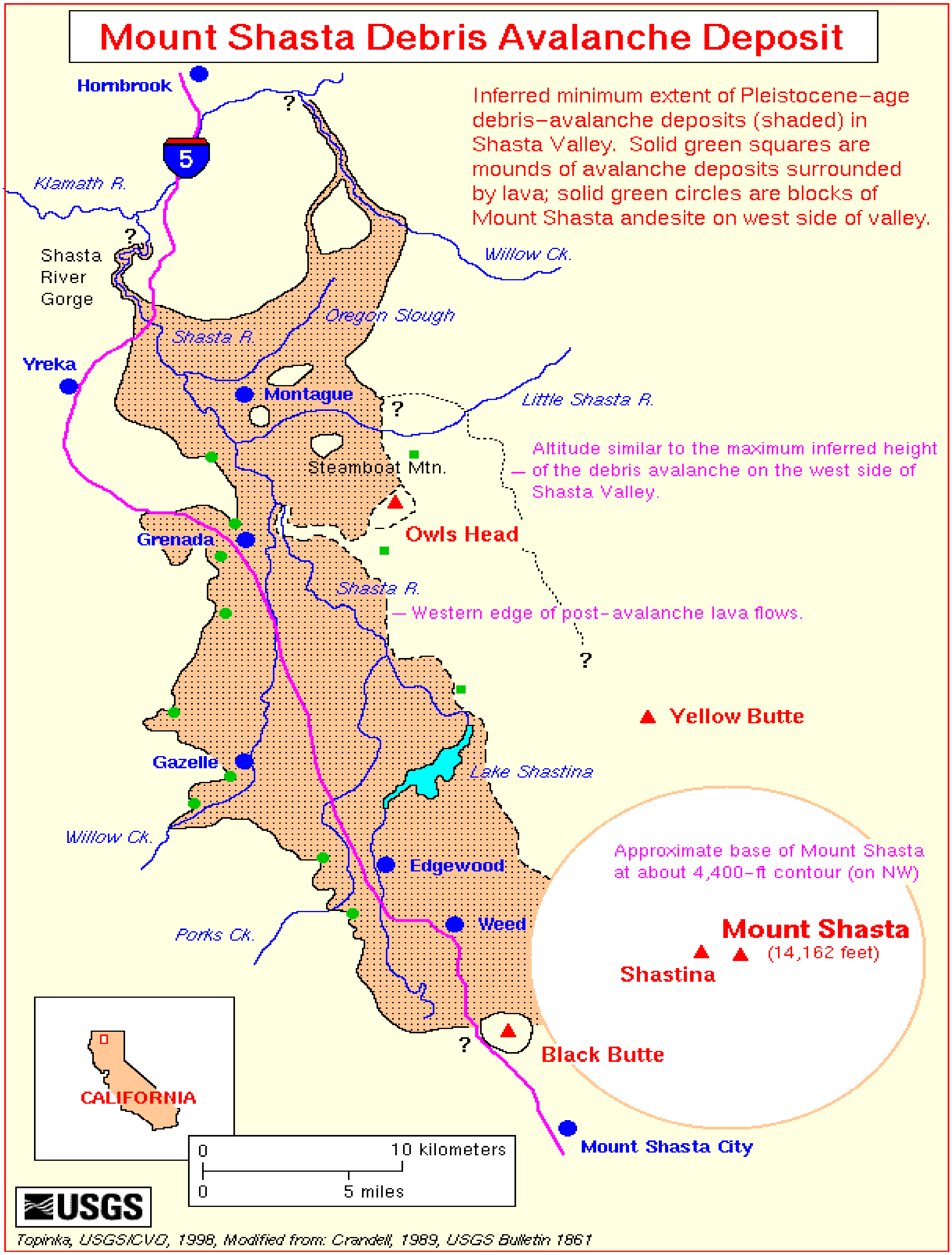
15.1.2 Debris Avalanches

According to the USGS, the deposits of a large debris avalanche extend northward from the base of Mount Shasta across the floor of Shasta Valley in Siskiyou County (see Figure 15-3). The northern extent of the deposit is near Montague, about 30 miles from the summit. The deposits cover about 261 square miles, and their estimated volume is 11 cubic miles, according to the Cascades Volcano Observatory. Radiometric dating suggests that the debris avalanche occurred 300,000 to 380,000 years ago.

Debris avalanches are flowing or sliding, incoherent and chaotic, wet or dry mixtures of soil and rock debris that move downslope from a volcano at a high speed. Volcanic-debris avalanches occur occasionally at large, steep-sided volcanoes and are among the most hazardous of volcanic events. The cause of debris avalanches may be due to the intrusion of magma and earthquake shaking, or the event may occur following a volcanic blast. Steep-sided volcanic cones may also fail due to the influence of gravity after gradual weakening over time by hydrothermal alteration.

Debris avalanches produce thick, hummocky deposits that can extend great distances (see Figure 15-4). Hundreds of mounds, hills, and ridges formed by the deposits are separated by flat areas that slope generally northward. The hills and ridges are formed by large block deposits, which include masses of lava tens to hundreds of feet across, as well as stratigraphic successions of unconsolidated deposits of pyroclastic flows, lahars, tephra, and alluvium, which were carried intact within the debris avalanche.

Flat areas between hills and ridges are underlain by an unsorted and unstratified mudflow-like deposit of sand, silt, clay, and rock fragments derived chiefly from the volcano. Boulders of volcanic rock from Mount Shasta are scattered along the west side of Shasta Valley and in the part of Shasta Valley that lies north of Montague, at heights of as much as 300 feet above the adjacent surface of the debris-avalanche deposits. The boulders represent a lag that was formed after the main body of the avalanche came to rest, when much of the still-fluid deposits drained away and flowed out of Shasta Valley down the Shasta River valley and into the Klamath River.



Source: USGS

Figure 15-3. Extent of Mount Shasta Debris Avalanche Deposits

Source: USGS

Figure 15-4. Hummocky, Volcanic Deposits from Mount Shasta Debris Avalanche

The debris avalanche probably originated in a quick succession of huge landslides of water-saturated rock on the northwest flank of ancestral Mount Shasta, each of which cut progressively deeper into the volcano. Evidence is lacking of similar recent volcanic activity, and the exact cause of the ancient debris avalanches are not known.

Debris avalanches destroy everything in their paths by impact or burial beneath tens of feet of debris. Because debris avalanches occur with little warning and can travel at high speeds, areas that might be affected should be evacuated *before* such avalanches occur. Therefore, local government officials might decide to evacuate some areas in advance of threatened eruption.

15.2. HAZARD PROFILE

15.2.1 Past Events

Figure 15-5 summarizes past eruptions in the Cascade Range. Recent activity includes the following:

- May 18, 1980, Mount St. Helens eruption—After a lateral blast, 23 square miles of volcanic material buried the North Fork of the Toutle River. There were 57 human fatalities.
- May 22, 1915, Lassen Peak eruption—An explosive eruption produced a pyroclastic flow that devastated an area as far as 4 miles northeast of the summit. The eruption also generated lahars that traveled more than 12 miles down Lost Creek and floods that went down Hat Creek.

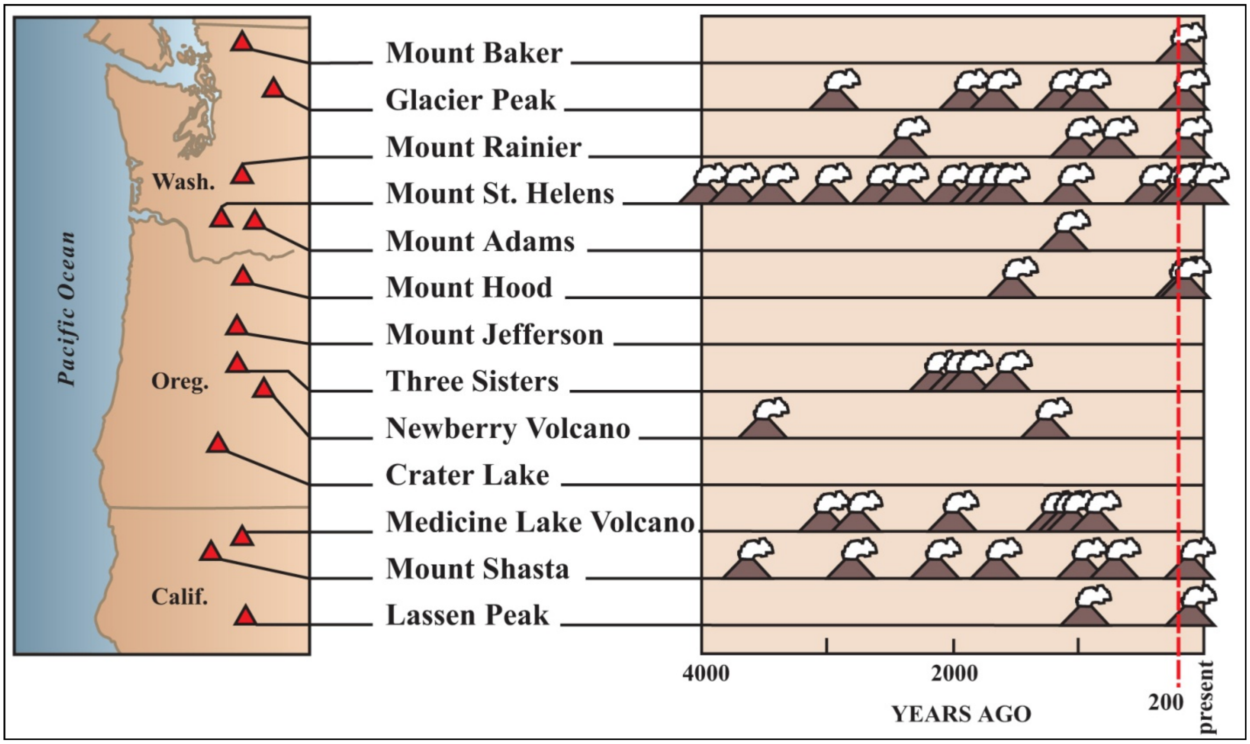


Figure 15-5. Past Eruptions in the Cascade Range

15.2.2 Location

Figure 15-5 shows the location of the Cascade Range volcanoes, most of which have the potential to produce a significant eruption. The Cascade Range extends more than 1,000 miles from southern British Columbia into northern California and includes 13 potentially active volcanic peaks in the U.S. Four major Cascade volcanoes are relatively close to Siskiyou County: Crater Lake is about 80 miles to the north; and Lassen Peak is about 65 miles to the south of the county boundary. Mt. Shasta is in the south-central area of the county and the Medicine Lake Volcano is in the eastern portion of the county. Of additional volcanic importance are the Black Butte Cinder Cone, just west of Mount Shasta and Mount Shastina, a large subsidiary cone on the west flank of Mount Shasta.

15.2.3 Frequency

Many Cascade volcanoes have erupted in the recent past and will be active again in the foreseeable future. Given an average rate of one or two eruptions per century during the past 12,000 years, these disasters are not part of our everyday experience; however, in the past hundred years, Lassen Peak and Mount St. Helens have erupted with terrifying results. Mount Shasta has erupted, on the average, at least once per 800 years during the last 10,000 years, and about once per 600 years during the last 4,500 years. The last known eruption occurred just over 200 years ago. On the basis of its past behavior, Mount Shasta is not likely to erupt large volumes of tephra in the future; areas subject to the greatest risk from air-fall tephra are located mainly east and within about 30 miles of the summit of the volcano. The degree of risk from air-fall tephra decreases progressively as the distance from the volcano increases.

15.2.4 Severity

The explosive disintegration of Mount St. Helens' north flank in 1980 vividly demonstrated the power that Cascade volcanoes can unleash. A 1-inch deep layer of ash weighs an average of 10 pounds per square foot, causing danger of structural collapse. Ash is harsh, acidic and gritty, and it has a sulfuric odor. Ash may also carry a high static charge for up to two days after being ejected from a volcano. When an ash cloud combines with rain, sulfur dioxide in the cloud combines with the rain water to form diluted sulfuric acid that may cause minor, but painful burns to the skin, eyes, nose, and throat.

Eruptions during the last 10,000 years produced lava flows and domes on and around the flanks of Mount Shasta, and pyroclastic flows from summit and flank vents extended as far as 30 miles from the summit. Most of these eruptions also produced large mudflows, many of which reached more than several tens of miles from Mount Shasta. Future eruptions like those of the past could endanger the neighboring communities of Weed, Mount Shasta, McCloud, and Dunsmuir, located at or near the base of Mount Shasta. Such eruptions will most likely produce deposits of ash, lava flows, domes, and pyroclastic flows. Lava flows and pyroclastic flows may affect low- and flat-lying ground almost anywhere near the summit of Mount Shasta, and mudflows may cover valley floors and other low areas as much as several tens of kilometers from the volcano.

Debris avalanches from volcanoes pose significant hazards to people and property. Debris avalanches may occur without warning, move great distances at high speed, cover large areas, initiate later blasts, and, if they enter the sea, cause tsunamis. The Mount St. Helens eruption was the first time eye-witness accounts and photographs documented the emplacement of a large volcanic debris avalanche. The debris-avalanche deposit at Mount St. Helens has provided a basis for interpretation of similar deposits elsewhere and has led to the realization that large-scale gravitational slope failures of volcanoes are more common than previously thought. Since 1980, volcanic hazard assessments have included consideration of hazards posed by debris avalanches in addition to other, more common products of eruptions, such as pyroclastic flows, lahars, lava flows, and tephra.

More than 150 Quaternary debris-avalanche deposits have been identified in recent studies based on geologic literature, topographic maps, and aerial photographs. The studies show that 17 volcanic debris avalanches are known or are inferred to have formed in the last 400 years, about 4 per century. This rate is several times the historical rate for eruptions producing Krakatau-type calderas, one of the most hazardous types of explosive eruptions. The Mount Shasta debris-avalanche deposit covers an area roughly 10 times the volume of the 1980 Mount St. Helens avalanche deposit.

15.2.5 Warning Time

Constant monitoring of all active volcanoes means that there should be more than adequate time for evacuation before an event. Since 1980, Mount St. Helens has settled into a pattern of intermittent, moderate and generally non-explosive activity, and the severity of tephra, explosions, and lava flows have diminished. The continuing eruptions of Mount St. Helens provide an unusual opportunity for scientists to study volcanic activity and to devise and test methods for predicting eruptions. Many successful predictions have been issued for eruptions since June 1980. All episodes, except for one very small event in 1984, have been successfully predicted several days to three weeks in advance. Eruption prediction and information about volcanic activity at Mount St. Helens provide the basis for hazard warnings of eruptive activity to the public and to local governments.

Volcano monitoring involves a variety of measurements and observations designed to detect changes at the surface of a volcano that reflect increasing pressure and stresses caused by the movement of magma within or beneath it. An eruption occurs when magma rises from its source or from a storage reservoir and reaches the Earth's surface. As it rises, the magma fractures overlying rocks, which causes earthquakes, and parts of the volcano deform as magma approaching the surface makes room for itself.

Monitoring active volcanoes chiefly involves the measurement of surface deformation, the investigation of earthquakes generated beneath the volcano, and the study of changes in gas emission rates accompanying the underground movement of magma. Additional geophysical and geochemical information is gathered through sampling of newly erupted lava and tephra, studies of thermal patterns on the dome, surveys of local electrical and magnetic fields, measurements of changes in the Earth's gravity field, examination of photographs, and measurements of temperature at steam vents.

Many of the methods used to monitor volcanoes were developed at the U.S. Geological Survey's Hawaiian Volcano Observatory, where the activity of the Kilauea and Mauna Loa shield volcanoes is monitored. Although the techniques are similar, their application and interpretation have been modified and adapted to the stratovolcanoes of the Cascade Range. Mt. Shasta and the other Cascade Range volcanoes are closely monitored by several groups, including the USGS Cascades Volcano Observatory.

15.3. SECONDARY HAZARDS

The secondary hazards associated with volcanic eruptions are mud flows and landslides. Where volcanic eruptions with flank failures or debris avalanches are located near the ocean or enclosed bodies of water, tsunamis and seiches (waves generated by the sudden displacement of water) may be secondary impacts.

15.4. CLIMATE CHANGE IMPACTS

Large-scale volcanic eruptions can reduce the amount of solar radiation reaching the Earth's surface, lowering temperatures in the lower atmosphere and changing atmospheric circulation patterns. The massive outpouring of gases and ash can influence climate patterns for years. Sulfuric gases convert to sub-micron droplets containing about 75 percent sulfuric acid. These particles can linger three to four years in the stratosphere. Volcanic clouds absorb terrestrial radiation and scatter a significant amount of incoming solar radiation, an effect that can last from two to three years following a volcanic eruption.

15.5. EXPOSURE

Siskiyou County is most exposed to lahars from a Mt. Shasta eruption. Lahars could travel down any of the creeks or valleys that drain Mt. Shasta. Anything in the path of a lahar is potentially exposed to damage. Mount Shasta is not considered to be a large tephra producer like Mount St. Helens. Probabilistic tephra productions maps are not available for Mount Shasta, so analysis of this risk exposure was not performed. It should be assumed that volcanic activity on any of the Southern Cascade Volcanoes could produce some degree of tephra accumulation within the planning area. However, since the degree of that potential is not currently known, this risk assessment focuses on exposure to the lahar hazard within the planning area for the Whitney Creek and Mud Creek drainages.

15.5.1 Population

Population counts of those exposed to the volcano hazard were generated by analyzing census blocks that intersect with the lahar hazard zones. Census blocks do not follow the same boundaries as the lahar zones. Therefore, the methodology used to generate these estimates evaluated the number of buildings within the potential lahar zone, and then estimated the total population by multiplying the number of residential structures by the average Siskiyou County household size of 2.4 persons per household. Using this approach, it was estimated that the exposed population is 9,293 (20 percent of the total county population).

15.5.2 Property

Most of the County would be exposed to ash fall and tephra accumulation in the event of a volcanic eruption. Property located along the lahar inundation areas would be exposed to lahar flows as well as a potential debris avalanche (see Figure 15-3). Table 15-1 lists the total number of Siskiyou County structures located in the lahar zones or debris avalanche zones and their values. The majority of the properties exposed to lahar are in unincorporated Siskiyou County. The Cities of Weed and Montague as well as Lake Shastina CSD could have significant exposure to debris avalanches.

TABLE 15-1.
STRUCTURES EXPOSED TO VOLCANO/LAHAR/DEBRIS AVALANCHE

	Buildings Exposed	Assessed Value			% of Total Assessed Value
		Structure	Contents	Total	
Dorris	0	0	0	0	0
Dunsmuir	0	0	0	0	0
Etna	0	0	0	0	0
Fort Jones	0	0	0	0	0
Montague	558[a]	$41,485,718	$30,267,898	$71,754,174	100.00%
Mt. Shasta	0	0	0	0	0
Tulelake	0	0	0	0	0
Weed	1,003[a]	$125,492,838	$108,474,307	$233,968,148	100.00%
Yreka	0	0	0	0	0
Unincorporated	2,862	$389,519,391	$287,823,099	$677,345,352	25.87%
Total	**4,423**	**$556,497,947**	**$426,565,304**	**$983,067,674**	**22.37%**

a. Structures exposed to potential debris avalanches (see Figure 15-3).

15.5.3 Critical Facilities

Infrastructure exposed to lahar inundation includes bridges that cross the Shasta and Little Shasta Rivers in the lahar zone. All transportation routes are exposed to ash fall and tephra accumulation, which could create hazardous driving conditions on roads and highways and hinder evacuations and response. Seventeen school facilities and six fire stations are exposed to lahar outflow zones. Table 15-2 summarizes the exposed critical facilities in the County.

15.5.4 Environment

The environment is highly exposed to the effects of a volcanic eruption. Even if ash fall from a volcanic eruption were to fall elsewhere, it could still be spread throughout the County by the surrounding rivers and streams. A volcanic blast would expose the local environment to many effects such as lower air quality, and many other elements that could harm local vegetation and water quality.

TABLE 15-2. CRITICAL FACILITIES EXPOSED TO LAHAR HAZARDS	
Medical and Health Services	6
Government/Shelters	2
Protective Function	9
Schools	17
Hazmat	0
Other Critical Function	16
Bridges	53
Water	3
Wastewater	0
Total	**106**

15.6. VULNERABILITY

15.6.1 Population

The vulnerability of the population to volcanic eruptions is considered to be fairly low due to the predictability of volcanic activity as well as early warning capability. However, in the event of a volcanic eruption the entire population of Siskiyou County is potentially vulnerable to the damaging effects of volcanic ash fall. The elderly, very young and those who experience ear, nose and throat problems are especially vulnerable to the tephra hazard. Since there is generally adequate warning time before a volcanic event, the population vulnerable to the lahar hazard consists of those who choose not to evacuate or are unable to evacuate, including the elderly and the very young.

15.6.2 Property

There are currently no generally accepted damage functions for volcanic hazards in risk assessment platforms such as HAZUS-MH. Therefore the planning team was not able to generate damage estimates for this hazard. All properties listed in Table 15-1 are vulnerable to the lahar hazard in Siskiyou County. These lahar inundation areas are the outflow areas of past volcanic eruptions and are potential outflow areas for future volcanic eruptions. The most vulnerable structures would be those that are located closest to the lahar outflow areas, those that could be within debris avalanche zones and those that are subject to pyroclastic flows.

Also vulnerable are other properties that are located throughout the County that are subject to ash fall. Among these properties, the most vulnerable structures are those that are not as structurally sound and may collapse under the excessive weight of tephra, particularly when mixed with rainfall or snow.

15.6.3 Critical Facilities

Transportation routes that intersect with the lahar inundation zone are most vulnerable, especially depending on their structural stability. The roads of most concern would be Highways 89 and 97. Any potential impact on Interstate-5 could have huge economic impacts on Siskiyou County as well as the rest of California. The most vulnerable spots are those that directly intersect with a lahar outflow area and are not structurally sound. Those in the direction of wind would also be vulnerable to tephra accumulations.

Utilities are vulnerable to damage from lahars due to the debris that may be carried. Water treatment plants and wastewater treatment plants are vulnerable to contamination from ash fall and debris that may be carried by a lahar. Most vulnerable are those that are located on or near parcels that intersect with the lahar outflow area or those that receive input from area streams and rivers that lahar flow through.

15.6.4 Environment

The environment is especially vulnerable to the effects of a volcanic eruption. Siskiyou County rivers and streams are vulnerable to damage due to ash fall, especially since ash fall can be carried throughout the County by means of the McCloud River, Whitney Creek and Mud Creek. The sulfuric acid contained in volcanic ash could be very damaging to area vegetation, waters, wildlife and air quality. A lahar could be very damaging to area rivers and streams and could redirect water flow and cause changes in water courses.

15.7. FUTURE TRENDS IN DEVELOPMENT

Lahar zones are not identified in the California State Hazard Mitigation Plan. However, most lahar zones follow drainages similar to the 100-year and 500-year floodplains of rivers or creeks. Therefore, land use and development restrictions in known floodplains and drainages adjacent to volcanoes could reduce future exposure and lessen the impacts of a volcanic lahar.

15.8. SCENARIO

In the event of a volcanic eruption in Siskiyou County, there would likely be minimal loss of life, due to adequate warnings. However, there could be a great loss of property, especially in Weed, Mount Shasta, McCloud, Dunsmuir and areas of unincorporated county. There would also be the possibility of severe environmental impacts due to lahar flows in area rivers and streams. The areas subject to the greatest risk from air-fall tephra are located mainly east and within about 50 kilometers of the summit of the volcano. Severe environmental impacts would be anticipated.

15.9. ISSUES

Since volcanic episodes have been fairly predictable in the recent past, there is probably less concern about loss of life than there is concern about loss of property, infrastructure and severe environmental impacts. Preparedness for response and recovery from potential volcanic impacts will be key to reducing the impacts to life and property within the planning area

CHAPTER 16.
WILDFIRE

16.1 GENERAL BACKGROUND

A wildland fire is any uncontrolled fire occurring on undeveloped land that requires fire suppression. Wildland fires can be ignited by natural occurring events such as lightning or by human activity such as smoking, campfires, equipment use, and arson.

DEFINITIONS

Interface Area—An area susceptible to wildland fires and where wildland vegetation and urban or suburban development occur together. An example would be smaller urban areas and dispersed rural housing in forested areas.

Wildland fire—Fires that result in uncontrolled destruction of forests, brush, field crops, grasslands, and real and personal property in non-urban areas. Because of their distance from firefighting resources, they can be difficult to contain and can cause a great deal of destruction.

Wildland fires are costly, compromising watersheds, open space, timber, range, recreational opportunities, wildlife habitats, endangered species, historic and cultural assets, wild and scenic rivers, other scenic assets and local economies, as well as putting lives and property at risk.

Short-term loss caused by a wildland fire can include the destruction of timber, wildlife habitat, scenic vistas, and watersheds. Long-term effects include smaller timber harvests, reduced access to affected recreational areas, and destruction of cultural and economic resources and community infrastructure. Vulnerability to flooding increases due to the destruction of watersheds. The potential for significant damage to life and property exists in areas designated as “Wildland Urban Interface” (WUI) areas, where development is adjacent to densely vegetated areas.

On average, 10,000 wildland fires burn half a million acres in California annually. While the number of acres burned fluctuates from year to year, a trend that has remained constant is the rise in wildland fire-related losses. The challenge is in how to reduce wildland fire losses within a framework of California’s diverse ecosystems.

16.1.1 Local Conditions Related to Wildland fire

How a fire behaves primarily depends on the following:

Fuel—Fuel refers to all combustible material available to burn within a given land area. Fuel types in Siskiyou County include timber, timber with grass understory, grass, brush, oak woodland and desert sage and juniper stands. Each fuel has its own burning characteristics based on moisture content, volume, live-to-dead vegetation ratio, size, arrangement and genetic makeup. Fuel loading is measured in tons per acre. Grass is considered a light fuel with approximately three-quarters of a ton per acre. Thick brush, a heavy fuel, can have a density of over 21 tons per acre. Grass burns rapidly, with a short period of intense, maximum heat output. Brush has a long sustained high heat output, making it more difficult to control. Non-compacted fine fuel such as grass spreads fire rapidly since more of its surface can be heated at one time. Compacted fuel such as pine litter burns more slowly because heat and air only reach the top of the fuel. Fuel arrangement affects how readily fuel burns and fire spreads:

- **Vertical arrangement** refers to the continuity of fuel from the forest floor to the tree canopy. Fuels with a continuous vertical arrangement are known as ladder fuels; they are influential in behavior, often turning a ground fire into a crown fire.
- **Crown or canopy closure** refers to the density of a forest created by treetops, and is very important in the lateral progression of fire through the forest canopy.

Weather—Weather conditions that influence fire behavior include temperature, relative humidity, wind speed and direction, precipitation, atmospheric stability, and aloft winds. When the temperature is high, relative humidity is low, wind speed is increasing and coming from the east-offshore flow, and there has been little or no precipitation so vegetation is dry, conditions are very favorable for extensive and severe wildland fires. These conditions occur more frequently inland where temperatures are higher and fog is less prevalent. During summer, the county's abundant vegetation dries out and becomes hazardous fuel. That fuel combined with a Chinook wind-hot and dry from the Great Basin-can produce extreme fire danger.

Precipitation in Northern California is usually at its lowest from July to September. Thunderstorm activity, which typically begins in June with wet storms, turns dry with little or no precipitation reaching the ground as the season progresses into July and August. Thunderstorms with dry lightning are more prevalent in the eastern portion of the county. July and August are when local winds (slope winds and sea breezes) predominate, with the Pacific jet stream weak and well to the north. By mid or late September, north to northeast winds return to the north half of the planning area, bringing in moist ocean air.

The Siskiyou Mountains can experience twice the number of lightning ignitions that occur in the Cascades or Olympic Mountains. The higher number of lightning ignitions is due to both increased lightning frequency and decreasing summer precipitation patterns characteristic of the Klamath-Siskiyou region. July and August have been reported as the months of greatest number of lightning strikes, but August and September have the highest proportion of actual lightning-caused fire ignitions.

Terrain—Terrain includes slope and elevation. The terrain of a region influences the amount and moisture of fuel; the impact of weather conditions such as temperature and wind; potential barriers to fire spread, such as highways and lakes; and elevation and slope of land forms (fire spreads more easily uphill than downhill).

Time of Day—A fire's peak burning period generally is between 1 p.m. and 6 p.m.

16.1.2 Wildland fire Protection Responsibility in California

Local, state, tribal, and federal organizations have primary legal (and financial) responsibility for wildland fire protection. In many instances, two fire organizations have dual primary responsibility on the same parcel of land—one for wildland fire protection and the other for structural or "improvement" fire protection. Per the *2010 California State Hazard Mitigation Plan*, this layering of responsibility and resulting dual policies, rules, practices and ordinances can cause conflict or confusion. To address wildland fire jurisdictional responsibilities, the California state legislature in 1981 adopted Public Resource Code Section 4291.5 and Health and Safety Code Section 13108.5 establishing the following responsibility areas:

Federal Responsibility Areas (FRAs)—FRAs are fire-prone wildland areas that are owned or managed by a federal agency such as the U.S. Forest Service, National Park Service, Bureau of Land Management, U.S. Fish and Wildlife Service, or U.S. Department of Defense. Primary financial and rule-making jurisdictional authority rests with the federal land agency. In many instances, FRAs are interspersed with private land ownership or leases. Fire protection for developed private property is usually not the responsibility of the federal land management agency; structural protection responsibility is that of a local government agency.

State Responsibility Areas (SRAs)—SRAs are lands in California where the California Department of Forestry and Fire Protection (CAL FIRE) has legal and financial responsibility for wildland fire protection and where CAL FIRE administers fire hazard classifications and building standard regulations. SRAs are defined as lands that meet the following criteria:

- Are county unincorporated areas
- Are not federally owned
- Have wildland vegetation cover rather than agricultural or ornamental plants
- Have watershed and/or range/forage value
- Have housing densities not exceeding three units per acre.
- Where SRAs contain built environment or development, the responsibility for fire protection of those improvements (non-wildland) is that of a local government agency.

Local Responsibility Areas (LRAs)—LRAs include land in cities, cultivated agriculture lands and non-flammable areas in unincorporated areas, and lands that do not meet the criteria for SRA or FRA. LRA fire protection is typically provided by city fire departments, fire protection districts, and counties, or by CAL FIRE under contract to local governments. LRAs may include flammable vegetation and WUI areas where the financial and jurisdictional responsibility for improvement and wildland fire protection is that of a local government agency.

SRAs were originally mapped in 1985 and are reviewed annually for changes or adjustments in boundaries. LRAs were originally mapped in 1996, although this mapping has not changed, many local governments have made similar designations under their own authority

16.2 HAZARD PROFILE

The *2010 California State Hazard Mitigation Plan* provides the following description of wildland fire hazard and risk:

> "The diversity of WUI settings and disagreement about alternative mitigation strategies has led to confusion and different methods of defining and mapping WUI areas. One major disagreement has been caused by terms such as "hazard" and "risk" being used interchangeably. Hazard is the physical condition that can lead to damage to a specific asset or resource. The term fire hazard is related to those physical conditions related to fire and its ability to cause damage, specifically how often a fire burns a given locale and what the fire is like when it burns (its fire behavior). Thus, fire hazard only refers to the potential characteristics of the fire itself. Risk is the likelihood of a fire occurring at a given site (burn probability) and the associated mechanisms of fire behavior that cause damage to assets and resources (fire behavior)."

Risk refers to the likelihood of a hazard and the scale of damage it is expected to produce. There are different risks for various assets/resources subjected to the same hazard. For instance, a wildland fire may cause damage to soils but not cause damage to a large tree. Consequently, risk assessments include hazard, but must also include characterization of the assets/resources.

16.2.1 Past Events

Siskiyou County has an extensive fire history due to the abundance of fuel sources combined with the climate and topography of the planning area. Per CAL FIRE, there have been 681 fires within the State Responsibility Area of Siskiyou County that burned over 15,753 acres since 2012. Table 16-1 lists the number and types of fires from 2012 to 2017. Table 16-2 list the acres burned from 2012-2017. Two of the twenty largest fires in California's fire history have occurred within Siskiyou County. In 2008 the Klamath Theater Complex fire, which was started by lightning, burned 192,038 acres and caused two fatalities. In 2014 the Happy Camp Complex fire which was also caused by lightning burned 134,056 acres, as well as consuming 6 structures.

TABLE 16-1.
FIRES BY CAUSE—CAL FIRE SISKIYOU UNIT, 2012-2017

	2017	2016	2015	2014	2013	2012	**Total**
Undetermined	28	18	25	20	11	19	**121**
Lightning	41	20	48	57	57	6	**229**
Campfires	1	9	1	14	0	12	**37**
Smoking	0	2	0	3	1	2	**8**
Debris Burning	23	17	15	7	16	22	**100**
Arson	12	2	6	6	3	1	**30**
Equipment Use	21	7	8	2	6	5	**49**
Playing with Fire	1	3	1	0	2	1	**8**
Vehicle	4	4	0	6	1	**3**	**18**
Railroad	0	1	2	6	0	**0**	**9**
Electrical Power	5	10	5	3	4	1	**28**
Miscellaneous	12	6	2	3	10	11	**44**
Total	**148**	**99**	**113**	**127**	**111**	**83**	**681**

TABLE 16-2.
ACRES BURNED—CAL FIRE SISKIYOU UNIT, 2012-2017

	2017	2016	2015	2014	2013	2012	**Total**
Acres	945.69	849.49	519.24	13155.4	132.56	150.8	**15753.24**

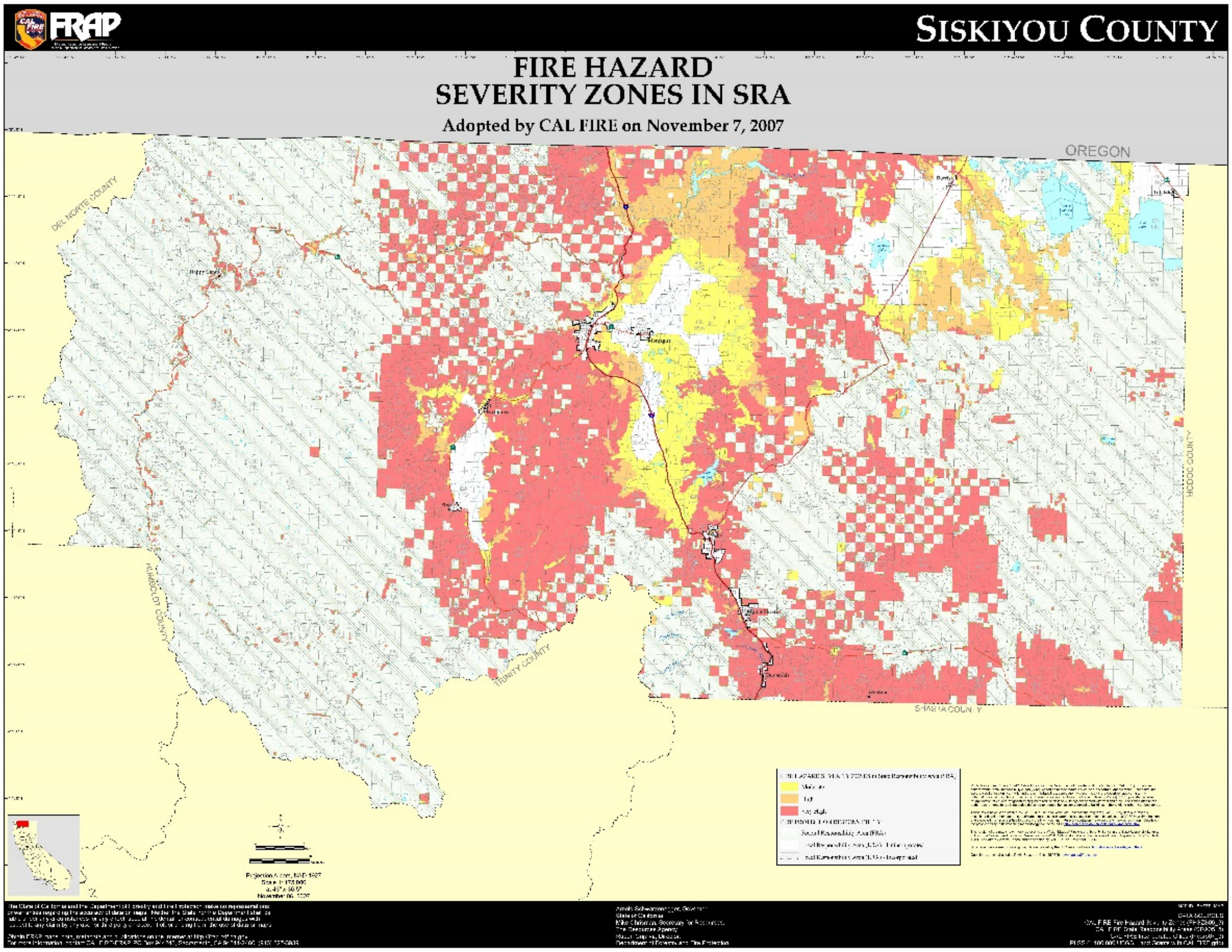
16.2.2 Location

CAL FIRE maps areas of significant fire hazards based on factors such as fuel, weather and terrain. Taking these factors into consideration, a fire hazard severity scale has been devised that characterizes zones by the number of days of moderate, high and extreme fire hazard. These zones, referred to as Fire Hazard Severity Zones (FHSZ), define the application of various mitigation strategies to reduce risk associated with wildland fires.

The FHSZ model is built from existing data and hazard constructs developed by CAL FIRE’s Fire and Resource Assessment Program. The model refines the zones to characterize fire exposure mechanisms that cause ignitions to structures. The model characterizes potential fire behavior for vegetation fuels, which are by nature dynamic. Since model results are used to identify permanent engineering mitigations for structures, it is desirable that the model reflect changes in fire behavior over the length of time a structure is likely to be in place. Significant land-use changes need to be accounted for through period maintenance routines.

The model output of fire probability also is based on frequency of fire weather, ignition patterns, expected rate-of spread, and past fire history. It also accounts for flying ember production, and hazards based on the area of influence where embers are likely to land and cause ignitions. This is the principal driver of hazard in densely developed areas. A related concern in built-out areas is the relative density of vegetative fuels that can serve as sites for new spot fires within the urban core and spread to adjacent structures.

In Siskiyou County, approximately 3.2 million acres are in a high, very high or extreme FHSZ. This represents over 75 percent of the area of the County. The geography, weather patterns and vegetation in the Siskiyou County planning area provide ideal conditions for recurring wildland fires. Map 16-1 shows the FHSZ map for Siskiyou County. This map is the basis for this wildland fire risk assessment.



Map 16-1 Siskiyou County Fire Hazard Severity Zones

16.2.3 Frequency

Within the State Responsibility Area of Siskiyou County there has been an average of 109 wildland fires per year since 2010. An average of 2,004 acres per year where damaged by wildland fires within this area.

16.2.4 Severity

Potential losses from wildland fire include human life, infrastructure, structures and other improvements, and natural resources. Smoke and air pollution from wildland fires can be a health hazard, especially for sensitive populations including children, the elderly and those with respiratory and cardiovascular diseases. Wildland fire may also threaten the health and safety of those fighting the fires. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke. In addition, wildland fire can lead to ancillary impacts such as landslides in steep ravine areas and flooding due to the impacts of silt in local watersheds.

16.2.5 Warning Time

Wildland fires are often caused by humans, intentionally or accidentally. There is no way to predict when one might break out. Since fireworks often cause brush fires, extra diligence is warranted around the Fourth of July when the use of fireworks is highest. Dry seasons and droughts are factors that greatly increase fire likelihood. Dry lightning may trigger wildland fires. Severe weather can be predicted, so special attention can be paid during weather events that may include lightning. Reliable National Weather Service lightning warnings are available on average 24 to 48 hours prior to a significant electrical storm.

If a fire does break out and spread rapidly, residents may need to evacuate within days or hours. A fire's peak burning period generally is between 1 p.m. and 6 p.m. Once a fire has started, fire alerting is reasonably rapid in most cases. The use of developing technology such as cell phones and applications, social media and two-way radio communications has further contributed to a significant improvement in warning time.

16.3 SECONDARY HAZARDS

Wildland fires can generate a range of secondary effects, which in some cases may cause more widespread and prolonged damage than the fire itself. Fires can cause direct economic losses in the reduction of harvestable timber and indirect economic losses in reduced tourism. Wildland fires cause the contamination of reservoirs, destroy transmission lines and contribute to flooding. They strip slopes of vegetation, exposing them to greater amounts of runoff. This in turn can weaken soils and cause failures on slopes. Major landslides can occur several years after a wildland fire. Most wildland fires burn hot and for long durations that can bake soils, especially those high in clay content, thus increasing the imperviousness of the ground. This increases the runoff generated by storm events, thus increasing the chance of flooding.

16.4 CLIMATE CHANGE IMPACTS

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

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

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

16.5 EXPOSURE

16.5.1 Population

Exposed population could not be calculated directly because census block group areas do not coincide with the fire risk areas. However, in July of 2017 census population within Siskiyou County where estimated to be 43,853. This number can be used as the population susceptible to the dangers and risk of exposure to wildland fires within Siskiyou County.

16.5.2 Property

Property damage from wildland fires can be severe and can significantly alter entire communities. Private homes and buildings are especially susceptible wildland fire, as well as timber and range land throughout Siskiyou County. Private industry within the county are also highly susceptible incur significant impacts from wildland fires.

16.5.3 Critical Facilities and Infrastructure

In the event of wildland fire, there would likely be significant damage to infrastructure within Siskiyou County. Most roads would be without damage except in the worst scenarios. Power lines, communication lines and railroads are the most at risk to wildland fire because most of their supporting structures are made of wood and susceptible to burning. Many local water systems throughout Siskiyou County include wooden structure components making them highly susceptible to damage from wildland fires. Pipelines could also be damaged and could provide a source of fuel for fires, as well as a danger to fire fighters.

16.5.4 Environment

Fire is a natural and critical ecosystem process in most terrestrial ecosystems, dictating in part the types, structure, and spatial extent of native vegetation. However, wildland fires can cause severe environmental impacts:

- **Damaged Fisheries—**Critical fisheries can suffer from increased water temperatures, sedimentation, and changes in water quality.

- **Soil Erosion—**The protective covering provided by foliage and dead organic matter is removed, leaving the soil fully exposed to wind and water erosion. Accelerated soil erosion occurs, causing landslides and threatening aquatic habitats.
- **Spread of Invasive Plant Species—**Non-native woody plant species frequently invade burned areas. When weeds become established, they can dominate the plant cover over broad landscapes, and become difficult and costly to control.
- **Disease and Insect Infestations—**Unless diseased or insect-infested trees are swiftly removed, infestations and disease can spread to healthy forests and private lands. Timely active management actions are needed to remove diseased or infested trees.
- **Destroyed Endangered Species Habitat—**Catastrophic fires can have devastating consequences for endangered species.
- **Soil Sterilization—**Topsoil exposed to extreme heat can become water repellant, and soil nutrients may be lost. It can take decades or even centuries for ecosystems to recover from a fire. Some fires burn so hot that they can sterilize the soil.

Many ecosystems are adapted to historical patterns of fire occurrence. These patterns, called “fire regimes,” include temporal attributes (e.g., frequency and seasonality), spatial attributes (e.g., size and spatial complexity), and magnitude attributes (e.g., intensity and severity), each of which have ranges of natural variability. Ecosystem stability is threatened when any of the attributes for a given fire regime diverge from its range of natural variability.

16.6 VULNERABILITY

Structures, above-ground infrastructure, critical facilities and natural environments are all vulnerable to the wildland fire hazard within Siskiyou County. There is currently no validated damage function available to support wildland fire mitigation planning. Except as discussed in this section, vulnerable populations, property, infrastructure and environment are assumed to be the same as described in the section.

16.6.1 Population

Smoke and air pollution from wildland fires can be a severe health hazard, especially for sensitive populations, including children, the elderly and those with respiratory and cardiovascular diseases. Smoke generated by wildland fire consists of visible and invisible emissions that contain particulate matter (soot, tar, water vapor, and minerals), gases (carbon monoxide, carbon dioxide, nitrogen oxides), and toxics (formaldehyde, benzene). Emissions from wildland fires depend on the type of fuel, the moisture content of the fuel, the efficiency (or temperature) of combustion, and the weather. Public health impacts associated with wildland fire include difficulty in breathing, odor, and reduction in visibility.

Wildland fire may also threaten the health and safety of those fighting the fires. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke.

16.6.2 Property

Damage Inspection Reports can be generated following catastrophic events such as floods, fires and other damaging incidents. Damage inspection Teams can be requested through the Incident Command System (ICS). Damage Inspection Teams (DINS) asses damaged structures and losses during and after emergency incidents. These Teams provide detailed reports to agencies involved in emergency incidents.

16.6.3 Critical Facilities and Infrastructure

Critical facilities of wood frame construction within Siskiyou County are especially vulnerable during wildland fire events. In the event of wildland fire, there would likely be damage infrastructure. Most roads would be without damage except in the worst scenarios. Power lines, communication lines and railroads are also at high risk from wildland fire because of the use of wood in their construction increase the susceptibility to damage and burning. Fires can create conditions that block or prevent access and can isolate residents and emergency service providers. Wildland fire can also have a direct impact on bridges especially those with wood construction or decking. Many bridges in areas of high to moderate fire risk are important because they provide the only ingress and egress to large areas and in some cases to isolated neighborhoods.

16.7 FUTURE TRENDS IN DEVELOPMENT

Siskiyou County and the incorporated cities have adopted general plans with associated safety elements pursuant to state laws. Maintaining the abundance of natural resources within Siskiyou County is a high priority for its land use programs and managers. To meet the intent of California state mandates, Siskiyou County and all planning partners are committed to assuring that future growth and development in the planning area take the hazards of wildland fires into account.

16.8 SCENARIO

With any additional interface development, a wildland fire in Siskiyou County would have the potential to cause even greater damage than previous fires. A major conflagration might begin with a wet spring, adding to the fuels that are already present on the forest floor. Flashy fuels would build throughout the spring. A dry summer could follow the wet spring, exacerbated by winds. The summer would continue see the continued onset of insect infestation and tree mortality. Holidays inevitably bring many hikers and campers to the area. Careless campfires, a tossed lit cigarette, or a sudden lighting storm triggering a multitude of fires.

The embers from these fires could be carried by strong winds. The deposition zone for these embers would be deep in the forests and interface zones. Fires that start in flat areas would normally move more slowly, but winds would produce rapid fire growth and long-range spotting. It is not unusual for a wildland fire pushed by wind to burn rapidly burn in one direction and then later change course. This is one of many ways that fires can escape containment, typically during periods when response capabilities are overwhelmed. These long-range spot fires would most likely merge. Suppression resources would be redirected from protecting the natural resources to saving remote subdivisions.

The worst-case scenario in Siskiyou County would probably coincide with an active fire season in the entire American west, spreading resources thin. Firefighters, exhausted or committed to fighting conflagrations in other areas, may be unavailable to assist the County. Many federal assets would be responding to other fires that started earlier in the season. While local fire districts would be valuable in the urban interface areas, they have limited wildland fire capabilities or experience. Even though the existence and spread of the fire would be well known, it may not be possible to respond to it adequately. Thus, an initially manageable fire could become significant before meaningful resources are dispatched or could arrive at the incident.

To further complicate the problem, heavy rains could follow, causing flooding and landslides and releasing tons of sediment into rivers, permanently changing the floodplains of the county and damaging sensitive habitat and riparian areas. Such a fire followed by rain could release millions of cubic yards of sediment into rivers and streams for years, creating new floodplains and changing existing ones. With the forests removed from the watershed, discharges could easily double. Floods that previously would have been expected every 50 years may occur every couple of years. With the streambeds inability to carry this increased discharge because of increased sediment, floodplains and floodplain elevations would increase. These conditions could be intensified due to the impacts of climate change.

16.9 ISSUES

The major issues for wildland fire are the following:

- Isolation of neighborhoods and communities. Several vulnerable and isolated populations are in areas of high and very high risk for wildland fire.
- Public education and outreach to people living in or near the fire hazard zones should include information about and assistance with mitigation activities such as defensible space, and advance identification of evacuation routes and safe zones.
- Wildland fires could cause landslides as a secondary natural hazard.
- A large number of the areas building stock and critical facilities are wood-frame structures in areas of high and very high risk from wildland fire.
- Climate change could affect the wildland fire hazard.
- Future growth into interface areas should continue to be managed.
- Area fire districts need to continue to train on wildland-urban interface events.
- Vegetation management activities. This would include enhancement through expansion of the target areas as well as additional resources.
- Regional consistency of higher building code standards such as residential sprinkler requirements and prohibitive combustible roof standards.

- Fire department water supply in high risk wildland fire areas.
- Expand certifications and qualifications for fire department personnel. Ensure that all firefighters are trained in basic wildland fire behavior, basic fire weather, and that all company officers and chief level officers are trained in the wildland command and strike team leader level.

CHAPTER 17.
PLANNING AREA RISK RANKING

A risk ranking was performed for the hazards of concern described in this plan. This risk ranking assesses the probability of each hazard's occurrence as well as its likely impact on the people, property, and economy of the planning area. The risk ranking was conducted via facilitated brainstorming sessions with the Steering Committee. Estimates of risk were generated with data from HAZUS-MH using methodologies promoted by FEMA. The results are used in establishing mitigation priorities.

17.1. PROBABILITY OF OCCURRENCE

The probability of occurrence of a hazard is indicated by a probability factor based on likelihood of annual occurrence:

- High—Hazard event is likely to occur within 25 years (Probability Factor = 3)
- Medium—Hazard event is likely to occur within 100 years (Probability Factor =2)
- Low—Hazard event is not likely to occur within 100 years (Probability Factor =1)
- No exposure—There is no probability of occurrence (Probability Factor = 0)

The assessment of hazard frequency is generally based on past hazard events in the area. Table 17-1 summarizes the probability assessment for each hazard of concern for this plan.

TABLE 17-1.
PROBABILITY OF HAZARDS

Hazard Event	Probability (high, medium, low)	Probability Factor
Dam Failure	Low	1
Drought	High	3
Earthquake	Medium	2
Flood	High	3
Landslide	Medium	2
Severe Weather	High	3
Volcano	Low	1
Wildfire	High	3

17.2. IMPACT

Hazard impacts were assessed in three categories: impacts on people, impacts on property and impacts on the local economy. Numerical impact factors were assigned as follows:

- **People**—Values were assigned based on the percentage of the total ***population exposed*** to the hazard event. The degree of impact on individuals will vary and is not measurable, so the calculation assumes for simplicity and consistency that all people exposed to a hazard because they live in a hazard zone will be equally impacted when a hazard event occurs. It should be noted that planners can use an element of subjectivity when assigning values for impacts on people. Impact factors were assigned as follows:

  - High—50 percent or more of the population is exposed to a hazard (Impact Factor = 3)
  - Medium—25 percent to 49 percent of the population is exposed to a hazard (Impact Factor = 2)
  - Low—25 percent or less of the population is exposed to the hazard (Impact Factor = 1)
  - No impact—None of the population is exposed to a hazard (Impact Factor = 0)

- **Property**—Values were assigned based on the percentage of the total ***property value exposed*** to the hazard event:
  - High—30 percent or more of the total assessed property value is exposed to a hazard (Impact Factor = 3)
  - Medium—15 percent to 29 percent of the total assessed property value is exposed to a hazard (Impact Factor = 2)
  - Low—14 percent or less of the total assessed property value is exposed to the hazard (Impact Factor = 1)
  - No impact—None of the total assessed property value is exposed to a hazard (Impact Factor = 0)
- **Economy**—Values were assigned based on the percentage of the total ***property value vulnerable*** to the hazard event. Values represent estimates of the loss from a major event of each hazard in comparison to the total assessed value of the property exposed to the hazard. For some hazards, such as wildfire, landslide and severe weather, vulnerability was considered to be the same as exposure due to the lack of loss estimation tools specific to those hazards. Loss estimates separate from the exposure estimates were generated for the earthquake and flood hazards using HAZUS-MH.
  - High—Estimated loss from the hazard is 20 percent or more of the total assessed property value (Impact Factor = 3)
  - Medium—Estimated loss from the hazard is 10 percent to 19 percent of the total assessed property value (Impact Factor = 2)
  - Low—Estimated loss from the hazard is 9 percent or less of the total assessed property value (Impact Factor = 1)
  - No impact—No loss is estimated from the hazard (Impact Factor = 0)

The impacts of each hazard category were assigned a weighting factor to reflect the significance of the impact. These weighting factors are consistent with those typically used for measuring the benefits of hazard mitigation actions: impact on people was given a weighting factor of 3; impact on property was given a weighting factor of 2; and impact on the operations was given a weighting factor of 1.

Table 17-2, Table 17-3 and Table 17-4 summarize the impacts for each hazard.

TABLE 17-2.
IMPACT ON PEOPLE FROM HAZARDS

Hazard Event	Impact (high, medium, low)	Impact Factor	Multiplied by Weighting Factor (3)
Dam Failure	Low	1	3 x 1= 3
Drought	Low	1	3 x 1 = 3
Earthquake	Medium	2	3 x 2 = 6
Flood	Medium	2	3 x 2 = 6
Landslide	Low	1	3 x 1 = 3
Severe Weather	High	3	3 x 3 = 9
Volcano	Medium	2	3 x 2 = 6
Wildfire	High	3	3 x 3 = 9

TABLE 17-3.
IMPACT ON PROPERTY FROM HAZARDS

Hazard Event	Impact (high, medium, low)	Impact Factor	Multiplied by Weighting Factor (3)
Dam Failure	Low	1	2 x 1 = 2
Drought	Low	1	2 x 1 = 2
Earthquake	Medium	2	2 x 2 = 4
Flood	Medium	2	2 x 2 = 4
Landslide	Low	1	2 x 1 = 2
Severe Weather	High	3	2 x 3 = 6
Volcano	Medium	2	2 x 2 = 4
Wildfire	High	3	2 x 3 = 6

**TABLE 17-4.
IMPACT ON ECONOMY FROM HAZARDS**

Hazard Event	Impact (high, medium, low)	Impact Factor	Multiplied by Weighting Factor (3)
Dam Failure	Low	1	1 x 1 = 1
Drought	Medium	2	1 x 2 = 2
Earthquake	Medium	2	1 x 2 = 2
Flood	Medium	2	1 x 2 = 2
Landslide	Low	1	1 x 1 = 1
Severe Weather	High	3	1 x 3 = 3
Volcano	High	3	1 x 3 = 3
Wildfire	High	3	1 x 3 = 3

17.3. RISK RATING AND RANKING

The risk rating for each hazard was determined by multiplying the probability factor by the sum of the weighted impact factors for people, property and operations, as summarized in Table 17-5.

Based on these ratings, a priority of high, medium or low was assigned to each hazard. The hazards ranked as being of highest concern are severe weather, wildfire and flood. Hazards ranked as being of medium concern are earthquake and drought. The hazards ranked as being of lowest concern are volcano, landslide and dam failure. Table 17-6 shows the hazard risk ranking.

**TABLE 17-5.
HAZARD RISK RATING**

Hazard Event	Probability Factor	Sum of Weighted Impact Factors	Total (Probability x Impact)
Dam Failure	1	(1+ 2+ 3) = 6	1 x 6 = 6
Drought	3	(3+ 2+2) = 7	3 x 7 = 21
Earthquake	2	(6+4+2) = 12	2 x 12 = 24
Flood	3	(6+4+2) = 12	3 x 12 = 36
Landslide	2	(3+2+1) = 6	2 x 6 = 12
Severe Weather	3	(9+6+3) = 18	3 x 18 = 54
Volcano	1	(6+4+3) = 13	1 x 13 = 13
Wildfire	3	(9+6+3) = 18	3 x 18 = 54

TABLE 17-6.
HAZARD RISK RANKING

Hazard Ranking	Hazard Event	Category
1	Severe Weather	High
1	Wildfire	High
2	Flood	High
3	Earthquake	Medium
4	Drought	Medium
5	Volcano	Low
6	Landslide	Low
7	Dam Failure	Low

CHAPTER 18.
OTHER HAZARDS OF INTEREST

The hazards that are assessed in Chapter 9 through Chapter 16 and rated and ranked in Chapter 17 are those that present significant risks within the Siskiyou County planning area. Additional hazards, both natural and human-caused, were identified by the Steering Committee as having some potential to impact the planning area, but at a much lower risk level than the hazards of concern. These other hazards are identified as hazards of interest.

A short profile of each hazard of interest, including a qualitative discussion of its potential to impact Siskiyou County, is included in the sections below. No formal risk assessment of these hazards was performed, and no mitigation initiatives have been developed to address them. However, all planning partners for this plan should be aware of these hazards and should take steps to reduce the risks they present whenever it is practical to do so.

18.1. AIR QUALITY/SMOKE POLLUTION

While an individual air quality or smoke pollution incident is not as significant as a flood or earthquake, cumulatively, air quality degradation is likely more hazardous to the health of vulnerable populations. Pollutants include smog, soot, particulate matter and toxic air contaminants. Air pollution is a continuous problem, particularly within the densely populated basins. Smoke pollution from wildfires can be a problem in almost any region. Dense smoky air tends to settle in the mountainous valleys of Siskiyou County, making breathing and visibility challenging, especially for those who work outdoors or have respiratory issues. Fortunately, with increasing regulation, toxic emissions are declining throughout the state; however, the reduction in smoke pollution rests with improved wildfire mitigation techniques.

18.2. AVALANCHES

18.2.1 How Avalanches Occur

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

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

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

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

18.2.2 Local Avalanche History

The California State Hazard Mitigation Plan indicates that avalanches are threats to communities, residents and visitors to the high mountain areas of Siskiyou County. Significant events have damaged or destroyed ski resorts at Mt. Shasta, they have also blocked and damaged roadways. The Shasta Avalanche Center at the Shasta-Trinity National Forest in Mt. Shasta provides up-to-date snow conditions and avalanche danger levels. The resources provided by the Center are primarily geared toward the general public who engage in snow-related recreational activities.

According to Eric White, lead climbing ranger and avalanche specialist at the USFS Mt. Shasta Ranger Station, there is only a patchy history of avalanches on Mt. Shasta. There is some data from avalanches in the old Ski Bowl when the Ski Bowl resort was operating, listed on West Wide Avalanche Network. There is little to no information before that and little after the Ski Bowl closed until the Avalanche Center opened in 1998. While hundreds of avalanches occur in the surrounding area every season, there have been only two avalanche fatalities on Mt. Shasta:

- One fatality occurred on April 2, 1983 when three climbers were digging a snow cave on Green Butte at the top of Powder Bowl. Two of the climbers were caught up in the avalanche but survived (one was carried and partially buried, and the other was carried on the surface of the avalanche). The third climber, a 28-year-old male, was carried 600 vertical feet and was buried 5 feet deep. He was found by a probe team 24 hours after the avalanche occurred.
- The other fatality occurred on November 19, 1973. A party of five climbers were heading up Avalanche Gulch after the mountain had received around 5.5 feet of snow and strong winds. November 19 was the first clear day of the month. The climbers were near Helen Lake (at 10,400 feet) in Avalanche Gulch when they triggered the slide at around 3 p.m. Three of the five climbers ended up on the surface of the debris. One climber was buried with just his arm showing but was found by the three other climbers and was dug out unharmed. A search for the fifth climber began the following morning, but poor visibility, high winds, heavy snowfall and avalanche danger caused the search to be abandoned. The body of the 25-year-old male was found 11 months later by some climbers in Avalanche Gulch.

Mt. Shasta’s Ranger Station has recorded close calls involving minor injuries and lost ski equipment on Mt. Shasta, especially in Giddy-Giddy Gulch, Avalanche Gulch, Sun Bowl, Powder Bowl, Old Ski Bowl and Gray Butte. There have been human-triggered avalanches and close calls in other high winter-use areas like Castle Lake, Mt. Eddy and Ash Creek Butte. There was a report of a complete avalanche burial in Ash Creek Butte in 2000, but the snowmobiler was recovered alive by his companions.

Several avalanches have damaged buildings and the lift at the Mt. Shasta Ski Bowl. A massive avalanche in the Old Ski Bowl in 1995, long after the resort had closed, covered the road with deep snow, huge trees and boulders and kept the road closed through the summer of 1995. It also removed a quarter mile of power lines, which have since been replaced by underground wires in the lower portion of the Old Ski Bowl. A USFS climbing ranger mapped the approximate avalanche debris area with GPS a few years ago. Most of the historic avalanche pathways on Mt. Shasta are away from structures and power lines. Some avalanches have occurred on the Everitt Memorial Hwy (County Road A10) without injuries or damage, mostly in the long road cut below Bunny Flat. Avalanches in Powder Bowl on Green Butte have historically crossed the road, but that section of road is closed to automobiles in the winter.

A large avalanche reported near Upper Soda Springs in north Dunsmuir in January 1890 dammed the river and buried a train engine and snowplow on the train tracks. USFS Mt. Shasta Rangers have also heard reports of small avalanches on the Callahan/Cecilville Road and the Forks/Etna Road.

18.2.3 Potential Avalanche Scenario

Serious avalanche concerns include the potential for a mass casualty incident in Avalanche Gulch during late spring when climbing reaches its peak. Hundreds of climbers visit Avalanche Gulch on the weekends in May and June. Recently, five human-triggered slides occurred in Avalanche Gulch in May within an hour of each other and within one square mile.

Another concerning scenario involves avalanches at Castle Lake (or other lakes in the area), where a victim could be buried on the lake and broken ice would create a dangerous rescue situation. Castle Lake and Cliff Lake each have active avalanche pathways that deposit snow into the lakes and are becoming increasingly popular ski/snowboard lines. In an avalanche rescue emergency, the nearest trained ice rescue team could be many miles away. More information about the location and extent of avalanches in Siskiyou County is needed to mitigate any future losses to life and property.

18.3. ENERGY SHORTAGES

The 2000-2001 California electricity crisis brought to light issues about the state's dependency on out-of-state energy resources and in-state transmission challenges. Since then, the state has taken steps to lessen market manipulation, construct additional transmission systems and implement energy conservation programs, yet California continues to be challenged with population growth and demand for additional power, along with severe weather events that necessitate considerable energy supplies.

The impacts of energy shortages are felt most severely by vulnerable populations. Those who rely on electrical power for life-sustaining medical equipment and the young or elderly subject to extreme heat or severe cold are most vulnerable to the loss of power.

Siskiyou County's planning partners can increase their ability to cope with energy shortages and power disruptions. Some mitigation actions include strengthening minimum building code standards and requiring backup generators, modifying zoning ordinances for electrical power requirements and improving growth and development trends to better understand future demand for energy. Additionally, the state has developed an online toolkit (California OES, 2003) to help local governments address electric power disruption. This document identifies potential disruptions, types of customers affected and the types of facilities and populations with critical electrical needs.

18.4. FISH DISEASE

Like humans, fish can suffer from disease and parasites. Fish scales and a mucus layer provide a first line of defense from diseases, however pathogens may breach this layer and cause inflammation and infection. Low-grade infections may become fatal when things that cause fish stress, such as natural droughts, pollution, invasive plant or animal species or predators are introduced. The transfer of non-local fish bait can also transmit fish diseases such as whirling disease.

Some diseases may result in mass fish die-offs. A recently discovered disease causes huge fish kills in shallow marine or lake waters. Where large numbers of fish are confined to a relatively small area, excretions from the fish may produce toxins and the fish can develop bleeding lesions causing their scales to fall off in the water. Marine or freshwater microorganisms then feast on the blood and flakes of tissue while the affected fish die. Fish kills by these dinoflagellates are common, and they may also have been responsible for kills in the past that were thought to have had other causes. Mass fish kills like these can be viewed as natural mechanisms for regulating the population of exceptionally abundant fish. To exacerbate the problem, the rate at which the kills occur increases as polluted land runoff increases.

Improving fish habitat and environments is a critical step Siskiyou County's planning partners can take to reduce fish diseases. Some mitigation alternatives include strengthening land management and stormwater runoff management regulations to reduce the amount of pollutants flowing into fish habitats. Another mitigation action involves using cleaner fish, such as wrasses, to attract and remove external parasites from the skin of other fish. Antibiotics and pesticides may also be used to control diseases and parasites in fish.

It is commonly known that the transportation of fish from one location to another is against the law and causes the introduction of fish and parasites alien to the ecosystem. Mitigation opportunities exist to improve angler education about the spread of fish disease and consistent enforcement by agencies responsible for managing fish and fish habitats.

18.5. HAZARDOUS MATERIALS

According to the California State Hazard Mitigation Plan, hazardous materials are substances that are flammable, combustible, explosive, toxic, noxious, corrosive, an oxidizer, an irritant or radioactive. Hazardous material spills or releases can pose a risk to life, health and property. An incident may result in the evacuation of a facility or an entire neighborhood. In addition to the immediate risk from hazardous materials releases to life, public health, air quality, water quality and the environment, long-term public health and environmental impacts may result from sustained use or exposure to certain substances.

Federal laws that regulate hazardous materials include the Superfund Amendments and Reauthorization Act of 1986, the Resource Conservation and Recovery Act of 1976, the October 2007 Hazardous Materials Transportation Act, the Occupational Safety and Health Act, the Toxic Substances Control Act, and the Clean Air Act. California law established the Unified Program, which consolidates, coordinates, and makes consistent the administrative requirements, permits, inspections and enforcement activities of six environmental and emergency response programs. The programs are regulated and overseen by Cal EPA, however local governments are responsible for implementing and enforcing the standards.

Hazardous materials are everywhere in Siskiyou County and are likely accidently released or spilled numerous times each day. Eliminating these widespread substances throughout the county would be nearly impossible, but the threats of an accidental release or spill may be reduced by mitigation. The following required mitigation efforts pertaining to hazardous substances are implemented through state and federal regulation:

- Fixed Facilities:
  - Process hazard analysis through the California Division of Occupational Safety and Health
  - Policies and procedures, hazard communication, and training
  - Placarding and labeling of containers
  - Hazard assessment
  - Security
  - Process and equipment maintenance

  - Mitigating techniques (flares, showers, mists, containment vessels, failsafe devices)
  - Use of inherently safer alternative products
  - Emergency plans and coordination
  - Response procedures
- Transported:
  - Placards and labeling of containers
  - Proper container established for material type
  - Random inspections of transporters
  - Safe handling policies and procedures
  - Hazard communications
  - Training for handlers
  - Permitting
  - Transportation flow studies, e.g., restricting HAZMAT transportation over certain routes.

18.6. NOXIOUS WEEDS

The California Department of Food and Agriculture Plant Health Division is responsible for protecting California's plant and flood supply by keeping invasive species out of the state. The Integrated Pest Control Branch conducts a wide range of pest management and eradication projects; however, some non-native plant species introduced into California spread aggressively and may be able to disrupt agricultural production and ecological systems. Some invasive species are known to cause harmful impacts, including lowering agricultural productivity, altering ecosystem functions (e.g., nutrient cycles, hydrology and wildfire frequency), outcompeting and excluding native plants and animals, and adding to maintenance costs of roads, parks and waterways. Noxious and invasive weeds infest millions of acres in the state and result in hundreds of millions of dollars in control costs and lost productivity. Eradicating weeds at the earliest stages of invasion is widely recognized as more cost-effective and efficient than the long-term commitment of resources to ongoing containment or eliminating established weeds.

Siskiyou County's Environmental and Natural Resource Protection Program promotes and protects the agricultural industry of Siskiyou County and provides leadership in developing policy on issues facing the county's agricultural resources in the following areas related to noxious weed abatement:

- Pesticide use enforcement and environmental monitoring
- Plant protection and quarantine inspection
- Pest detection
- Vegetation management
- Vertebrate pest management
- Nursery inspection
- Seed inspection
- Apiary Inspection
- Integrated pest management.

PART 3 — MITIGATION STRATEGY

CHAPTER 19.
MITIGATION ALTERNATIVES

Catalogs of hazard mitigation alternatives were developed that present a broad range of alternatives to be considered for use in the planning area, in compliance with 44CFR (Section 201.6(c)(3)(ii)). One catalog was developed for each hazard of concern evaluated in this plan. The catalogs for each hazard are listed in Table 19-1 through Table 19-8. The catalogs present alternatives that are categorized in two ways:

- By what the alternative would do:
  - Manipulate a hazard
  - Reduce exposure to a hazard
  - Reduce vulnerability to a hazard
  - Increase the ability to respond to or be prepared for a hazard
- By who would have responsibility for implementation:
  - Individuals
  - Businesses
  - Government.

Hazard mitigation initiatives recommended in this plan were selected from among the alternatives presented in the catalogs. The catalogs provide a baseline of mitigation alternatives that are backed by a planning process, are consistent with the planning partners' goals and objectives, and are within the capabilities of the partners to implement. However, not all the alternatives meet all the planning partners' selection criteria.

**TABLE 19-1.
CATALOG OF MITIGATION ALTERNATIVES—DAM FAILURE**

Personal Scale	Corporate Scale	Government Scale
Manipulate Hazard		
• None	1. Remove dams 2. Remove levees 3. Harden dams	1. Remove dams 2. Remove levees 3. Harden dams
Reduce Exposure		
• Relocate out of dam failure inundation areas.	• Replace earthen dams with hardened structures	1. Replace earthen dams with hardened structures 2. Relocate critical facilities out of dam failure inundation areas. 3. Consider open space land use in designated dam failure inundation areas.
Reduce Vulnerability		
• Elevate home to appropriate levels.	• Flood-proof facilities within dam failure inundation areas	1. Adopt higher regulatory floodplain standards in mapped dam failure inundation areas. 2. Retrofit critical facilities within dam failure inundation areas.
Increase Preparation or Response Capability		
1. Learn about risk reduction for the dam failure hazard. 2. Learn the evacuation routes for a dam failure event. 3. Educate yourself on early warning systems and the dissemination of warnings.	1. Educate employees on the probable impacts of a dam failure. 2. Develop a Continuity of Operations Plan.	1. Map dam failure inundation areas. 2. Enhance emergency operations plan to include a dam failure component. 3. Institute monthly communications checks with dam operators. 4. Inform the public on risk reduction techniques 5. Adopt real-estate disclosure requirements for the re-sale of property located within dam failure inundation areas. 6. Consider the probable impacts of climate in assessing the risk associated with the dam failure hazard. 7. Establish early warning capability downstream of listed high hazard dams. 8. Consider the residual risk associated with protection provided by dams in future land use decisions.

TABLE 19-2.
CATALOG OF MITIGATION ALTERNATIVES—DROUGHT

Personal Scale	Corporate Scale	Government Scale
Manipulate Hazard		
None	None	Groundwater recharge through stormwater management
Reduce Exposure		
None	None	Identify and create groundwater backup sources
Reduce Vulnerability		
1. Drought-resistant landscapes 2. Reduce water system losses 3. Modify plumbing systems (through water saving kits)	1. Drought-resistant landscapes 2. Reduce private water system losses	1. Water use conflict regulations 2. Reduce water system losses 3. Distribute water saving kits
Increase Preparation or Response Capability		
• Practice active water conservation	• Practice active water conservation	1. Public education on drought resistance 2. Identify alternative water supplies for times of drought; mutual aid agreements with alternative suppliers 3. Develop drought contingency plan 4. Develop criteria "triggers" for drought-related actions 5. Improve accuracy of water supply forecasts 6. Modify rate structure to influence active water conservation techniques

TABLE 19-3.
CATALOG OF MITIGATION ALTERNATIVES—EARTHQUAKE

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

TABLE 19-4.
CATALOG OF MITIGATION ALTERNATIVES—FLOOD

Personal Scale	Corporate Scale	Government Scale
Manipulate Hazard		
1. Clear stormwater drains and culverts 2. Institute low-impact development techniques on property	1. Clear stormwater drains and culverts 2. Institute low-impact development techniques on property	1. Maintain drainage system 2. Institute low-impact development techniques on property 3. Dredging, levee construction, and providing regional retention areas 4. Structural flood control, levees, channelization, or revetments. 5. Stormwater management regulations and master planning 6. Acquire vacant land or promote open space uses in developing watersheds to control increases in runoff
Reduce Exposure		
1. Locate outside of hazard area 2. Elevate utilities above base flood elevation 3. Institute low impact development techniques on property	1. Locate business critical facilities or functions outside hazard area 2. Institute low impact development techniques on property	1. Locate or relocate critical facilities outside of hazard area 2. Acquire or relocate identified repetitive loss properties 3. Promote open space uses in identified high hazard areas via techniques such as: planned unit developments, easements, setbacks, greenways, sensitive area tracks. 4. Adopt land development criteria such as planned unit developments, density transfers, clustering 5. Institute low impact development techniques on property 6. Acquire vacant land or promote open space uses in developing watersheds to control increases in runoff
Reduce Vulnerability		
1. Retrofit structures (elevate structures above base flood elevation) 2. Elevate items within house above base flood elevation 3. Build new homes above base flood elevation 4. Flood-proof existing structures	1. Build redundancy for critical functions or retrofit critical buildings 2. Provide flood-proofing measures when new critical infrastructure must be located in floodplains	1. Harden infrastructure, bridge replacement program 2. Provide redundancy for critical functions and infrastructure 3 Adopt appropriate regulatory standards, such as: increased freeboard standards, cumulative substantial improvement or damage, lower substantial damage threshold; compensatory storage, non-conversion deed restrictions. 4. Stormwater management regulations and master planning. 5. Adopt “no-adverse impact” floodplain management policies that strive to not increase the flood risk on downstream communities.

**TABLE 19-4.
CATALOG OF MITIGATION ALTERNATIVES—FLOOD**

Personal Scale	Corporate Scale	Government Scale
Increase Preparation or Response Capability		
1. Buy flood insurance 2. Develop household mitigation plan, such as retrofit savings, communication capability with outside, 72-hour self-sufficiency during and after an event	1. Keep cash reserves for reconstruction 2. Support and implement hazard disclosure for the sale/re-sale of property in identified risk zones. 3. Solicit cost-sharing through partnerships with other stakeholders on projects with multiple benefits.	1. Produce better hazard maps 2. Provide technical information and guidance 3. Enact tools to help manage development in hazard areas (stronger controls, tax incentives, and information) 4. Incorporate retrofitting or replacement of critical system elements in capital improvement plan 5. Develop strategy to take advantage of post-disaster opportunities 6. Warehouse critical infrastructure components 7. Develop and adopt a Continuity of Operations Plan 8. Consider participation in the Community Rating System 9. Maintain existing data and gather new data needed to define risks and vulnerability 10. Train emergency responders 11. Create a building and elevation inventory of structures in the floodplain 12. Develop and implement a public information strategy 13. Charge a hazard mitigation fee 14. Integrate floodplain management policies into other planning mechanisms within the planning area. 15. Consider the probable impacts of climate change on the risk associated with the flood hazard 16. Consider the residual risk associated with structural flood control in future land use decisions 17. Enforce National Flood Insurance Program 18. Adopt a Stormwater Management Master Plan

TABLE 19-5.
CATALOG OF MITIGATION ALTERNATIVES—LANDSLIDE

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

TABLE 19-6.
CATALOG OF MITIGATION ALTERNATIVES—SEVERE WEATHER

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

TABLE 19-7.
CATALOG OF RISK REDUCTION MEASURES—VOLCANO

Personal Scale	Corporate Scale	Government Scale
Manipulate Hazard		
None	None	Limited success has been experienced with lava flow diversion structures
Reduce Exposure		
Relocate outside of hazard area, such as lahar zones	• Locate mission critical functions outside of hazard area, such as lahar zones whenever possible.	Locate critical facilities and functions outside of hazard area, such as lahar zones, whenever possible.
Reduce Vulnerability		
None	• Protect corporate critical facilities and infrastructure from potential impacts of severe ash fall (air filtration capability)	• Protect critical facilities from potential problems associated with ash fall. • Build redundancy for critical facilities and functions.
Increase Preparation or Response Capability		
• Develop and practice a household evacuation plan.	1. Develop and practice a corporate evacuation plan 2. Inform employees through corporate sponsored outreach 3. Develop a cooperative	1. Public outreach, awareness. 2. Tap into state volcano warning system to provide early warning to Siskiyou County residents of potential ash fall problems

TABLE 19-8.
CATALOG OF MITIGATION ALTERNATIVES—WILDFIRE

Personal Scale	Corporate Scale	Government Scale
Manipulate Hazard		
• Clear potential fuels on property such as dry overgrown underbrush and diseased trees	• Clear potential fuels on property such as dry underbrush and diseased trees	1. Clear potential fuels on property such as dry underbrush and diseased trees 2. Implement best management practices on public lands.
Reduce Exposure		
1. Create and maintain defensible space around structures 2. Locate outside of hazard area 3. Mow regularly	1. Create and maintain defensible space around structures and infrastructure 2. Locate outside of hazard area	1. Create and maintain defensible space around structures and infrastructure 2. Locate outside of hazard area 3. Enhance building code to include use of fire resistant materials in high hazard area.
Reduce Vulnerability		
1. Create and maintain defensible space around structures and provide water on site 2. Use fire-retardant building materials 3. Create defensible spaces around home	1. Create and maintain defensible space around structures and infrastructure and provide water on site 2. Use fire-retardant building materials 3. Use fire-resistant plantings in buffer areas of high wildfire threat.	1. Create and maintain defensible space around structures and infrastructure 2. Use fire-retardant building materials 3. Use fire-resistant plantings in buffer areas of high wildfire threat. 4. Consider higher regulatory standards (such as Class A roofing) 5. Establish biomass reclamation initiatives
Increase Preparation or Response Capability		
1. Employ techniques from the National Fire Protection Association's Firewise Communities program to safeguard home 2. Identify alternative water supplies for fire fighting 3. Install/replace roofing material with non-combustible roofing materials.	1. Support Firewise community initiatives. 2. Create /establish stored water supplies to be utilized for firefighting.	1. More public outreach and education efforts, including an active Firewise program 2. Possible weapons of mass destruction funds available to enhance fire capability in high-risk areas 3. Identify fire response and alternative evacuation routes 4. Seek alternative water supplies 5. Become a Firewise community 6. Use academia to study impacts/solutions to wildfire risk 7. Establish/maintain mutual aid agreements between fire service agencies. 8. Create/implement fire plans 9. Consider the probable impacts of climate change on the risk associated with the wildfire hazard in future land use decisions

CHAPTER 20.
AREA-WIDE MITIGATION INITIATIVES

20.1. SELECTED COUNTY-WIDE MITIGATION INITIATIVES

The planning partners and the Steering Committee determined that some initiatives from the mitigation catalogs could be implemented to provide hazard mitigation benefits countywide. Table 20-1 lists the recommended countywide initiatives, the lead agency for each, and the proposed timeline. The parameters for the timeline are as follows:

- Short Term = to be completed in 1 to 5 years
- Long Term = to be completed in greater than 5 years
- Ongoing = currently being funded and implemented under existing programs.

20.2. BENEFIT/COST REVIEW

The action plan must be prioritized according to a benefit/cost analysis of the proposed projects and their associated costs (44CFR, Section 201.6(c)(3)(iii)). The benefits of proposed projects were weighed against estimated costs as part of the project prioritization process. The benefit/cost analysis was not of the detailed variety required by FEMA for project grant eligibility under the Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation (PDM) grant program. A less formal approach was used because some projects may not be implemented for up to 10 years, and associated costs and benefits could change dramatically in that time. Therefore, a review of the apparent benefits versus the apparent cost of each project was performed. Parameters were established for assigning subjective ratings (high, medium, and low) to the costs and benefits of these projects.

Cost ratings were defined as follows:

- **High**—Existing funding will not cover the cost of the project; implementation would require new revenue through an alternative source (for example, bonds, grants, and fee increases).
- **Medium**—The project could be implemented with existing funding but would require a re-apportionment of the budget or a budget amendment, or the cost of the project would have to be spread over multiple years.
- **Low**—The project could be funded under the existing budget. The project is part of or can be part of an ongoing existing program.

Benefit ratings were defined as follows:

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

Using this approach, projects with positive benefit versus cost ratios (such as high over high, high over medium, medium over low, etc.) are considered cost-beneficial and are prioritized accordingly.

TABLE 20-1.
ACTION PLAN—COUNTYWIDE MITIGATION INITIATIVES

Hazards Addressed	Lead Agency	Possible Funding Sources or Resources	Time Line[a]	Objectives
CW-1—Continue to maintain a countywide hazard mitigation plan website to house the plan and plan updates, in order to provide the public an opportunity to monitor plan implementation and progress. Each planning partner may support the initiative by including an initiative in its action plan and creating a web link to the website.				
All Hazards	County OES	General Fund	Short term/ongoing	1, 5, 7, 8
CW-2—Leverage public outreach partnering capabilities to inform and educate the public about hazard mitigation and preparedness.				
All Hazards	County OES	General Fund	Short term/ongoing	1, 5, 7, 8, 9
CW-3—Coordinate all mitigation planning and project efforts, including grant application support, to maximize all resources available to the planning partnership.				
All Hazards	County OES	General Fund, FEMA mitigation grants	Short term/ongoing	1, 2, 3, 4, 5, 7, 8, 9
CW-4—Support the collection of improved data (hydrologic, geologic, topographic, volcanic, historical, etc.) to better assess risks and vulnerabilities.				
All Hazards	County OES	General Fund, FEMA mitigation grants	Short term/ongoing	1, 3, 5, 7, 8
CW-5—Provide coordination and technical assistance in grant application preparation that includes assistance in cost vs. benefit analysis for grant-eligible projects.				
All Hazards	County OES	General Fund, FEMA mitigation grants	Short term/ongoing	1, 8
CW-6—Where appropriate, support retrofitting, purchase, or relocation of structures or infrastructure located in hazard-prone areas to protect structures/infrastructure from future damage, with repetitive loss and severe repetitive loss properties as priority when applicable.				
All Hazards	County OES	FEMA mitigation grants	Long term	1, 2, 4, 5, 6
CW-7— Continue to maintain the Steering Committee as a viable committee to monitor the progress of the hazard mitigation plan, provide technical assistance to Planning Partners and oversee the update of the plan as necessary.				
All Hazards	County OES	General Fund	Short term/ongoing	1, 8
CW-8— In areas of the County with urban/wildland fire interface exposure, continue to promote access for ingress and egress as part of a defensible space initiative.				
Wildfire	Siskiyou Area Fire Safe Council	FEMA mitigation Grants, Fire Safe Council funding sources	Short term/ongoing	1,5,7,8,9
CW-9— Promote landscape approach to fuel reduction as part of a defensible space initiative in areas with high wildfire exposure.				
Wildfire	Siskiyou Area Fire Safe Council	FEMA mitigation Grants, Fire Safe Council funding sources	Short term/ongoing	1,5,7,8,9

For many of the strategies identified in this action plan, the partners may seek financial assistance under the HMGP or PDM programs, both of which require detailed benefit/cost analyses. These analyses will be performed on projects at the time of application using the FEMA benefit-cost model. For projects not seeking financial assistance from grant programs that require detailed analysis, the partners reserve the right to define “benefits” according to parameters that meet the goals and objectives of this plan.

20.3. COUNTY-WIDE ACTION PLAN PRIORITIZATION

Table 20-2 lists the priority of each countywide initiative, using the same parameters used by each of the planning partners in selecting their initiatives. A qualitative benefit-cost review was performed for each of these initiatives. There have been no significant changes sense the 2012 plan. They are the same reflection. The priorities are defined as follows:

- **High Priority**—A project that meets multiple objectives (i.e., multiple hazards), has benefits that exceed cost, has funding secured or is an ongoing project and meets eligibility requirements for the HMGP or PDM grant program. High priority projects can be completed in the short term (1 to 5 years).
- **Medium Priority**—A project that meets goals and objectives, that has benefits that exceed costs, and for which funding has not been secured but that is grant eligible under HMGP, PDM or other grant programs. Project can be completed in the short term, once funding is secured. Medium priority projects will become high priority projects once funding is secured.
- **Low Priority—**A project that will mitigate the risk of a hazard, that has benefits that do not exceed the costs or are difficult to quantify, for which funding has not been secured, that is not eligible for HMGP or PDM grant funding, and for which the time line for completion is long term (1 to 10 years). Low priority projects may be eligible for other sources of grant funding from other programs.

TABLE 20-2.
PRIORITIZATION OF COUNTYWIDE MITIGATION INITIATIVES

Initiative #	# of Objectives Met	Benefits	Costs	Do Benefits equal or exceed Costs?	Is project Grant eligible?	Can Project be funded under existing programs/ budgets?	Priority (High, Med., Low)
CW-1	4	High	Low	Yes	No	Yes	High
CW-2	5	Low	Low	Yes	No	Yes	Med
CW-3	9	Med	Low	Yes	Yes	Yes	High
CW-4	5	High	High	Yes	Yes	No	High
CW-5	2	Med	Low	Yes	Yes	No	High
CW-6	5	High	High	Yes	Yes	No	High
CW-7	2	Low	Low	Yes	No	Yes	High
CW-8	5	High	Low	Yes	Yes	Yes	High
CW-9	5	High	Low	Yes	Yes	Yes	High

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APPENDIX A. ACRONYMS AND DEFINITIONS

August 2018

APPENDIX A.
ACRONYMS AND DEFINITIONS

ACRONYMS

AB—Assembly Bill

Cal OES—California Office of Emergency Services

CAL FIRE—California Department of Forestry and Fire Protection

CCR—California Code of Regulations

CEQA—California Environmental Quality Act

CFR—Code of Federal Regulations

cfs—cubic feet per second

CIP—Capital Improvement Plan

CRS—Community Rating System

DFIRM—Digital Flood Insurance Rate Maps

DHS—Department of Homeland Security

DMA —Disaster Mitigation Act

EAP—Emergency Action Plan

EPA—U.S. Environmental Protection Agency

ESA—Endangered Species Act

FEMA—Federal Emergency Management Agency

FERC—Federal Energy Regulatory Commission

FHSZ —Fire Hazard Severity Zone

FIRM—Flood Insurance Rate Map

FIS—Flood Insurance Study

FRA—Federal responsibility area

GIS—Geographic Information System

HAZUS-MH—Hazards, United States-Multi Hazard

HMGP—Hazard Mitigation Grant Program

IBC—International Building Code

IRC—International Residential Code

LRA—Local responsibility area

MCI—Multi-Casualty Incident

MM—Modified Mercalli Scale

NEHRP—National Earthquake Hazards Reduction Program

NFIP—National Flood Insurance Program

NOAA—National Oceanic and Atmospheric Administration

NWS—National Weather Service

PDI—Palmer Drought Index

PDM—Pre-Disaster Mitigation Grant Program

PGA—Peak Ground Acceleration

PHDI—Palmer Hydrological Drought Index

RAWS—Remote Automated Weather Station

RWQCB—Regional Water Quality Control Board

SEMS—Standardized Emergency Management System

SFHA—Special Flood Hazard Area

SHELDUS—Special Hazard Events and Losses Database for the US

SPI—Standardized Precipitation Index

USGS—U.S. Geological Survey

DEFINITIONS

100-Year Flood: The term "100-year flood" can be misleading. The 100-year flood does not necessarily occur once every 100 years. Rather, it is the flood that has a 1 percent chance of being equaled or exceeded in any given year. Thus, the 100-year flood could occur more than once in a relatively short period of time. The Federal Emergency Management Agency (FEMA) defines it as the 1 percent annual chance flood, which is now the standard definition used by most federal and state agencies and by the National Flood Insurance Program (NFIP).

Acre-Foot: An acre-foot is the amount of water it takes to cover 1 acre to a depth of 1 foot. This measure is used to describe the quantity of storage in a water reservoir. An acre-foot is a unit of volume. One acre foot equals 7,758 barrels; 325,829 gallons; or 43,560 cubic feet. An average household of four will use approximately 1 acre-foot of water per year.

Asset: An asset is any man-made or natural feature that has value, including, but not limited to, people; buildings; infrastructure, such as bridges, roads, sewers, and water systems; lifelines, such as electricity and communication resources; and environmental, cultural, or recreational features such as parks, wetlands, and landmarks.

Base Flood: The flood having a 1% chance of being equaled or exceeded in any given year, also known as the "100-year" or "1% chance" flood. The base flood is a statistical concept used to ensure that all properties subject to the National Flood Insurance Program (NFIP) are protected to the same degree against flooding.

Basin: A basin is the area within which all surface water—whether from rainfall, snowmelt, springs, or other sources—flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains, and ridges. Basins are also referred to as "watersheds" and "drainage basins."

Benefit: A benefit is a net project outcome and is usually defined in monetary terms. Benefits may include direct and indirect effects. For the purposes of benefit-cost analysis of proposed mitigation measures, benefits are limited to specific, measurable, risk reduction factors, including reduction in expected property losses (buildings, contents, and functions) and protection of human life.

Benefit/Cost Analysis: A benefit/cost analysis is a systematic, quantitative method of comparing projected benefits to projected costs of a project or policy. It is used as a measure of cost effectiveness.

Building: A building is defined as a structure that is walled and roofed, principally aboveground, and permanently fixed to a site. The term includes manufactured homes on permanent foundations on which the wheels and axles carry no weight.

Capability Assessment: A capability assessment provides a description and analysis of a community's current capacity to address threats associated with hazards. The assessment includes two components: an inventory of an agency's mission, programs, and policies, and an analysis of its capacity to carry them out. A capability assessment is an integral part of the planning process in which a community's actions to reduce losses are identified, reviewed, and analyzed, and the framework for implementation is identified. The following capabilities were reviewed under this assessment:

- Legal and regulatory capability
- Administrative and technical capability
- Fiscal capability

Community Rating System (CRS): The CRS is a voluntary program under the NFIP that rewards participating communities (provides incentives) for exceeding the minimum requirements of the NFIP and completing activities that reduce flood hazard risk by providing flood insurance premium discounts.

Critical Area: An area defined by state or local regulations as deserving special protection because of unique natural features or its value as habitat for a wide range of species of flora and fauna. A sensitive/critical area is usually subject to more restrictive development regulations.

Critical Facility: Facilities and infrastructure that are critical to the health and welfare of the population. These become especially important after any hazard event occurs. For the purposes of this plan, critical facilities include:

- Structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic and/or water reactive materials;
- Hospitals, nursing homes, and housing likely to contain occupants who may not be sufficiently mobile to avoid death or injury during a hazard event.
- Police stations, fire stations, vehicle and equipment storage facilities, and emergency operations centers that are needed for disaster response before, during, and after hazard events, and
- Public and private utilities, facilities and infrastructure that are vital to maintaining or restoring normal services to areas damaged by hazard events.
- Government facilities.

Cubic Feet per Second (cfs): Discharge or river flow is commonly measured in cfs. One cubic foot is about 7.5 gallons of liquid.

Dam: Any artificial barrier or controlling mechanism that can or does impound 10 acre-feet or more of water.

Dam Failure: Dam failure refers to a partial or complete breach in a dam (or levee) that impacts its integrity. Dam failures occur for a number of reasons, such as flash flooding, inadequate spillway size, mechanical failure of valves or other equipment, freezing and thawing cycles, earthquakes, and intentional destruction.

Debris Avalanche: Volcanoes are prone to debris and mountain rock avalanches that can approach speeds of 100 mph.

Debris Flow: Dense mixtures of water-saturated debris that move down-valley; looking and behaving much like flowing concrete. They form when loose masses of unconsolidated material are saturated, become unstable, and move down slope. The source of water varies but includes rainfall, melting snow or ice, and glacial outburst floods.

Debris Slide: Debris slides consist of unconsolidated rock or soil that has moved rapidly down slope. They occur on slopes greater than 65 percent.

Disaster Mitigation Act of 2000 (DMA); The DMA is Public Law 106-390 and is the latest federal legislation enacted to encourage and promote proactive, pre-disaster planning as a condition of receiving financial assistance under the Robert T. Stafford Act. The DMA emphasizes planning for disasters before they occur. Under the DMA, a pre-disaster hazard mitigation program and new requirements for the national post-disaster hazard mitigation grant program (HMGP) were established.

Drainage Basin: A basin is the area within which all surface water- whether from rainfall, snowmelt, springs or other sources- flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains and ridges. Drainage basins are also referred to as **watersheds** or **basins**.

Drought: Drought is a period of time without substantial rainfall or snowfall from one year to the next. Drought can also be defined as the cumulative impacts of several dry years or a deficiency of precipitation over an extended period of time, which in turn results in water shortages for some activity, group, or environmental function. A hydrological drought is caused by deficiencies in surface and subsurface water supplies. A socioeconomic drought impacts the health, well-being, and quality of life or starts to have an adverse impact on a region. Drought is a normal, recurrent feature of climate and occurs almost everywhere.

Earthquake: An earthquake is defined as a sudden slip on a fault, volcanic or magmatic activity, and sudden stress changes in the earth that result in ground shaking and radiated seismic energy. Earthquakes can last from a few seconds to over 5 minutes, and have been known to occur as a series of tremors over a period of several days. The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Casualties may result from falling objects and debris as shocks shake, damage, or demolish buildings and other structures.

Exposure: Exposure is defined as the number and dollar value of assets considered to be at risk during the occurrence of a specific hazard.

Extent: The extent is the size of an area affected by a hazard.

Fire Behavior: Fire behavior refers to the physical characteristics of a fire and is a function of the interaction between the fuel characteristics (such as type of vegetation and structures that could burn), topography, and weather. Variables that affect fire behavior include the rate of spread, intensity, fuel consumption, and fire type (such as underbrush versus crown fire).

Fire Frequency: Fire frequency is the broad measure of the rate of fire occurrence in a particular area. An estimate of the areas most likely to burn is based on past fire history or fire rotation in the area, fuel conditions, weather, ignition sources (such as human or lightning), fire suppression response, and other factors.

Flash Flood: A flash flood occurs with little or no warning when water levels rise at an extremely fast rate

Flood Insurance Rate Map (FIRM): FIRMs are the official maps on which the Federal Emergency Management Agency (FEMA) has delineated the Special Flood Hazard Area (SFHA).

Flood Insurance Study: A report published by the Federal Insurance and Mitigation Administration for a community in conjunction with the community’s Flood Insurance rate Map. The study contains such background data as the base flood discharges and water surface elevations that were used to prepare the FIRM. In most cases, a community FIRM with detailed mapping will have a corresponding flood insurance study.

Floodplain: Any land area susceptible to being inundated by flood waters from any source. A flood insurance rate map identifies most, but not necessarily all, of a community’s floodplain as the Special Flood Hazard Area (SFHA).

Floodway: Floodways are areas within a floodplain that are reserved for the purpose of conveying flood discharge without increasing the base flood elevation more than 1 foot. Generally speaking, no development is allowed in floodways, as any structures located there would block the flow of floodwaters.

Floodway Fringe: Floodway fringe areas are located in the floodplain but outside of the floodway. Some development is generally allowed in these areas, with a variety of restrictions. On maps that have identified and delineated a floodway, this would be the area beyond the floodway boundary that can be subject to different regulations.

Fog: Fog refers to a cloud (or condensed water droplets) near the ground. Fog forms when air close to the ground can no longer hold all the moisture it contains. Fog occurs either when air is cooled to its dew point or the amount of moisture in the air increases. Heavy fog is particularly hazardous because it can restrict surface visibility. Severe fog incidents can close roads, cause vehicle accidents, cause airport delays, and impair the effectiveness of emergency response. Financial losses associated with transportation delays caused by fog have not been calculated in the United States but are known to be substantial.

Freeboard: Freeboard is the margin of safety added to the base flood elevation.

Frequency: For the purposes of this plan, frequency refers to how often a hazard of specific magnitude, duration, and/or extent is expected to occur on average. Statistically, a hazard with a 100-year frequency is expected to occur about once every 100 years on average and has a 1 percent chance of occurring any given year. Frequency reliability varies depending on the type of hazard considered.

Fujita Scale of Tornado Intensity: Tornado wind speeds are sometimes estimated on the basis of wind speed and damage sustained using the Fujita Scale. The scale rates the intensity or severity of tornado events using numeric values from F0 to F5 based on tornado wind speed and damage. An F0 tornado (wind speed less than 73 miles per hour (mph)) indicates minimal damage (such as broken tree limbs), and an F5 tornado (wind speeds of 261 to 318 mph) indicates severe damage.

Goal: A goal is a general guideline that explains what is to be achieved. Goals are usually broad-based, long-term, policy-type statements and represent global visions. Goals help define the benefits that a plan is trying to achieve. The success of a hazard mitigation plan is measured by the degree to which its goals have been met (that is, by the actual benefits in terms of actual hazard mitigation).

Geographic Information System (GIS): GIS is a computer software application that relates data regarding physical and other features on the earth to a database for mapping and analysis.

Hazard: A hazard is a source of potential danger or adverse condition that could harm people and/or cause property damage.

Hazard Mitigation Grant Program (HMGP): Authorized under Section 202 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, the HMGP is administered by FEMA and provides grants to states, tribes, and local governments to implement hazard mitigation actions after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to disasters and to enable mitigation activities to be implemented as a community recovers from a disaster

Hazards U.S. Multi-Hazard (HAZUS-MH) Loss Estimation Program: HAZUS-MH is a GIS-based program used to support the development of risk assessments as required under the DMA. The HAZUS-MH software program assesses risk in a quantitative manner to estimate damages and losses associated with natural hazards. HAZUS-MH is FEMA's nationally applicable, standardized methodology and software program and contains modules for estimating potential losses from earthquakes, floods, and wind hazards. HAZUS-MH has also been used to assess vulnerability (exposure) for other hazards.

Hydraulics: Hydraulics is the branch of science or engineering that addresses fluids (especially water) in motion in rivers or canals, works and machinery for conducting or raising water, the use of water as a prime mover, and other fluid-related areas.

Hydrology: Hydrology is the analysis of waters of the earth. For example, a flood discharge estimate is developed by conducting a hydrologic study.

Intensity: For the purposes of this plan, intensity refers to the measure of the effects of a hazard.

Inventory: The assets identified in a study region comprise an inventory. Inventories include assets that could be lost when a disaster occurs and community resources are at risk. Assets include people, buildings, transportation, and other valued community resources.

Landslide: Landslides can be described as the sliding movement of masses of loosened rock and soil down a hillside or slope. Fundamentally, slope failures occur when the strength of the soils forming the slope exceeds the pressure, such as weight or saturation, acting upon them.

Lightning: Lightning is an electrical discharge resulting from the buildup of positive and negative charges within a thunderstorm. When the buildup becomes strong enough, lightning appears as a "bolt," usually within or between clouds and the ground. A bolt of lightning instantaneously reaches temperatures approaching 50,000ºF. The rapid heating and cooling of air near lightning causes thunder.

Lightning is a major threat during thunderstorms. In the United States, 75 to 100 Americans are struck and killed by lightning each year (see http://www.fema.gov/hazard/thunderstorms/thunder.shtm).

Liquefaction: Liquefaction is the complete failure of soils, occurring when soils lose shear strength and flow horizontally. It is most likely to occur in fine grain sands and silts, which behave like viscous fluids when liquefaction occurs. This situation is extremely hazardous to development on the soils that liquefy, and generally results in extreme property damage and threats to life and safety.

Local Government: Any county, municipality, city, town, township, public authority, school district, special district, intrastate district, council of governments (regardless of whether the council of governments is incorporated as a nonprofit corporation under State law), regional or interstate government entity, or agency or instrumentality of a local government; any Indian tribe or authorized tribal organization, or Alaska Native village or organization; and any rural community, unincorporated town or village, or other public entity.

Magnitude: Magnitude is the measure of the strength of an earthquake, and is typically measured by the Richter scale. As an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value.

Mass movement: A collective term for landslides, mudflows, debris flows, sinkholes and lahars.

Mitigation: A preventive action that can be taken in advance of an event that will reduce or eliminate the risk to life or property.

Mitigation Actions: Mitigation actions are specific actions to achieve goals and objectives that minimize the effects from a disaster and reduce the loss of life and property.

Objective: For the purposes of this plan, an objective is defined as a short-term aim that, when combined with other objectives, forms a strategy or course of action to meet a goal. Unlike goals, objectives are specific and measurable.

Peak Ground Acceleration: Peak Ground Acceleration (PGA) is a measure of the highest amplitude of ground shaking that accompanies an earthquake, based on a percentage of the force of gravity.

Preparedness: Preparedness refers to actions that strengthen the capability of government, citizens, and communities to respond to disasters.

Presidential Disaster Declaration: These declarations are typically made for events that cause more damage than state and local governments and resources can handle without federal government assistance. Generally, no specific dollar loss threshold has been established for such declarations. A Presidential Disaster Declaration puts into motion long-term federal recovery programs, some of which are matched by state programs, designed to help disaster victims, businesses, and public entities.

Probability of Occurrence: The probability of occurrence is a statistical measure or estimate of the likelihood that a hazard will occur. This probability is generally based on past hazard events in the area and a forecast of events that could occur in the future. A probability factor based on yearly values of occurrence is used to estimate probability of occurrence.

Repetitive Loss Property: Any NFIP-insured property that, since 1978 and regardless of any changes of ownership during that period, has experienced:

- Four or more paid flood losses in excess of $1000.00; or
- Two paid flood losses in excess of $1000.00 within any 10-year period since 1978 or
- Three or more paid losses that equal or exceed the current value of the insured property.

Return Period (or Mean Return Period): This term refers to the average period of time in years between occurrences of a particular hazard (equal to the inverse of the annual frequency of occurrence).

Riverine: Of or produced by a river. Riverine floodplains have readily identifiable channels. Floodway maps can only be prepared for riverine floodplains.

Risk: Risk is the estimated impact that a hazard would have on people, services, facilities, and structures in a community. Risk measures the likelihood of a hazard occurring and resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate, or low likelihood of sustaining damage above a particular threshold due to occurrence of a specific type of hazard. Risk also can be expressed in terms of potential monetary losses associated with the intensity of the hazard.

Risk Assessment: Risk assessment is the process of measuring potential loss of life, personal injury, economic injury, and property damage resulting from hazards. This process assesses the vulnerability of people, buildings, and infrastructure to hazards and focuses on (1) hazard identification; (2) impacts of hazards on physical, social, and economic assets; (3) vulnerability identification; and (4) estimates of the cost of damage or costs that could be avoided through mitigation.

Risk Ranking: This ranking serves two purposes, first to describe the probability that a hazard will occur, and second to describe the impact a hazard will have on people, property, and the economy. Risk estimates for the City are based on the methodology that the City used to prepare the risk assessment for this plan. The following equation shows the risk ranking calculation:

Risk Ranking = Probability + Impact (people + property + economy)

Robert T. Stafford Act: The Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 100-107, was signed into law on November 23, 1988. This law amended the Disaster Relief Act of 1974, Public Law 93-288. The Stafford Act is the statutory authority for most federal disaster response activities, especially as they pertain to FEMA and its programs.

Sinkhole: A collapse depression in the ground with no visible outlet. Its drainage is subterranean. It is commonly vertical-sided or funnel-shaped.

Special Flood Hazard Area: The base floodplain delineated on a Flood Insurance Rate Map. The SFHA is mapped as a Zone A in riverine situations and zone V in coastal situations. The SFHA may or may not encompass all of a community's flood problems

Stakeholder: Business leaders, civic groups, academia, non-profit organizations, major employers, managers of critical facilities, farmers, developers, special purpose districts, and others whose actions could impact hazard mitigation.

Stream Bank Erosion: Stream bank erosion is common along rivers, streams and drains where banks have been eroded, sloughed or undercut. However, it is important to remember that a stream is a dynamic and constantly changing system. It is natural for a stream to want to meander, so not all eroding banks are "bad" and in need of repair. Generally, stream bank erosion becomes a problem where development has limited the meandering nature of streams, where streams have been channelized, or where stream bank structures (like bridges, culverts, etc.) are located in places where they can actually cause damage to downstream areas. Stabilizing these areas can help protect watercourses from continued sedimentation, damage to adjacent land uses, control unwanted meander, and improvement of habitat for fish and wildlife.

Steep Slope: Different communities and agencies define it differently, depending on what it is being applied to, but generally a steep slope is a slope in which the percent slope equals or exceeds 25%. For this study, steep slope is defined as slopes greater than 33%.

Sustainable Hazard Mitigation: This concept includes the sound management of natural resources, local economic and social resiliency, and the recognition that hazards and mitigation must be understood in the largest possible social and economic context.

Thunderstorm: A thunderstorm is a storm with lightning and thunder produced by cumulonimbus clouds. Thunderstorms usually produce gusty winds, heavy rains, and sometimes hail. Thunderstorms are usually short in duration (seldom more than 2 hours). Heavy rains associated with thunderstorms can lead to flash flooding during the wet or dry seasons.

Tornado: A tornado is a violently rotating column of air extending between and in contact with a cloud and the surface of the earth. Tornadoes are often (but not always) visible as funnel clouds. On a local scale, tornadoes are the most intense of all atmospheric circulations, and winds can reach destructive speeds of more than 300 mph. A tornado's vortex is typically a few hundred meters in diameter, and damage paths can be up to 1 mile wide and 50 miles long.

Vulnerability: Vulnerability describes how exposed or susceptible an asset is to damage. Vulnerability depends on an asset's construction, contents, and the economic value of its functions. Like indirect damages, the vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power. Flooding of an electric substation would affect not only the substation itself but businesses as well. Often, indirect effects can be much more widespread and damaging than direct effects.

Watershed: A watershed is an area that drains downgradient from areas of higher land to areas of lower land to the lowest point, a common drainage basin.

Wildfire: These terms refer to any uncontrolled fire occurring on undeveloped land that requires fire suppression. The potential for wildfire is influenced by three factors: the presence of fuel, topography, and air mass. Fuel can include living and dead vegetation on the ground, along the surface as brush and small trees, and in the air such as tree canopies. Topography includes both slope and elevation. Air mass includes temperature, relative humidity, wind speed and direction, cloud cover, precipitation amount, duration, and the stability of the atmosphere at the time of the fire. Wildfires can be ignited by lightning and, most frequently, by human activity including smoking, campfires, equipment use, and arson.

Windstorm: Windstorms are generally short-duration events involving straight-line winds or gusts exceeding 50 mph. These gusts can produce winds of sufficient strength to cause property damage. Windstorms are especially dangerous in areas with significant tree stands, exposed property, poorly constructed buildings, mobile homes (manufactured housing units), major infrastructure, and aboveground utility lines. A windstorm can topple trees and power lines; cause damage to residential, commercial, critical facilities; and leave tons of debris in its wake.

Zoning Ordinance: The zoning ordinance designates allowable land use and intensities for a local jurisdiction. Zoning ordinances consist of two components: a zoning text and a zoning map.

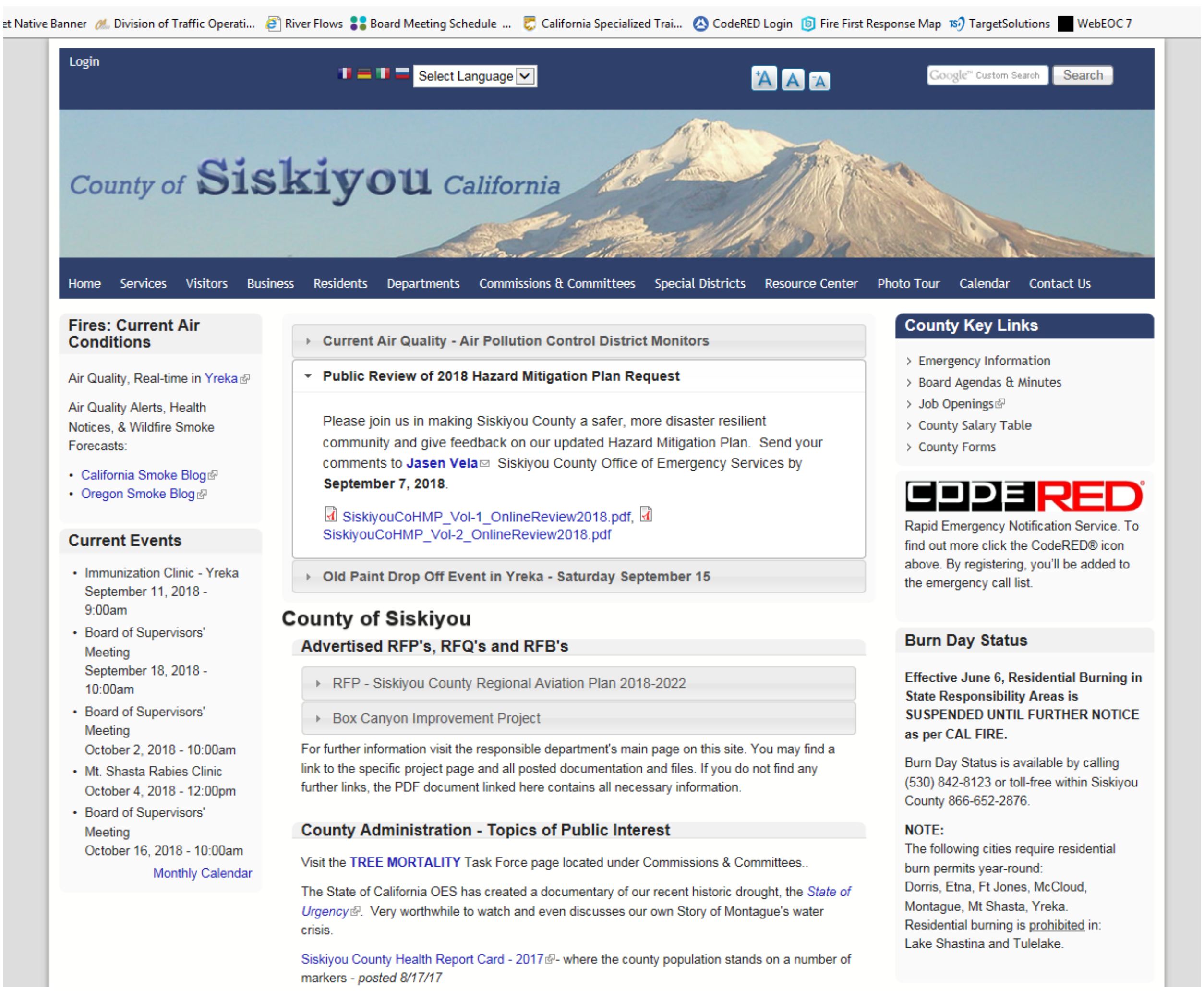
Siskiyou County

Hazard Mitigation Plan

APPENDIX B. PUBLIC OUTREACH

August 2018

APPENDIX B.
PUBLIC OUTREACH



et Native Banner | Division of Traffic Operati... | River Flows | Board Meeting Schedule ... | California Specialized Trai... | CodeRED Login | Fire First Response Map | TargetSolutions | WebEOC 7

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County of Siskiyou California

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Fires: Current Air Conditions

Air Quality, Real-time in Yreka

Air Quality Alerts, Health Notices, & Wildfire Smoke Forecasts:

- California Smoke Blog
- Oregon Smoke Blog

Current Events

- Immunization Clinic - Yreka
  September 11, 2018 - 9:00am
- Board of Supervisors' Meeting
  September 18, 2018 - 10:00am
- Board of Supervisors' Meeting
  October 2, 2018 - 10:00am
- Mt. Shasta Rabies Clinic
  October 4, 2018 - 12:00pm
- Board of Supervisors' Meeting
  October 16, 2018 - 10:00am

Monthly Calendar

Current Air Quality - Air Pollution Control District Monitors

Public Review of 2018 Hazard Mitigation Plan Request

Please join us in making Siskiyou County a safer, more disaster resilient community and give feedback on our updated Hazard Mitigation Plan. Send your comments to **Jasen Vela** Siskiyou County Office of Emergency Services by **September 7, 2018**.

SiskiyouCoHMP_Vol-1_OnlineReview2018.pdf, SiskiyouCoHMP_Vol-2_OnlineReview2018.pdf

Old Paint Drop Off Event in Yreka - Saturday September 15

County of Siskiyou

Advertised RFP's, RFQ's and RFB's

- RFP - Siskiyou County Regional Aviation Plan 2018-2022
- Box Canyon Improvement Project

For further information visit the responsible department's main page on this site. You may find a link to the specific project page and all posted documentation and files. If you do not find any further links, the PDF document linked here contains all necessary information.

County Administration - Topics of Public Interest

Visit the **TREE MORTALITY** Task Force page located under Commissions & Committees..

The State of California OES has created a documentary of our recent historic drought, the *State of Urgency*. Very worthwhile to watch and even discusses our own Story of Montague's water crisis.

Siskiyou County Health Report Card - 2017 - where the county population stands on a number of markers - *posted 8/17/17*

County Key Links

- Emergency Information
- Board Agendas & Minutes
- Job Openings
- County Salary Table
- County Forms

CODERED

Rapid Emergency Notification Service. To find out more click the CodeRED® icon above. By registering, you'll be added to the emergency call list.

Burn Day Status

Effective June 6, Residential Burning in State Responsibility Areas is SUSPENDED UNTIL FURTHER NOTICE as per CAL FIRE.

Burn Day Status is available by calling (530) 842-8123 or toll-free within Siskiyou County 866-652-2876.

NOTE:
The following cities require residential burn permits year-round:
Dorris, Etna, Ft Jones, McCloud, Montague, Mt Shasta, Yreka.
Residential burning is prohibited in:
Lake Shastina and Tulelake.

APPENDIX C.
EXAMPLE PROGRESS REPORT

August 2018

APPENDIX C.
EXAMPLE PROGRESS REPORT

Siskiyou County
Hazard Mitigation Plan
Annual Progress Report

Reporting Period: *(Insert reporting period)*

Background: Siskiyou County and participating cities and special purpose districts in the county developed a hazard mitigation plan to reduce risk from all hazards by identifying resources, information, and strategies for risk reduction. The federal Disaster Mitigation Act of 2000 requires state and local governments to develop hazard mitigation plans as a condition for federal disaster grant assistance. To prepare the plan, the participating partners organized resources, assessed risks from natural hazards within the county, developed planning goals and objectives, reviewed mitigation alternatives, and developed an action plan to address probable impacts from natural hazards. By completing this process, these jurisdictions maintained compliance with the Disaster Mitigation Act, achieving eligibility for mitigation grant funding opportunities afforded under the Robert T. Stafford Act. The plan can be viewed on-line at:

http://www.co.siskiyou.ca.us/PHS/emerg/hazard_mitigation.aspx

Summary Overview of the Plan's Progress: The performance period for the Hazard Mitigation Plan became effective on ____, 2011, with the final approval of the plan by FEMA. The initial performance period for this plan will be 5 years, with an anticipated update to the plan to occur before ______, 2016. As of this reporting period, the performance period for this plan is considered to be __% complete. The Hazard Mitigation Plan has targeted __ hazard mitigation initiatives to be pursued during the 5-year performance period. As of the reporting period, the following overall progress can be reported:

- __ out of __ initiatives (__%) reported ongoing action toward completion.
- __ out of __ initiatives (__%) were reported as being complete.
- __ out of __ initiatives (___%) reported no action taken.

Purpose: The purpose of this report is to provide an annual update on the implementation of the action plan identified in the Siskiyou County Hazard Mitigation Plan. The objective is to ensure that there is a continuing and responsive planning process that will keep the Hazard Mitigation Plan dynamic and responsive to the needs and capabilities of the partner jurisdictions. This report discusses the following:

- Natural hazard events that have occurred within the last year
- Changes in risk exposure within the planning area (all of Siskiyou County)
- Mitigation success stories
- Review of the action plan
- Changes in capabilities that could impact plan implementation
- Recommendations for changes/enhancement.

The Hazard Mitigation Plan Steering Committee: The Hazard Mitigation Plan Steering Committee, made up of planning partners and stakeholders within the planning area, reviewed and approved this progress report at its annual meeting held on _____, 201_. It was determined through the plan's development process that a steering committee would remain in service to oversee maintenance of the plan. At a minimum, the Steering Committee will provide technical review and oversight on the development of the annual progress report. It is anticipated that there will be turnover in the membership annually, which will be documented in the progress reports. For this reporting period, the Steering Committee membership is as indicated in Table 1.

TABLE 1.
STEERING COMMITTEE MEMBERS

Name	Title	Jurisdiction/Agency

Natural Hazard Events within the Planning Area: During the reporting period, there were __ natural hazard events in the planning area that had a measurable impact on people or property. A summary of these events is as follows:

- ____________________________
- ____________________________

Changes in Risk Exposure in the Planning Area: *(Insert brief overview of any natural hazard event in the planning area that changed the probability of occurrence or ranking of risk for the hazards addressed in the hazard mitigation plan)*

Mitigation Success Stories: *(Insert brief overview of mitigation accomplishments during the reporting period)*

Review of the Action Plan: Table 2 reviews the action plan, reporting the status of each initiative. Reviewers of this report should refer to the Hazard Mitigation Plan for more detailed descriptions of each initiative and the prioritization process.

Address the following in the "status" column of the following table:

- *Was any element of the initiative carried out during the reporting period?*
- *If no action was completed, why?*
- *Is the timeline for implementation for the initiative still appropriate?*
- *If the initiative was completed, does it need to be changed or removed from the action plan?*

TABLE 2.
ACTION PLAN MATRIX

Action Taken? (Yes or No)	Time Line	Priority	Status	Status (X, O,✓)
Initiative #__—_______________________[description]				
Initiative #__—_______________________[description]				
Initiative #__—_______________________[description]				
Initiative #__—_______________________[description]				
Initiative #__—_______________________[description]				
Initiative #__—_______________________[description]				
Initiative #__—_______________________[description]				
Initiative #__—_______________________[description]				
Initiative #__—_______________________[description]				
Initiative #__—_______________________[description]				
Initiative #__—_______________________[description]				
Initiative #__—_______________________[description]				
Initiative #__—_______________________[description]				

TABLE 2.
ACTION PLAN MATRIX

Action Taken? (Yes or No)	Time Line	Priority	Status	Status (X, O,✓)
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				
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Initiative #__—______________________[description]				
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				

Completion status legend:
- ✓= Project Completed
- O = Action ongoing toward completion
- X = No progress at this time

Changes That May Impact Implementation of the Plan: *(Insert brief overview of any significant changes in the planning area that would have a profound impact on the implementation of the plan. Specify any changes in technical, regulatory and financial capabilities identified during the plan's development)*

Recommendations for Changes or Enhancements: Based on the review of this report by the Hazard Mitigation Plan Steering Committee, the following recommendations will be noted for future updates or revisions to the plan:

- ____________________________
- ____________________________
- ____________________________
- ____________________________
- ____________________________
- ____________________________

Public review notice: *The contents of this report are considered to be public knowledge and have been prepared for total public disclosure. Copies of the report have been provided to the governing boards of all planning partners and to local media outlets and the report is posted on the Siskiyou County Hazard Mitigation Plan website. Any questions or comments regarding the contents of this report should be directed to:*

Insert Contact Info Here

APPENDIX D. PLAN ADOPTION RESOLUTIONS FROM PLANNING PARTNERS

January 2012

APPENDIX D.
PLAN ADOPTION RESOLUTIONS FROM PLANNING PARTNERS

To Be Provided With Final Release