



# 2022 Hazard Mitigation Plan

Prepared for the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians

Prepared by WSP USA Inc.

# CTCLUSI 2022 Hazard Mitigation Plan

2022

Prepared for:



CTCLUSI

1245 Fulton Avenue

Coos Bay, OR 97420

Prepared by:



WSP

333 SW Fifth Ave, Suite 608

Portland, OR 97204

# Table of Contents

<b>TABLE OF CONTENTS.....</b>	<b>I</b>
PROJECT MANAGER.....	
CONSULTANTS .....	
SPECIAL ACKNOWLEDGEMENTS .....	
ESTABLISHING THE HAZARD MITIGATION EMERGENCY MANAGEMENT TEAM .....	1
DEFINING THE FIVE-COUNTY SERVICE AREA HAZARD MITIGATION OVERVIEW .....	1
IDENTIFYING AND ASSESSING NATURAL HAZARD RISKS IN THE FIVE-COUNTY SERVICE AREA.....	2
ENGAGING CTCLUSI'S CITIZENS.....	3
DEVELOPING THE MITIGATION STRATEGY AND ACTION PLAN .....	3
WRITING, IMPLEMENTING, AND MAINTAINING THE PLAN .....	4
<b>1 INTRODUCTION TO HAZARD MITIGATION PLANNING.....</b>	<b>1-1</b>
1.1 WHAT IS NATURAL HAZARD MITIGATION PLANNING? .....	1-1
1.2 THE PURPOSE OF HAZARD MITIGATION PLANNING .....	1-2
<b>2 PLAN UPDATE – WHAT HAS CHANGED? .....</b>	<b>2-1</b>
2.1 PREVIOUS HAZARD MITIGATION PLAN .....	2-1
2.2 WHY UPDATE? .....	2-1
2.3 THE UPDATED PLAN – WHAT IS DIFFERENT? .....	2-1
<b>3 PLAN METHODOLOGY.....</b>	<b>3-1</b>
3.1 OVERVIEW .....	3-1
3.2 PROJECT TEAM FORMATION .....	3-1
3.3 EMERGENCY MANAGEMENT TEAM FORMATION .....	3-1
3.4 DEFINING THE FIVE-COUNTY SERVICE AREA .....	3-1
3.5 ENGAGING CTCLUSI CITIZENS .....	3-3
3.6 COORDINATION WITH OTHER AGENCIES.....	3-3
3.7 PLAN DEVELOPMENT CHRONOLOGY AND MILESTONES .....	3-4
<b>4 CONFEDERATED TRIBES OF COOS, LOWER UMPQUA, &amp; SIUSLAW INDIANS PROFILE .....</b>	<b>4-6</b>
4.1 HISTORY OF THE CONFEDERATED TRIBES OF COOS, LOWER UMPQUA, & SIUSLAW INDIANS – REMEMBERING WHERE WE CAME FROM .....	4-6
4.2 GEOGRAPHIC SETTING .....	4-7
4.3 TRIBAL ENROLLMENT .....	4-7
4.4 TRIBAL GOVERNANCE .....	4-9
4.5 TRIBAL ENTERPRISES – SUPPORTING OUR PEOPLE THROUGH ECONOMIC GROWTH .....	4-10
4.6 NATURAL RESOURCE CONSERVATION AND MANAGEMENT ON TRIBALLY-HELD LANDS .....	4-10
4.7 DEVELOPMENT TRENDS – LOOKING TO THE TRIBES' FUTURE .....	4-12
4.8 CAPABILITIES AND CAPACITY ASSESSMENT .....	4-12
<b>PART 2 .....</b>	<b>4-1</b>
<b>5 RISK ASSESSMENT.....</b>	<b>5-1</b>
5.1 INTRODUCTION .....	5-1
5.2 METHODOLOGY .....	5-1
5.3 LIMITATIONS .....	5-8
<b>6 EARTHQUAKE.....</b>	<b>6-1</b>
6.1 GENERAL BACKGROUND.....	6-1
6.2 CTCLUSI HAZARD PROFILE .....	6-2
6.3 SECONDARY HAZARDS AND CASCADING IMPACTS .....	6-8
6.4 POTENTIAL IMPACTS FROM FUTURE CLIMATE CONDITIONS .....	6-10
6.5 EXPOSURE AND VULNERABILITY.....	6-10

6.6 DEVELOPMENT TRENDS .....	6-12
6.7 ISSUES .....	6-13
6.8 HAZARD MAPS .....	6-13
<b>7 EPIDEMIC/PANDEMIC .....</b>	<b>7-1</b>
7.1 GENERAL BACKGROUND .....	7-1
7.2 CTCLUSI HAZARD PROFILE .....	7-2
7.3 SECONDARY HAZARDS AND CASCADING IMPACTS .....	7-6
7.4 POTENTIAL IMPACTS FROM FUTURE CLIMATE CONDITIONS .....	7-6
7.5 EXPOSURE AND VULNERABILITY .....	7-6
7.6 DEVELOPMENT TRENDS .....	7-7
7.7 ISSUES .....	7-7
7.8 HAZARD MAPS .....	7-7
<b>8 FLOOD AND SEA LEVEL RISE .....</b>	<b>8-1</b>
8.1 GENERAL BACKGROUND .....	8-1
8.2 CTCLUSI HAZARD PROFILE .....	8-2
8.3 SECONDARY HAZARDS AND CASCADING IMPACTS .....	8-7
8.4 POTENTIAL IMPACTS FROM FUTURE CLIMATE CONDITIONS .....	8-7
8.5 EXPOSURE .....	8-8
8.6 DEVELOPMENT TRENDS .....	8-11
8.7 ISSUES .....	8-11
8.8 HAZARD MAPS .....	8-11
<b>9 HAZARDOUS MATERIALS .....</b>	<b>9-1</b>
9.1 GENERAL BACKGROUND .....	9-1
9.2 CTCLUSI HAZARD PROFILE .....	9-3
9.3 SECONDARY HAZARDS AND CASCADING IMPACTS .....	9-5
9.4 POTENTIAL IMPACTS FROM FUTURE CLIMATE CONDITIONS .....	9-5
9.5 EXPOSURE .....	9-6
9.6 DEVELOPMENT TRENDS .....	9-8
9.7 ISSUES .....	9-9
9.8 HAZARD MAPS .....	9-9
<b>10 MASS EARTH MOVEMENTS .....</b>	<b>10-1</b>
10.1 GENERAL BACKGROUND .....	10-1
10.2 CTCLUSI HAZARD PROFILE .....	10-2
10.3 HAZARD RANKING .....	10-3
10.4 SECONDARY HAZARDS AND CASCADING IMPACTS .....	10-6
10.5 POTENTIAL IMPACTS FROM FUTURE CLIMATE CONDITIONS .....	10-7
10.6 EXPOSURE .....	10-7
10.7 DEVELOPMENT TRENDS .....	10-9
10.8 ISSUES .....	10-10
10.9 HAZARD MAPS .....	10-10
<b>11 SEVERE WEATHER EVENTS .....</b>	<b>11-1</b>
11.1 GENERAL BACKGROUND .....	11-1
11.2 CTCLUSI HAZARD PROFILE .....	11-2
11.3 PAST EVENTS .....	11-3
11.4 SECONDARY HAZARDS AND CASCADING IMPACTS .....	11-9
11.5 POTENTIAL IMPACTS FROM FUTURE CLIMATE CONDITIONS .....	11-10
11.6 EXPOSURE .....	11-11
11.7 DEVELOPMENT TRENDS .....	11-13
11.8 ISSUES .....	11-13

11.9 HAZARD MAPS .....	11-13
<b>12 TSUNAMI/SEICHES .....</b>	<b>12-1</b>
12.1 GENERAL BACKGROUND.....	12-1
12.2 CTCLUSI HAZARD PROFILE .....	12-2
12.3 SECONDARY HAZARDS AND CASCADING IMPACTS .....	12-5
12.4 POTENTIAL IMPACTS FROM FUTURE CLIMATE CONDITIONS .....	12-6
12.5 EXPOSURE AND VULNERABILITY.....	12-6
12.6 DEVELOPMENT TRENDS .....	12-8
12.7 ISSUES .....	12-9
12.8 HAZARD MAPS .....	12-9
<b>13 WILDFIRES.....</b>	<b>13-1</b>
13.1 GENERAL BACKGROUND.....	13-1
13.2 CTCLUSI HAZARD PROFILE .....	13-3
13.3 SECONDARY HAZARDS AND CASCADING IMPACTS .....	13-7
13.4 POTENTIAL IMPACTS FROM FUTURE CLIMATE CONDITIONS .....	13-8
13.5 EXPOSURE AND VULNERABILITY.....	13-8
13.6 DEVELOPMENT TRENDS .....	13-11
13.7 ISSUES .....	13-11
13.8 HAZARD MAPS .....	13-11
<b>14 MITIGATION STRATEGY.....</b>	<b>14-1</b>
14.1 CTCLUSI's 2022 HAZARD MITIGATION GOALS.....	14-1
14.2 ACTION PLAN .....	14-10
14.3 PLAN ADOPTION .....	14-11
14.4 PLAN IMPLEMENTATION AND MAINTENANCE STRATEGY.....	14-11
<b>APPENDIX A. ACRONYMS AND DEFINITIONS .....</b>	<b>A-1</b>
ACRONYMS .....	A-1
DEFINITIONS.....	A-2
<b>APPENDIX B. ANNUAL HAZARD MITIGATION PROGRESS REPORTING AND MITIGATION ACTION EVALUATION FORMS.....</b>	<b>B-1</b>
ANNUAL HAZARD MITIGATION PROGRESS REPORTING FORM .....	B-2
MITIGATION ACTION EVALUATION FORM .....	B-0
<b>APPENDIX C. PLANNING PROCESS WITH CTCLUSI CITIZENS.....</b>	<b>C-1</b>
<b>APPENDIX D. FEMA TRIBAL REVIEW TOOL .....</b>	<b>D-1</b>
SECTION 1: REGULATION CHECKLIST .....	D-2
SECTION 2: PLAN STRENGTHS AND OPPORTUNITIES FOR IMPROVEMENT .....	D-5
<b>APPENDIX E. PLAN ADOPTION RESOLUTION .....</b>	<b>E-1</b>
<b>APPENDIX F. HAZARD DESCRIPTIONS AND EVENT TABLES .....</b>	<b>F-1</b>
CTCLUSI's DISASTER DECLARATIONS .....	F-1
COMPREHENSIVE LIST OF FEMA DISASTER DECLARATIONS FOR COOS, CURRY, LINCOLN, DOUGLAS, AND LANE COUNTIES.....	F-4
SEVERE WEATHER EVENTS IN COOS, CURRY, LINCOLN, DOUGLAS, AND LANE COUNTIES RESULTING IN DEATHS/INJURIES OR \$25,000 OR MORE IN DAMAGES .....	F-6
ORIGINAL CTCLUSI HAZARD IDENTIFICATION AND RANKING RESULTS .....	F-9
<b>APPENDIX G. FEMA CODE OF FEDERAL REGULATIONS CROSSWALK .....</b>	<b>G-1</b>
<b>APPENDIX H. SERVICE AREA FACILITIES, PARCELS, + FOREST STANDS .....</b>	<b>H-1</b>
<b>APPENDIX I. REFERENCES.....</b>	<b>I-1</b>

# Acknowledgements

---

## Project Manager

---

### **Garrett Gray**

Interim Director of Planning  
Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians  
1245 Fulton Avenue, Coos Bay, OR 97420  
Phone: 541-888-1302 x7302  
Email: [ggray@ctclusi.org](mailto:ggray@ctclusi.org)

## Consultants

---

- **Trevor Clifford:** Project Manager, WSP
- **Colleen Kragen:** Mitigation Planner, WSP
- **Brennah McVey:** GIS Analyst, WSP

## Special Acknowledgements

---

The update of this plan would not have been possible without the dedication and commitment to the planning process by the CTCLUSI 2022 Hazard Mitigation Emergency Management Team, CTCLUSI Tribal Council, and CTCLUSI Citizens. We greatly appreciate their time and dedication.

## Executive Summary

The Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians (CTCLUSI) 2022 Hazard Mitigation Plan (HMP) update is a risk-informed, capabilities-based strategic planning document. The HMP identifies and prioritizes actions to mitigate hazard risks within the Tribes' Five-County Service Area, referred to in this plan as the "Service Area." The Service Area crosses the five Oregon counties of Coos, Curry, Douglas, Lane, and Lincoln, as shown in Figure 1. This plan demonstrates the Tribes' commitment to protecting its members, assets, and the environment from natural hazard impacts by creating specific mitigation actions that reduce the risk of the hazards.

Additionally, the plan follows the Federal Emergency Management Agency's (FEMA) requirements for a Tribal HMP. A FEMA approved 2022 HMP enables CTCLUSI to maintain eligibility for disaster-related federal grant assistance via the Disaster Mitigation Act (DMA) 2000 and supports applications for Hazard Mitigation Grant Program (HMGP) funding.

### Establishing the Hazard Mitigation Emergency Management Team

To oversee the development of the 2022 HMP update, CTCLUSI formed a nine-person Emergency Management Team. The members are listed in Table 0-1. The Emergency Management Team included personnel from departments across the Tribal government. They participated in four workshops, beginning February 2020 and ending June 2022. The workshops included:

- **Workshop 1:** Hazard Mitigation Planning Overview and Project Kickoff
- **Workshop 2:** Risk Assessment
- **Workshop 3:** Mitigation Strategy
- **Workshop 4:** Draft Plan Review

Workshop materials (i.e., agenda, slide deck, sign-in sheet, worksheet(s), and summaries) are available in Appendix C for review, documenting the plan development and decision-making process.

*Table 0-1. Emergency Management Team Members*

Name	Title	Department
<b>Garrett Gray</b>	Assistant Planner	Planning Department
<b>Janet Niessner</b>	Tribal Resource Response Specialist	Natural Resources & Culture
<b>Diann Weaver</b>	Assistant Director of Health Services/Self-Governance	Community Health & Wellness
<b>Armando Martinez</b>	Community Health Aid	Community Health & Wellness
<b>Larry Huffman</b>	Grants Coordinator	Finance Department

### Defining the Five-County Service Area Hazard Mitigation Overview

While CTCLUSI's traditional lands extend beyond Service Area, the Emergency Management Team agreed that the Five-County Service Area, mapped in Figure 3-1, is the coverage area in the previous HMP and continues to be the same for the 2022 HMP update. **During Workshop 1: Hazard Mitigation Planning Overview and Project Kickoff**, the Emergency Management Team agreed the 2022 HMP update would cover Tribal Citizens, properties, enterprises, and critical facilities within the Service Area. Tribal facilities are primarily located in Florence, Coos Bay, and North Bend. A list of CTCLUSI's facilities and critical



facilities is in Table 5-4. Table H-1 in Appendix H has a comprehensive list of all Tribal facilities and their addresses.

The Service Area includes approximately 9.5 million acres and covers the Siuslaw, Lower Umpqua, and Coos River watersheds along the Oregon coast; the ancestral territory is 1.6 million acres. Although the Tribes are geographically near each other, each Tribe has its unique history and culture (Confederated Tribes of Coos, Lower Umpqua, & Siuslaw). The Tribes promote their tribal culture, values, and beliefs, supporting their citizens and surrounding communities and counties.

### Identifying and Assessing Natural Hazard Risks in the Five-County Service Area

The purpose of a risk assessment is to describe the type, location, and extent of every natural hazard that could occur in the Service Area. Informed by qualitative and quantitative methods, the risk assessment includes information on previous hazard events within the Service Area and informs the probability of future hazard events. Additionally, the assessment incorporates an exposure and vulnerability assessment for CTCLUSI Citizens and assets in the Service Area.

**During Workshop 2: Risk Assessment**, the Emergency Management Team qualitatively identified and assessed natural hazard risks in the Service Area. Emergency Management Team members independently ranked each hazard based on the perceived severity, magnitude, frequency, onset, and duration for the potential worst-case and the most likely scenarios. Table 5-1 defines these hazard rankings. The Emergency Management Team identified ten natural hazards that can impact the Service Area. To improve the accessibility and utility of the hazard profiles, the Project Team consolidated drought and extreme heat into severe weather, resulting in the following eight hazard profiles HMP:

*Table 0-2. Natural Hazards Identified for the HMP*

No.	Initial Hazards	Consolidated Hazards
1	Earthquake	
2	Epidemic/Pandemic	
3	Flood and Sea Level Rise	
4	Hazardous Materials	
5	Mass Earth Movements (includes landslides)	
6	Severe Weather	Drought and Extreme Heat
7	Tsunami and Seiches	
8	Wildfires	

Following the qualitative identification and hazard scoring, the Project Team conducted a quantitative risk assessment using available geospatial information for the eight identified hazards. This qualitative process overlapped geospatial hazard layers with CTCLUSI's critical infrastructures and facilities, assets, and Tribal Citizen data. The methodology and results of this analysis are discussed further in Part 2 – Risk Assessment Results were illustrated through hazard-specific maps and tables, which show the exposure and vulnerability of critical infrastructures and facilities, assets, and Tribal Citizens; each hazard profile contains:

- General background and hazard description
- CTCLUSI specific: hazard rank, past events, location, frequency, severity, and warning time
- Potential secondary hazards and cascading impacts



- Potential future impacts from climate change
- CTCLUSI exposure and vulnerabilities: Citizens, properties, critical facilities, and the environment
- Development trends that can or already affect the hazard
- Issues for continuing consideration
- Hazard maps as applicable

### Engaging CTCLUSI's Citizens

On March 25, 2021, CTCLUSI held a virtual open house for Tribal Citizens to participate in the development of the risk assessment and mitigation strategies. CTCLUSI invited Tribal Citizens to comment on the draft plan during Workshop 4 – Draft Plan Review and a 30-day Tribal Citizen review period, which followed the workshop. Tribal Citizens were informed of opportunities to participate in the open house, workshop, and comment period via the Tribes' monthly new publication, *The Voice of CTCLUSI*. The results are detailed in Part 1 of the HMP, and the complete materials are in Appendix C.



### Developing the Mitigation Strategy and Action Plan

The Emergency Management Team updated the 2022 plan to meet federal hazard mitigation requirements. A crosswalk between this HMP and the Code of Federal Regulations (CFR) is in Appendix G. This completed crosswalk is a comparative analysis of the content in the 2022 CTCLUSI HMP and federal hazard mitigation planning requirements for federally-recognized Tribes.

**During Workshop 3: Mitigation Strategy**, the Emergency Management Team developed goals for the CTCLUSI 2022 HMP update based on the Emergency Management Team hazard identification results in Workshop 1 and the capabilities assessment in Workshop 2. The capability assessment reviewed CTCLUSI's planning and regulatory, administrative and technical, and financial capabilities; this is discussed further in Section 3.5. Additionally, the Emergency Management Team reviewed the Tribes' citizen and community member open house responses and compared them to the Workshop 2 results. The Tribal Citizen-driven, risk-informed, and capability-based goals for the CTCLUSI 2022 HMP are also consistent with the 2006 HMP (URS, 2006):

1. Promote disaster-resistant development
2. Build and support local capacity to enable the public to prepare for, respond to, and recover from disasters
3. Reduce the possibility of damage and losses due to coastal erosion
4. Reduce the possibility of damage and losses due to earthquakes
5. Reduce the possibility of damage and losses due to tsunamis
6. Reduce the possibility of damage and losses due to wildland fire
7. Reduce the possibility of damage and losses due to winter storm: flood
8. Reduce the possibility of damage and losses due to winter storm: landslides

9. Reduce the possibility of damage and losses due to winter storm: snow
10. Reduce the possibility of damage and losses due to winter storm: wind

The Emergency Management Team identified 47 hazard mitigation actions for inclusion in the CTCLUSI 2022 HMP to reduce or eliminate the loss of life and property resulting from hazard events. These actions are intended to meet the plan goals listed above and are within the current administrative capabilities of the CTCLUSI.

### Writing, Implementing, and Maintaining the Plan

The Emergency Management Team developed the CTCLUSI 2022 HMP with critical stakeholder and community involvement. The planning process included Tribal Citizen outreach and workshop engagement materials. A complete set of materials are in Appendix C. The plan meets or exceeds the requirements established under 44 CFR 201.7: Tribal Mitigation Plans (United States Government Publishing Office, 2010), as indicated in the FEMA Region X Tribal Mitigation Plan Review Tool in Appendix D.

Formal adoption by CTCLUSI will occur *Figure 0-1. Planning Process*

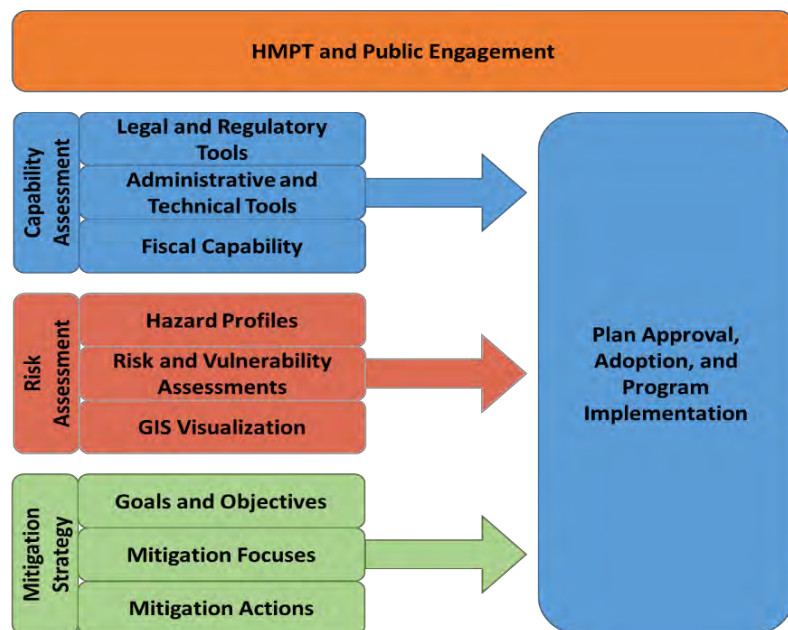
before the HMP is submitted to FEMA (Federal Emergency Management Agency, 2010). Once CTCLUSI has approved the plan, it is sent to FEMA Region X for review and FEMA's official Approval Pending Adoption (APA) letter. CTCLUSI documents the federal review process via the FEMA Region X Tribal Mitigation Plan Review Tool. Once approved by FEMA, CTCLUSI is eligible for federal hazard mitigation grant funding (Federal Emergency Management Agency, 2019).

Over the next five years, CTCLUSI will implement the actions listed in the plan to realize its goals. Plan implementation will be led by the CTCLUSI Planning Director and supported by the Emergency Management Team. The Emergency Management Team will meet annually to review:

- Mitigation action implementation
- Changes in natural hazard risks
- Update mitigation capabilities
- Reassess opportunities to continue Tribal citizen engagement
- Integration with other relevant plans and programs

The Progress Reporting template in Appendix B will be used to document this process. In five years, CTCLUSI will undertake a comprehensive plan update informed by these annual reports and notes:

- Progress reporting
- A strategy for continued engagement of CTCLUSI Citizens



- A commitment to planning integration with other relevant plans and programs
- Continued oversight from a plan maintenance Emergency Management Team

# CTCLUSI 2022 Hazard Mitigation Plan

## Part 1: Planning Process Overview and Tribal Profile



## Part 1

# 1 Introduction to Hazard Mitigation Planning

### 44 CFR 201.7

Local Mitigation Plans outline an entity's commitment to reducing risks associated with natural hazards.

## 1.1 What is Natural Hazard Mitigation Planning?

Hazard mitigation uses long- and short-term strategies to reduce or alleviate the loss of life, personal injury, and property damage resulting from a disaster. It involves planning efforts, policy changes, programs, studies, improvement projects, and other strategies to reduce hazard impacts. Mitigation plans are vital to breaking the cycle of disaster damage, reconstruction, and repeated damage. Title 44 of the CFR, Part 201 – Mitigation Planning, Section 201.2, defines hazard mitigation as “any action taken to reduce or eliminate the long-term risk to human life and property from natural hazards” (Code of Federal Regulations, 2013, p. 364). There are textboxes throughout this plan highlighting the HMP's compliance with these relevant CFRs.

FEMA's *Tribal Mitigation Planning Handbook* states that natural hazards are physical and environmental events that can harm or destroy individuals, land, property, communities, and so on; for example, earthquakes, tornadoes, pandemics, or epidemic/pandemics (Federal Emergency Management Agency, 2019). The mitigation planning process is displayed in Figure 1-1.

To develop and implement practical hazard mitigation actions, communities apply a planning process that mirrors the mitigation planning process. This cycle outlines the critical planning steps to reduce the impact or remove the risk of natural hazards. These components establish a consistent approach for decision making, resource allocation, and progress tracking for the HMP.

Figure 1-1. The Mitigation Planning Process (Federal Emergency Management Agency, 2019)



### 1.1.1 The 2000 Disaster Mitigation Act

Before 2000, federal disaster funding focused on relief and recovery after a disaster occurred, with a limited budget for hazard mitigation planning in advance. On October 30, 2000, Congress passed the 2000 DMA, amending the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988. The DMA shifted federal emphasis toward hazard preparedness and mitigation (Title 42 of the United States Code Section 5121 et seq.) (Federal Emergency Management Agency, 2019). The 2000 Act replaced the previous mitigation planning section (409) with a new section (322).

The DMA requires state, local, and tribal government entities to develop and adopt FEMA-approved hazard mitigation plans as a condition for federal disaster grant assistance (Federal Emergency Management Agency, 2007). Section 322 emphasized the need for state, tribal, and local entities to coordinate and collaborate on mitigation planning and implementation efforts (Federal Emergency Management Agency, 2007). Additionally, Section 322 established the legal basis for the Federal Emergency Management Agency's (FEMA's) mitigation plan requirements for the Hazard Mitigation Assistance grant programs.

The DMA encourages cooperation among state, local, and tribal authorities in pre-disaster planning and emphasizes community-based planning before disasters occur. The act also promotes sustainability, including the sound management of natural resources, local economic and social resiliency, and addressing hazards and mitigation in the most extensive possible social and economic context (Federal Emergency Management Agency, 2019). The enhanced planning network described in the DMA helps local organizations and governments articulate precise needs for mitigation, resulting in a faster allocation of funding and more cost-effective risk-reduction projects.

### 1.1.2 2006 CTCLUSI HMP

CTCLUSI prepared its initial HMP in 2006 in compliance with the DMA. The Tribes officially adopted the first HMP on November 12, 2006, and FEMA approved the plan. The 2006 HMP's purpose was to guide CTCLUSI toward disaster resistance per Tribal sovereignty, community needs, and federal grant and disaster fund recipient requirements.

CTCLUSI is updating its HMP to identify and prioritize actions to reduce or alleviate risks from natural hazards, reducing the loss of life, personal injury, and property damage to CTCLUSI Citizens and Tribal enterprises. This update to the HMP fulfills a DMA requirement that hazard mitigations plans be updated every five years to maintain eligibility for disaster-related federal grant assistance. This plan guides efforts to efficiently mitigate hazards that affect Tribal properties and Citizens and work with other agencies to mitigate and respond to hazards that cross jurisdictional boundaries.

#### 44 CFR 201.7(C)(6)

The plan must assure the tribal government will comply with applicable Federal statutes and regulations in effect with respect to the periods for which it receives grant funding, including 2 CFR Parts 200 and 3002, and will amend its plan whenever necessary to reflect changes in tribal or Federal laws and statutes.

## 1.2 The Purpose of Hazard Mitigation Planning

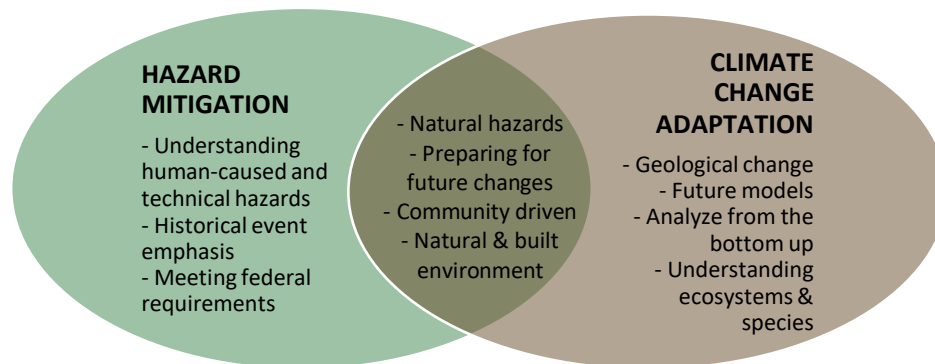
All CTCLUSI Citizens are the beneficiaries of this HMP. CTCLUSI updated the 2006 HMP to assess previous hazards and mitigation actions, identify new or escalated hazards, and develop, update, and prioritize mitigation actions. These actions reduce or alleviate risks from natural hazards, reducing the loss of life, personal injury, and property damage for CTCLUSI and its Citizens. The plan establishes a roadmap for CTCLUSI to mitigate hazards within the Service Area. Stakeholder participation during the plan update ensures the results are targeted and effective.

- Enables access to federal grant funding to reduce disaster risk through mitigation actions
- Meet or exceed the DMA 2000 requirements
- Complete a risk assessment focusing on hazards of concern within the Service Area
- Ensure compliance with federal hazard mitigation planning requirements
- Review existing CTCLUSI plans and programs to identify opportunities for integration of hazard mitigation principles and cooperation with planning partners

### 1.2.1 Climate Change Adaptation and the CTCLUSI 2022 Hazard Mitigation Plan

Climate adaptation planning is like natural hazard mitigation planning. Both are adjustments in human and natural systems to mitigate the impacts of hazards, except that the former focuses on climate-related hazards. While climate change itself is not a hazard, it may change the characteristics of a hazard within the Service Area (e.g., extent). Climate change adaptation strategies enable Tribes to reduce vulnerability to all types of natural hazards by predicting these changes and increasing local capacity to adapt. Figure 1-2 shows the key aspects of hazard mitigation and climate change adaptation and where the two intersect (ICLEI Local Governments for Sustainability USA, 2015).

*Figure 1-2. Hazard Mitigation and Climate Adaption Planning Relationship (ICLEI Local Governments for Sustainability USA, 2015)*



### 1.2.2 Who Will Benefit from this Plan?

CTCLUSI Citizens ultimately benefit from this hazard mitigation plan. The plan strives to reduce the risk for the Citizens and Tribal enterprises within the Service Area. It provides a viable planning framework for all foreseeable natural hazards that can have a negative effect. Participation in developing the plan by stakeholders and Tribal Citizens ensures outcomes that mutually benefit the Tribes and the local communities. The plan's goals and recommendations lay the groundwork for developing and implementing Tribal mitigation activities and partnerships.

### 1.2.3 Contents of this Plan

This hazard mitigation plan has three primary parts:

- **Part 1:** Planning Process and Tribal Profile
- **Part 2:** Risk Assessment
- **Part 3:** Mitigation Strategy

Each part includes elements required under federal guidelines. Additionally, DMA compliance requirements are cited at the beginning of plan sections to illustrate compliance and highlight each section's importance and utility to the reader. The HMP appendices provide details and supporting data:

- **Appendix A:** Acronyms and Definitions
- **Appendix B:** Annual Hazard Mitigation Progress Reporting and Mitigation Action Evaluation Forms
- **Appendix C:** Planning Process with CTCLUSI Citizens and Community Members
- **Appendix D:** FEMA Tribal Review Tool
- **Appendix E:** Plan Adoption Resolution



- **Appendix F:** Hazard Descriptions and Event Tables
- **Appendix G:** FEMA Code of Federal Regulations Crosswalk
- **Appendix H:** Service Area Facilities, Parcels, + Forest Tracks
- **Appendix I:** References

#### 1.2.4 Plan Approach

The CTCLUSI 2022 HMP development process followed these steps:

- Formed the Planning Team
- Established the Emergency Management Team
- Defining the Service Area
- Engaged Tribal Citizens
- Coordinating with other agencies
- Reviewing existing programs
- Plan development chronology and milestones
- Conduct the risk assessment
- Develop mitigation actions
- Confirm the plan implementation strategy

#### 1.2.5 Grant Funding

A FEMA Pre-Disaster Hazard Mitigation Grant supplemented the planning effort. The CTCLUSI Planning Department was designated to manage the project. Grant funding covered 75 percent of the cost for the development of this plan.

## 2 Plan Update – What has Changed?

### 2.1 Previous Hazard Mitigation Plan

The CTCLUSI prepared its initial HMP in compliance with the DMA in 2006. The Tribes officially adopted the HMP on November 12, 2006, and FEMA subsequently approved the plan. The Tribe's defined purpose for the local HMP was to guide the CTCLUSI toward disaster resilience in full accord with the character and needs of the community and federal requirements. The 2006 HMP identified these ten goals (URS, 2006):

1. Promote disaster-resistant development
2. Build and support local capacity to enable the public for, respond to, and recover from disasters
3. Reduce the possibility of damage and losses due to coastal erosion
4. Reduce the possibility of damage and losses due to earthquakes
5. Reduce the possibility of damage and losses due to tsunamis
6. Reduce the possibility of damage and losses due to wildland fire
7. Reduce the possibility of damage and losses due to winter storm: flood
8. Reduce the possibility of damage and losses due to winter storm: landslides
9. Reduce the possibility of damage and losses due to winter storm: snow
10. Reduce the possibility of damage and losses due to winter storm: wind

#### **44 CFR 201.7(d)(3) & 201.7(c)(4)(iii)**

Describe the plan's revisions to reflect changes in development, progress in tribal mitigation efforts, and changes in priorities.

The initial HMP identified and profiled eight hazards affecting the CTCLUSI based on historical and anecdotal information and current plans and studies. The 2006 plan recommended 54 actions for mitigating the ten identified hazards.

### 2.2 Why Update?

#### 2.2.1 Federal Eligibility

The CFR Title 44 stipulates that hazard mitigation plans must present a schedule for monitoring, evaluating, and updating. The CFR provides an opportunity to reevaluate recommendations, monitor the impacts of actions that have been accomplished, and determine if there is a need to change the focus of mitigation strategies. DMA compliance is contingent on meeting the plan update requirement. Tribes covered by an expired plan are not eligible for federal funding under the DMA.

#### 2.2.2 Changes in Development

HMP updates must also reflect development changes in the Service Area since the approval of the previous plan under 44CFR. The update must describe development changes in hazard-prone areas that increased or decreased vulnerability. If no development changes impacted a Tribe's overall vulnerability, plan updates could validate the information in the previously approved plan. This requirement ensures that the mitigation strategy addresses the exposure and vulnerability of existing and potential development and considers possible future conditions that could impact vulnerability.

### 2.3 The Updated Plan – What is Different?

The CTCLUSI 2022 HMP was developed using the best available data and current plans and studies, following the same basic planning process as in 2006. The Emergency Management Team and Project Team were critical components in the process. The risk assessment was also informed by the 2020 Oregon

Natural Hazards Mitigation Plan and other regional HMPs. The updated 2022 plan differs from the 2006 plan in the following ways:

- The plan has been reorganized into three parts:
  - Planning Process Overview and Tribal Profile
  - Risk Assessment
  - Mitigation Strategy
- Additional and emerging hazards have been added to the risk assessment
- The hazard profiles have been expanded to include discussion of the effects of climate change on hazard risks and community vulnerability.
- Due to the ongoing novel coronavirus (COVID-19) pandemic and requirements and recommendations for social distancing, outreach to Tribal Citizens was accomplished virtually.
- Table G-1 in Appendix G crosswalks the CFR requirements for HMPs between the previous plan and the 2022 update.

## 3 Plan Methodology

### 3.1 Overview

The CTCLUSI 2022 Hazard Mitigation Plan update process:

- Formed the Project Team
- Included CTCLUSI's response to the 2000 DMA
- Established a Emergency Managment Team
- Defined the Five-County Service Area
- Conducted a risk assessment
- Engaged the Tribal Citizens
- Reviewed existing programs

#### 44 CFR 201.7(c)(1)

The plan must document the planning process, including how it was prepared and who was involved in the process.

### 3.2 Project Team Formation

CTCLUSI hired WSP, referred to as the Project Team in this HMP, to update their 2006 HMP. The Project Team designed the plan sections and facilitated stakeholder workshops. Throughout the planning process, the Project Team reported directly to the CTCLUSI Project Manager. Primary CTCLUSI and WSP Project Team members included:

- **Garrett Gray:** Assistant Planner, CTCLUSI
- **Trevor Clifford:** Project Manager, WSP
- **Colleen Kragen:** Mitigation Planner, WSP
- **Brennah McVey:** GIS Analyst, WSP

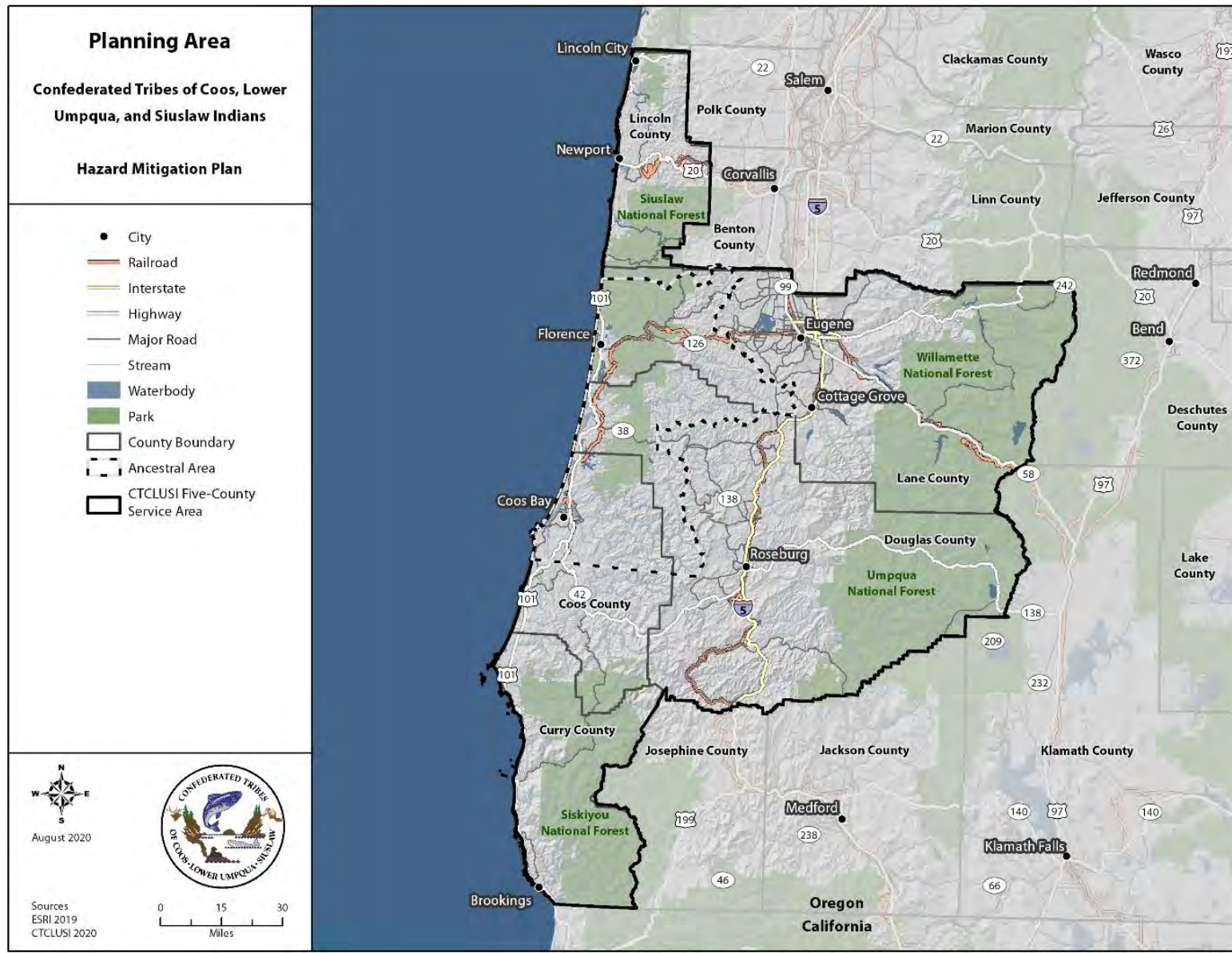
### 3.3 Emergency Managment Team Formation

Hazard mitigation planning enhances collaboration and support among parties whose interests can be affected by hazard losses. A broad range of stakeholders can identify and create partnerships to achieve a shared vision for community risk reduction by working together. To ensure broad representation in the planning process, CTCLUSI leveraged the pre-existing Emergency Managment Team to oversee all phases of the plan update. The members of the committee included key CTCLUSI Citizens and other critical stakeholders from the Service Area. Members are listed in Table 0-1.

### 3.4 Defining the Five-County Service Area

The Emergency Managment Team agreed that the CTCLUSI 2022 HMP should cover all Tribal Citizens, properties, and critical facilities within the Five-County Service Area, which crosses the Oregon counties of Coos, Curry, Douglas, Lane, and Lincoln, shown in Figure 3-1 on the next page. The Service Area encompasses the Tribes' ancestral area, approximately 1.6 million acres in the Siuslaw, Lower Umpqua, and Coos River watersheds along the Oregon coast. Tribal facilities are primarily located in Florence, Coos Bay, and North Bend. A list of CTCLUSI's facilities and critical facilities is in Table 5-4. Table H-1 in Appendix H has a comprehensive list of all Tribal facilities and their addresses.

1 Figure 3-1. The CTCLUSI Five-County Service Area



2

### 3.5 Engaging CTCLUSI Citizens

For this 2022 HMP, the public is defined as CTCLUSI "Citizens." Broad participation by CTCLUSI Citizens in the 2022 planning process ensured varied points of view about the Service Area's needs were considered and addressed. Details of citizen involvement in the plan drafting process are in Appendix C of this plan. Participation in the planning process from CTCLUSI Citizens was encouraged through:

- On March 25, 2021, CTCLUSI held a virtual open house for Tribal Citizens opportunities to interact with the Project Team and participate in the development of the risk assessment and mitigation strategies
- The 30-day Tribal Citizen review period followed Workshop 4, providing Citizens an opportunity to provide feedback on any sections of the plan.

[open house feedback]

#### Hazard Mitigation Plan Webpage

All CTCLUSI Citizens were invited to participate in the plan update process and comment on the draft HMP. The CTCLUSI provided updates on the Planning Department's public web page and provided the draft plan for public review on the web page between [date] and [date]: <https://ctclusi.org/planning-department/>.

### 3.6 Coordination with Other Agencies

In addition to the Tribal Government agencies represented in the Emergency Management Team, the Project Team engaged the leadership and staff of all Tribal Government departments throughout the update process, to solicit input via email and workshop invitations.

In the draft review process, CTCLUSI conducted FEMA's standard 30-day public comment period. The Project Team invited all Tribal Government Departments and Citizens to review and comment on the draft plan. The Citizens and departments were notified of the public comment period on the Tribes' website. The plan's final version was sent to FEMA Region X for pre-adoption review, ensuring program compliance.

#### 3.6.1 Review Existing Programs

FEMA emphasizes the importance of reviewing related plans and requirements in conjunction with an HMP development or update. By comparing these existing documents CTCLUSI can align their mitigation actions, risk assessments, and mitigation goals more effectively and efficiently. Section 4.8 of this plan reviews Tribal laws and ordinances in effect within the Tribes' Service Area that can affect hazard mitigation actions. Table 3-1 below lists the State and local plans reviewed during the 2022 HMP update, including the State of Oregon Natural Hazards Mitigation Plan (2020), other CTCLUSI plans, and plans from Coos, Curry, Lincoln, Douglas, and Lane Counties.

#### 44 CFR 201.7(c)(1)(i)

The plan must document an opportunity for public comment during the drafting stage and prior to plan approval, with a tribal government definition of "public."

#### 44 CFR 201.7(c)(1)(ii)

The plan documents, as appropriate, the opportunity for neighboring communities, tribal and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process.

#### 44 CFR 201.7(c)(1)(iii)

The plan describes the review and incorporation of existing plans, studies, and reports.



Table 3-1. Existing Plans Reviewed from CTCLUSI and the Five-County Service Area

CTCLUSI	Coos County	Curry County	Lincoln County	Douglas County	Lane County
<b>2006 HMP</b>	2016 Natural HMP	2016 Natural HMP	2015 Multi-Jurisdictional Natural HMP	2016 Multi-Jurisdictional Natural HMP	2018 Multi-Jurisdiction HMP
<b>2008 Emergency Operations Plan</b>	2011 Community Wildfire Protection Plan	2008 Community Wildfire Protection Plan	2007 Comprehensive Plan	2017 Community Wildfire Protection Plan	2020 Community Wildfire Protection Plan
<b>2018 Tribal Estuary Response Plan</b>	2014 Emergency Operations Plan	2015 Emergency Operations Plan	2015 Emergency Operations Plan	2017 Comprehensive Hazard Analysis	2019 Emergency Operations Plan
<b>2016 Wetland Inventory and Assessment</b>	1985 Comprehensive Plan			2017 Comprehensive Plan	2009 Rural Comprehensive Plan

The review of these plans and programs informed the development of CTCLUSI's 2022 HMP. Existing Tribal plans were reviewed to develop the goals in this HMP, supporting CTCLUSI's overarching goals and objectives. CTCLUSI's existing 2006 HMP, the 2008 Emergency Operations Plan (EOP), and the 2009 Draft Continuity of Operations Plan (COOP) were reviewed during the HMP initial planning stage to ensure hazard consistency between these plans.

### 3.7 Plan Development Chronology and Milestones

Table 3-2. Emergency Management Team Meetings

Date	Event	Description
<b>November 8, 2019</b>	Tribes release a request for proposals to update their hazard mitigation plan	- Secure contractor support to facilitate the update of the Tribes' hazard mitigation plan
<b>February 7, 2020</b>	Tribes select WSP as their technical support contractor	- Technical support secured
<b>March 12, 2020</b>	Emergency Management Team Workshop #1: Kickoff	<ul style="list-style-type: none"> <li>- Overview of planning process, purpose, and requirements</li> <li>- Confirmation of the Service Area</li> <li>- Update goals, objectives, and actions</li> <li>- Hazard identification and ranking</li> <li>- Capability assessment overview</li> <li>- Planning for Tribal engagement</li> <li>- Next steps and action items</li> </ul>



Date	Event	Description
<b>October 20, 2020</b>	Emergency Managment Team Workshop #2: Risk Assessment	<ul style="list-style-type: none"> <li>- Hazard Mitigation Refresher</li> <li>- Update on the planning process</li> <li>- Capability and capacity assessment feedback</li> <li>- Hazard identification and ranking feedback</li> <li>- Review of 2006 hazard mitigation actions</li> <li>- Distribution of risk assessment worksheet</li> <li>- Map review</li> <li>- Planning for Tribal citizen open house</li> <li>- Next steps and action items</li> </ul>
<b>February 3, 2021</b>	Emergency Managment Team Workshop #3: Mitigation Actions	<ul style="list-style-type: none"> <li>- Update and review of the planning process</li> <li>- Mitigation strategy development</li> <li>- Mitigation action development worksheet</li> <li>- Mitigation action prioritization worksheet</li> <li>- Next steps and action items</li> </ul>
<b>June 23, 2022</b>	Emergency Managment Team Workshop #4: Draft HMP Review	<ul style="list-style-type: none"> <li>- Review all sections of the plan with the Emergency Management Team</li> <li>- Discuss plan implementation and maintenance program, including ongoing Tribal Citizen engagemenet</li> <li>- Finalize plan ahead of 30-day Tribal Citizen review period</li> </ul>

## 4 Confederated Tribes of Coos, Lower Umpqua, & Siuslaw Indians Profile

### 4.1 History of the Confederated Tribes of Coos, Lower Umpqua, & Siuslaw Indians – Remembering Where We Come From

CTCLUSI is made up of:

- The Coos Tribes: the Hanis Coos and the Miluk Coos
- The Lower Umpqua Tribe
- The Siuslaw Tribe

The ancestral homelands of the CTCLUSI are approximately 1.6 million acres in the Siuslaw, Lower Umpqua, and Coos Rivers from the Coastal Range in the east to the Pacific Ocean in the west (Confederated Tribes of Coos, Lower Umpqua, & Siuslaw) (URS, 2006). The Tribes hunted, fished, and gathered, relying on abundant natural resources within their territories. Fish such as salmon and shellfish made up a large part of their diets. Timber resources, specifically the cedar tree, provided shelter, clothing, and transportation (URS, 2006).

Tribes along the west coast of Oregon spoke a diverse array of languages. The two Coos bands spoke different dialects of the Coos language (*hanis* and *miluk*) and had different cultures and histories. To the north, the Lower Umpqua and Siuslaw tribes spoke the Siuslaw language (*sha'yuushtl'a quuiich*). This cultural diversity mirrors the range of ecosystems and the ecological richness of the Tribes' homelands (Confederated Tribes of Coos, Lower Umpqua, & Siuslaw).

European-Americans began to settle the ancestral homelands of the CTCLUSI in the early 1800s. The Coos, Lower Umpqua, and Siuslaw Tribes initially accommodated and maintained relations with European-Americans. However, in the mid-1800s, the Tribes experienced increasing pressure as settlers consumed ever-increasing resources and land (URS, 2006). In 1855, the U.S. government drafted a treaty that promised to compensate the Tribes in exchange for their lands. CTCLUSI signed the treaty; however, Congress never ratified it and continued to open the area to settlement.

Additionally, the U.S. government rounded up members of the Tribes and forcefully marched them north to Fort Umpqua. These Tribal members were imprisoned to prevent their involvement in the Rogue River War between white settlers and Indians to the south (Confederated Tribes of Coos, Lower Umpqua, & Siuslaw). In 1860, the Tribes were moved again. They marched 60 miles up the coast to a reservation on the Yachats River and were held there for 17 years. During their imprisonment, the Tribes' populations were reduced by more than 50 percent due to starvation, mistreatment, and disease. Tragically they also lost most of the ancestral lands that sustained them (Confederated Tribes of Coos, Lower Umpqua, & Siuslaw) (URS, 2006).

Once they were released, members of CTCLUSI's Tribes settled along Coos Bay and the Siuslaw and Umpqua Rivers. Following the 1855 treaty, the Bureau of Indian Affairs (BIA) officially combined these Tribes into the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians. Although, the Tribes continued to live separately until 1916 when they created a formal, democratic Tribal government known as CTCLUSI (URS, 2006).

In 1954, the Tribes were unknowingly included in the Western Oregon Termination Act, which terminated their alliance with the U.S. government and official recognition as a sovereign nation. Federal assistance to Tribal governments ceased with the passage of this Act. Between 1955 and 1984, CTCLUSI maintained its government and provided essential services to its Tribal Citizens.

The Tribes' sovereignty was restored on October 17, 1984, when President Ronald Reagan signed Public Law 98-481, the Coos, Lower Umpqua, and Siuslaw Restoration Act. Since the restoration, the Tribes have established beneficial programs for Tribal Citizens, achieved the return of Tribal forest lands and other properties, and developed government facilities, Tribal enterprises, and housing (URS, 2006) (Confederated Tribes of Coos, Lower Umpqua, & Siuslaw, 2020).

## 4.2 Geographic Setting

The CTCLUSI's Service Area is between the Coastal Range and the southwest coast of Oregon, in the Five-County Service Area, which includes Coos, Curry, Douglas, Lane, and Lincoln counties. Within this area, most Tribal properties are located in the coastal cities of Florence, Coos Bay, and North Bend. Forest parcels and three Ranches are located further inland. Figure 3-1 shows Tribal properties along with the boundaries of the Service Area and the Tribes' ancestral homelands. CTCLUSI has three types of land parcels:

- **Reservation:** Geographically defined area held in trust by the federal government where Tribal Government has sovereign jurisdiction over the reservation land, and all government entities respect it.
- **Fee:** When Tribes acquire additional land and pay taxes for the land.
- **Trust:** Properties that exclusively belong to the Tribes and are non-taxable.

### 4.2.1 Tribal Lands – Rooting the Tribes' Mitigation Program with a Sense of Place

In 1941, the BIA took a small, privately donated parcel (6.12 acres) into trust for the CTCLUSI in the city of Coos Bay. The Tribes constructed a Tribal Hall on this parcel that is still in use today and is listed on the National Register of Historic Places (Confederated Tribes of Coos, Lower Umpqua, & Siuslaw). The Tribes maintained this small reservation between 1954 and 1984 when the U.S. government formally recognized the Tribes as a sovereign nation.

Since 1984, the federal government returned forest lands and other properties within CTCLUSI's ancestral homeland. These lands include Gregory Point (Baldich), Coos Head, and multiple forest parcels. CTCLUSI develops and maintains these areas for the cultural and economic benefit of Tribal Citizens.

## 4.3 Tribal Enrollment

Currently, CTCLUSI has 1,313 enrolled Tribal Citizens, and of that total number, 760 Tribal Citizens are within the Five-County Service Area. The remaining Citizens reside in other locations.

### 4.3.1 Demographics

Enrollment and demographic data came from CTCLUSI. Table 4-1 on the next page shows the demographic breakdown.

Table 4-1. CTCLUSI Member Demographics

Demographics	Members in the Service Area	Total Members
Age 0-17	169	400
Age 18-24	48	154
Age 25-34	81	233
Age 35-44	49	150
Age 45-54	53	136
Age 55+	107	240
<b>Total</b>	<b>507</b>	<b>1,313</b>
Male	253	664
Female	254	649
<b>Total</b>	<b>507</b>	<b>1,313</b>

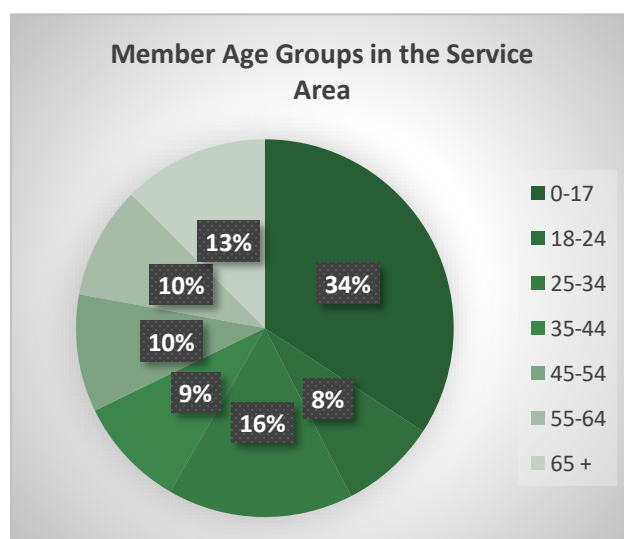
#### 4.3.2 Vulnerable Populations

Protecting vulnerable populations that are at a higher risk is a primary goal of hazard mitigation planning. These populations can include children, low-income households, senior citizens, disenfranchised minorities, and those that speak English as a second language or do not speak English (Federal Emergency Management Agency, 2009).

The Tribal demographics distinguished between member age groups and gender. Nearly half, 47 percent, of CTCLUSI's population in the Service Area fall into vulnerable population categories of minors and those over 65 years old. These age groups are illustrated in the pie chart in Figure 4-1.

- **Under 19 years old – 34 percent**
  - Individuals under 18 are vulnerable populations as they are legally dependent on adults and usually require adult supervision, especially during a disaster. Additional challenges arise when children are away from their guardians, such as during daycare or school.
- **65 years or older – 13 percent**
  - This population group is more vulnerable because they may need more support or resources after an earthquake, such as medical care, mobility, or transportation support.

Figure 4-1. CTCLUSI Member Age Percentages Chart



It is critical to identify potentially vulnerable populations during plan development to establish mitigation actions that account for special considerations to protect these populations. Each of the hazard profiles assesses risk for vulnerable populations in Sections 6 to 13.

## 4.4 Tribal Governance

### 4.4.1 Tribal Government and Council

CTCLUSI is a self-governed and sovereign nation. The government is led by a Tribal Council consisting of a Tribal Chief, who serves for ten years, and six members, who serve four-year terms. The Tribes' general council elects the Chief and Council members. They have legislative and executive authority over the Tribal government, except when the general council has the authority (Confederated Tribes of Coos, Lower Umpqua, & Siuslaw, 2020). The broader Tribal government oversees and provides administrative support to all Tribal departments, programs, and services and is responsible for the day-to-day operations of the Tribes (Confederated Tribes of Coos, Lower Umpqua, & Siuslaw, n.d.).

### 4.4.2 Government Departments

CTCLUSI's Tribal Government is comprised of nine Departments. Table 4-2 lists Tribal departments and provides a brief description of their services.

*Table 4-2. CTCLUSI Tribal Departments*

Department	Services
<b>Court &amp; Peace Giving</b>	Exercises the Tribes' sovereignty by providing conflict resolution (Confederated Tribes of Coos, Lower Umpqua, & Siuslaw, 2020).
<b>Administration Support Services / Enrollment</b>	Manages and maintains all Tribal member records and enrolls new members with the assistance of the Enrollment Committee (Confederated Tribes of Coos, Lower Umpqua, & Siuslaw, n.d.).
<b>Finance</b>	Responsible for the oversight of Tribal government financial resources and other assets per Generally Accepted Accounting Principles. Provides monthly financial reports to the Tribal Council, prepares combined budgets from Tribal departments for reviewing and tracking expenditures, completes federal and state grant reporting, and provides accurate and consistent accounting of all the financial transactions of the CTCLUSI (Confederated Tribes of Coos, Lower Umpqua, & Siuslaw, 2021).
<b>Housing</b>	Works in partnership with community-based organizations to provide housing services, including the development and maintenance of decent, safe, and affordable housing, for all eligible Tribal members, members of other Tribes, and other needy families (Confederated Tribes of Coos, Lower Umpqua, & Siuslaw, 2021).
<b>Human Resources</b>	Manages hiring and employment for Tribal government and enterprises. Manages benefits for Tribal employees (Confederated Tribes of Coos, Lower Umpqua, & Siuslaw, n.d.).
<b>Culture &amp; Natural Resources</b>	Works to manage and conserve natural and cultural resources on Tribally-held lands and, in cooperation with other governments, influence conservation and resource management throughout the Tribes' ancestral homelands. The department's goals include maintaining and improving Tribal environmental quality and managing natural resources for economic and social benefits. The Tribes' Forestry Management program is part of the department and manages the Tribes' seven forest tracts, totaling 14,742 acres (Confederated Tribes of Coos, Lower Umpqua, & Siuslaw, n.d.). The department also educates others and promotes the economic and cultural significance of the land for Tribal self-determination and sovereignty (Confederated Tribes of Coos, Lower Umpqua, & Siuslaw, n.d.).

Department	Services
<b>Planning</b>	Supports economic development and job growth within the Tribes through development, implementation, and management of the Tribes' five and ten-year strategic plans. Assists in managing the Tribes' master planning, including general planning, capital improvement planning, and land use planning. The Tribes' planning programs include Tribal properties (Coos Head and the Hollering Place), Emergency Preparedness, GIS, Realty and Land Use, Transportation, and Transit (Confederated Tribes of Coos, Lower Umpqua, & Siuslaw, 2021).
<b>Police</b>	Full-service police and public safety organization responsible for delivering law enforcement services to Tribal communities and enterprises (Confederated Tribes of Coos, Lower Umpqua, & Siuslaw, n.d.).
<b>Community Health &amp; Wellness</b>	The Health Services Division provides limited OTC medications and safety items like smoke alarms, bicycle helmets, and infant car seats and gift baskets containing education materials, safety items, and gifts for expectant Tribal parents. Additionally, Diabetes, education, fitness programs, water testing, and well and septic programs are coordinated.
<b>Family Support Services</b>	Our Family Support Services are inclusive of mental health support and referral services, parenting classes, employment assistance, youth activities, home visiting, and family events. Further, Family Support Services also include Behavioral Health support, Childcare (CCDF) Program, Circles of Healing, Low Income Heating and Energy Assistance Program (LIHEAP), Substance Abuse Support, and Youth Prevention Programs.

## 4.5 Tribal Enterprises – Supporting Our People through Economic Growth

The CTCLUSI owns three Tribal businesses:

- Blue Earth Services & Technology
- Ocean Dunes Golf Links
- Three Rivers Casino & Resort

Tribal businesses and enterprises, including the Tribes' forestry resources and three Ranches, bring revenue to the Tribes, allowing the CTCLUSI to develop and expand Tribal services and facilities.

## 4.6 Natural Resource Conservation and Management on Tribally-Held Lands

### 4.6.1 Annual Climate

The Service Area experiences a predominantly mild climate, with local variations in precipitation and temperature based on ecoregion and topography. Table 4-3 shows average precipitation and mean temperature ranges in the Service Area between 1901 and January 2021. Precipitation is most common in the winter, mainly from the rain in lower elevations and snow building to snowpack at higher elevations in the Cascades Range. Winter storms can bring high winds and heavy precipitation that increases the risk of landslides. The summers are often drier; this can contribute to drought conditions and wildfire risks. The inland parts of Lane and Douglas counties generally experience warmer summers and cooler winters than the rest of the Service Area (Oregon Office of Emergency Management, 2021).

*Table 4-3. Average Precipitation and Temperatures (National Centers for Environmental Information, 2021)*

County	Annual Precipitation (in)	January min/max °F	July min/max °F
<b>Coos</b>	69	35/48	50/73
<b>Curry</b>	86	35/47	51/76
<b>Douglas</b>	53	32/44	50/78

County	Annual Precipitation (in)	January min/max °F	July min/max °F
Lane	64	31/42	50/76
Lincoln	90	36/46	50/72

#### 4.6.2 Department of Cultural and Natural Resources

CTCLUSI conserves and manages the Tribes' cultural and natural resources within their lands and ancestral homelands to benefit Tribal Citizens. The Tribes' Natural Resources & Culture Department has established programs to protect lands, waters, and cultural and natural resources.

The Air and Water programs are responsible for monitoring and investigating contamination to those resources, with ongoing mitigation for improvement to Tribal community health. The Tribal Response Program is responsible for remediation of contaminated properties, and response planning and actions in protecting cultural and natural resources of the Tribe. The Restoration and Wetlands Program undertakes restoration for both Tribal properties and incoming properties, as well as monitors the health of wetlands on the coast. The Forest Management Program manages the Tribe's forest tracts, including for timber management and wildfire response. The Tribal Historic Preservation Program oversees the planning, response, and mitigation for cultural resource protection. The department additionally holds programs for Tribal youth and membership, such as the Cultural Stewardship Program, Tobacco Prevention Program, Language, and more, to perpetuate the culture of the Tribe, as well as educate membership on cultural and natural resources.

All of these programs overlap and collaborate to effectively manage Tribal properties and response actions off-Tribal properties through numerous operating plans, including: the Tribal Environmental Plan, the Strategic Energy Plan, Forest Management Plan, the Tribe's Water Quality Standards, Integrated Water Quality Monitoring Plan, Tribal Estuary Response Plan, Wastewater Monitoring Plan, the Laboratory Management Plan, the Integrated Solid Waste Management Plan, and the Curations Management Plan. Numerous documents assist in implementing these plans, such as standard operating procedures and Tribal codes, all of which undergo extensive review by partner agencies for integrated implementation under trust responsibilities.

An example of department efforts in resource protection is shown through the Tribes' Traditional Cultural Property (TCP), *Q'alya Ta Kukwis Shichdii Me*. Since time immemorial, Coos Bay and its sloughs, inlets, and adjacent uplands have been central to Coos Tribe and encompass cultural, sacred, religious, and historical significance sites. The Coos Tribe used the bay for fishing, gathering, ceremony, and to lay the dead to rest. In recognition of the cultural significance, identity, and connection to this place and resources, and to protect these features for future generations, CTCLUSI designated a TCP Historic District around Coos Bay and Jordan Cove, *Q'alya Ta Kukwis Shichdii Me*, which translates to *Jordan Cove and the Bay of the Coos People*. The district is a 26-square-mile area, including portions of private and public land in the cities of Coos Bay and North Bend and adjacent unincorporated areas in Coos County. The TCP *Q'alya Ta Kukwis Shichdii Me* was found to be eligible for the National Register of Historic Places by the National Parks Service in 2020. This landscape with all of its features are considered just some of the uncountable resources that are vulnerable to the hazards listed in this plan.



#### 4.7 Development Trends – Looking to the Tribes' Future

The Tribes continue to acquire fee-simple and trust lands for the benefit of Tribal Citizens. The Planning Department manages strategic, capital improvements, and land use planning for Tribal properties. Most Tribal development is planned in Florence, Coos Bay, and North Bend's coastal communities near existing Tribal communities. These planned developments include two sites:

- **Coos Head Area:** The 43-acre Coos Head area, currently owned by CTCLUSI, is a former brownfield site formerly occupied by a military facility. The Tribes have completed environmental remediation of the site and have developed the Coos Head Area Master Plan to guide redevelopment. The intent is to dedicate approximately 23 acres to community-oriented, revenue-generating land uses, including an interpretive center, conference center, hotel, and recreational vehicle campground. The remaining approximately 20 acres of the site would be developed with Tribal uses, including a replicated Tribal village, ethnobotany interpretive areas and trails, a community center, Tribal housing, and camping facilities (Confederated Tribes of Coos, Lower Umpqua, & Siuslaw, 2018).

##### 44 CFR 201.7(d)(3)

The plan is revised to reflect changes in priorities and development trends.

#### 4.8 Capabilities and Capacity Assessment

The CTCLUSI 2022 HMP is a capability and capacity-based plan. Capability is the ability to provide something, while Capacity is the amount that can be provided. For example, an Emergency Manager can coordinate a mitigation program; however, the same Emergency Manager likely would not have the capacity to coordinate each mitigation action.

The Project Team and the Emergency Management Team completed a comprehensive hazard mitigation capabilities and capacity assessment during **Workshop 1: Project Kickoff Meeting**. First, the Emergency Management Team identified CTCLUSI's current resources, abilities, and local area agreements that support the HMP. Next, each hazard's exposure and vulnerability were weighed against the current capacities to determine the level of risk. The assessment evaluated the following resource groups:

- Planning and Regulatory
- Administrative and Technical
- Financial
- Education and Outreach

##### 44 CFR 201.7(c)(1)(iv)

The Capabilities and Capacity Assessment shows how the planning process was integrated to the extent possible with other ongoing tribal planning efforts and other FEMA programs and initiatives.

##### 4.8.1 Planning and Regulatory

Planning and regulatory capabilities include the plans, policies, codes, and ordinances that mitigate the impacts of hazards.

Plan Title	Yes/No Year	Are Hazards Addressed ?	How are related projects identified?	Can the plan aid mitigation implementation ?	Accomplishments (2006-2022)
<b>Comprehensive/ Master Plan</b>	Yes, Coos Head Area Master Plan, 2018	Yes	Plan includes mitigation actions to support future growth	Plan outlines opportunities and constraints for the Coos Head Area: open spaces and natural areas and tsunami inundation and flood zones	Continuing to build on their previous accomplishments in self-determination and self-sufficiency
<b>Capital Improvements Plan</b>	No, but the general plan has capital improvements				
<b>Economic Development Initiative</b>	Yes, 2018	No			Congress passes S.1285, Oregon Tribal Economic Development Act
<b>Emergency Operations Plan</b>	Yes, 2009				
<b>Continuity of Operations Plan</b>	Yes, 2009	Yes	Plan identifies essential government administration functions, lead departments, and prioritizes them	Outlines alert, notification, and emergency operations implementation	Tribal Government Administration will complete a COOP Test, Training & Exercise Plan
<b>Transportation Plan</b>	Yes, 2010	No, but addresses public safety	Plan has short, mid, and long-term recommendations for Indian Trust Lands	Road inventory can aid in identifying hazards and prioritize mitigation actions	Maintain road inventory and mapping
<b>Stormwater Management Plan</b>	No				
<b>Community Wildfire Protection Plan</b>	No				

Plan Title	Yes/No Year	Are Hazards Addressed ?	How are related projects identified?	Can the plan aid mitigation implementation ?	Accomplishments (2006-2022)
<b>Climate Change Resiliency Plan</b>	No				
<b>Comprehensive Emergency Management Plan</b>	Yes	Yes	The plan identifies capability, funding sources, mitigation goals, and actions	Mitigation Goals and Potential Actions are in Table 6-4 (e.g., disaster-resistant development, capacity building for preparedness and response)	The system exists to track the initiation, status, and completion of mitigation activities. Goals and progress review on completion and implementation of activities is done at the annual review
<b>Flood Plain Management Plan</b>	No				
<b>Other special plans (e.g., disaster recovery, climate change adaptation)</b>	2009 Tribal Radio System Assessment Plan	No, but addresses public safety	Plan outlines information on CTCLUSI Public Safety Radio System	Identifies maps of radio coverage area and radio system recommendations and enhancements (e.g., providing reliable radio system service in and near Coos Bay)	Procedures for radio systems and a standardized radio frequency template. Herman Peak was scheduled for a new shelter and 180-foot tower in 2009; while this asset is available to CTCLUSI, it is not owned by the Tribes.
<b>Strategic Energy Plan</b>	Yes, 2022				
<b>Forest Management Plan</b>					

Plan Title	Yes/No Year	Are Hazards Addressed ?	How are related projects identified?	Can the plan aid mitigation implementation ?	Accomplishments (2006-2022)
Water Quality Standards, Water Quality Monitoring Plan					
Integrated Solid Waste Management Plan	Yes, 2013				
Tribal Environmental Plan					
Laboratory Management Plan					
Curations Management Plan					
Tribal Estuary Response Plan	Yes, 2018				
Wastewater Monitoring Plan	Yes				

Hazard Mitigation Codes, Permitting, and Inspections	Yes/No + Year	Describe code and if it is adequately enforced	Accomplishments (2006-2022)
<b>Building Code</b>	Yes, 2012	Version/Year: CTCLUSI Building Code	Uniform performance standards and safeguards for health, safety, welfare, comfort, and security
<b>Building Code Effectiveness Grading Schedule</b>	N/A		
<b>Fire Department Insurance Services Office (ISO) Rating</b>	No	Rating:	
<b>Site Plan Review Requirements</b>	No	Permit Review Committee	

Land-use Planning & Mitigation Ordinances	Yes/No + Year	Describe its hazard mitigation effectiveness	Describe ordinance and if it is adequately enforced	Accomplishments (2006-2022)
<b>Zoning Ordinance</b>	No			
<b>Subdivision Ordinance</b>	No			
<b>Floodplain Ordinance</b>	No			
<b>Natural Hazard Specific Ordinance (e.g., stormwater)</b>	No			
<b>Flood Insurance Rate Maps</b>	No			
<b>Acquisition of Land for Open Space and Recreation Uses</b>	Yes	Applicable ordinances and policies are built into Tribal Code		
<b>Water quality standards, which reduce public health risks, and Air Ordinance</b>	No		CTCLUSI adheres to State of Oregon standards	

Rate the Overall Planning and Regulatory Capabilities				
Very Low	Low	Moderate	High	Very High

How can the Tribes expand Planning and Regulatory Capabilities and reduce risks?

#### 4.8.2 Administrative and Technical

Administrative and technical capabilities include staff, skills, and resources that may be leveraged for mitigation planning and implementation.

CTCLUSI 2022 Hazard Mitigation Plan

Administration	Yes/No	Is coordination effective?	Accomplishments (2006-2022)
Planning Commission	Yes, Tribal Planning Department and Tribal Council		
Mitigation Planning Team	Yes	Yes	Established in 2022
Maintenance programs to reduce risk (e.g., tree trimming, clearing drainage systems)	Yes	Yes	
Mutual aid agreements (inter-local agreements)	A Memorandum of Agreement (MOA) with the U.S. Coast Guard and the North West Committee and Regional Response Team is being developed at the time of this writing.		

Staff	Yes/No Full-Time/Part-Time	Is there staff to enforce regulations?	Is outside coordination effective?	Is training effective?	Accomplishments (2006-2022)
Chief Building Official	Yes, full-time	Yes	Yes	Yes	
Floodplain Administrator	No				
Emergency Manager	Yes, is the Director of Planning	No, staff capacity is inadequate		No	
Director of Planner	Yes				
Civil Engineer	No				
GIS Coordinator	No				
Other	Yes: Transportation Coordinator; Chief of Police; Director of Community Health				
Planning Department	Yes, Tribal Planning Department				
Department of Natural Resources & Culture	Yes, all department staff	Yes, all department staff	Yes	Yes, ongoing	Plan updates, new staff, increased equipment and facilities

Technical	Yes/No Year Adopted	Is capability leveraged for risk mitigation?	Accomplishments (2006-2022)
<b>Warning Systems and Services (e.g., reverse 911)</b>	Yes, CTCLUSI Alert Hub App		
<b>Hazard Data and Information</b>	Yes, 2022 HMP	Yes, created inventory (population/buildings/critical facilities) and vulnerability estimates. A comprehensive risk assessment of injuries or loss of life, loss of facility and system functions, and economic losses.	
<b>Grants Management Department</b>	Yes, the Grants Management Department manages grants		

Rate the Overall Administrative and Technical Capabilities				
Very Low	Low	Moderate	High	Very High

How can the Tribe expand Administrative and Technical Capabilities and reduce risks?
Hiring an Emergency Management Coordinator to help expand capacity and Tribal Resources

#### 4.8.3 Financial

Financial capabilities include funding sources that do not need to be repaid (e.g., government grants, taxes, user fees, and philanthropic sources) and finance (e.g., bonds, private lending).

Funding Resource	Access/Eligibility (Yes/No)	How is funding used for mitigations?	If not, can it be?	Accomplishments (2006-2022)
<b>Capital Improvement Project Funding</b>	Yes			
<b>Authority to levy taxes for specific purposes (e.g., special assessment districts)</b>	No			
<b>Utility Fees (e.g., electric, water)</b>	Yes, Revenue Bonds (public utility revenues)			
<b>Impact fees for new development</b>	Yes, System Development Charges for commercial development			



Funding Resource	Access/Eligibility (Yes/No)	How is funding used for mitigations?	If not, can it be?	Accomplishments (2006-2022)
<b>Stormwater Utility Fee</b>	No			
<b>Take on debt (e.g., General Obligation Bonds)</b>	Yes, sale of Tribal Bonds in Tribal Code			
<b>Take on debt through private activities (e.g., loan)</b>	Yes, Down Payment Loan Assistance, Emergency Assistance, and Home Repair for Tribal Members	Yes, for Emergency Assistance		
<b>Indian Community Development Block Grant</b>	Yes	Grants are used for preventative maintenance		
<b>Other Federal Funding Programs</b>	Yes, 2008 Air Quality Program: Region 10 Environmental Protection Agency's (EPA) Tribal Response Program and Project Performance Grant; EPA's Clean Water Grants; BIA's Tribal Resilience Program (coastal management and planning)	Air Quality Program: installed a particulate matter (PM) 2.5 & Meteorological Monitoring Project on tribal lands		
<b>State Funding Programs</b>	Yes, Oregon Public Health Emergency Preparedness Grants			
<b>Insurance Products</b>	No			
<b>Other</b>	N/A			
<b>Hard Dollars</b>	No			
<b>Environmental Protection Agency State and Tribal Response Program</b>	Yes	Response planning, brownfields remediation, laboratory contaminants analysis		Increased staff, equipment, facilities, partnerships, agreements.
<b>Environmental Protection Agency Clean Air Act Section 105</b>	Yes	Mitigation, planning, monitoring		Increased staff, equipment, facilities, partnerships, agreements.
<b>Environmental Protection Agency Clean Water Act Section 106 and 319</b>	Yes	Mitigation, planning, monitoring		Increased staff, equipment, facilities, partnerships, agreements.

Funding Resource	Access/Eligibility (Yes/No)	How is funding used for mitigations?	If not, can it be?	Accomplishments (2006-2022)
<b>BIA</b>	Yes	Forest Management Plan, hazard mitigation		
<b>Bureau of Indian Affairs' Self Determination Funding</b>	Yes	Cultural Resources Protection		
<b>Department of the Interior Tribal Historic Preservation Office</b>	Yes	Cultural Resources Protection		

Rate the Overall Financial Capabilities				
Very Low	Low	Moderate	High	Very High

How can the Tribe expand Financial Capabilities and reduce risks?

#### 4.8.4 Education and Outreach

Education and outreach capabilities include ongoing programs that local-to-federal government, nonprofit, and other organizations provide to communities that may be leveraged to implement hazard mitigation actions and build community resilience. Please indicate which of the following programs currently exist and how they are or could be used to mitigate hazards and build resilience.

Program/Organization	Yes/No Year	How the program relates to resilience and mitigation	How it assists resilience or mitigation activities?	Accomplishments (2006-2022)
<b>Citizen groups/nonprofit organizations (e.g., environmental protection, emergency preparedness)</b>	Yes, 2011	Three Rivers Foundation serves as a charitable giving arm of CTCLUSI, the Board of which comprised of Tribal Council	Grants for resilience and mitigation actions	
<b>Ongoing public education or information program (e.g., fire safety,)</b>	Yes	Public Health alert notifications and Health & Wellness Programs	Early warnings and community engagement	

Program/Organization	Yes/No Year	How the program relates to resilience and mitigation	How it assists resilience or mitigation activities?	Accomplishments (2006-2022)
Natural disaster or safety-related school programs	No			
StormReady certification	No			
Firewise Communities certification	No			
Public and private partnerships to address hazards	No			
Tribal Response Program	Yes, ongoing			
Forest Management Program	Yes, ongoing			
Air Quality Program	Yes, ongoing			
Water Quality Program	Yes, ongoing			
Tribal Historic Preservation Office	Yes, ongoing			
Prevention Program	Yes, ongoing			
Restoration and Wetlands	Yes, ongoing			

Rate the Overall Education and Outreach Capabilities				
Very Low	Low	Moderate	High	Very High

How can the Tribe expand Education and Outreach Capabilities and reduce risks?

# CTCLUSI Hazard Mitigation Plan Part 2: Risk Assessment



## Part 2

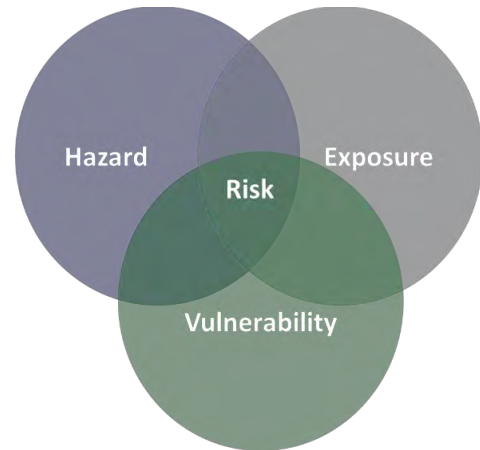
### 5 Risk Assessment

#### 5.1 Introduction

Risk is the intersection of a hazard, the exposure to the hazard, and vulnerability to that hazard; this is illustrated in Figure 5-1. Risk exists where a structure, population, and/or infrastructure are exposed and possibly vulnerable to a hazard. If there is no exposure or vulnerability, there is no risk from the hazard. The HMP incorporates mitigation actions to minimize or remove exposures and/or vulnerabilities, reducing or removing the risk. The risk assessment process focuses on the following elements:

- **Hazard Identification and Ranking:** Determine the hazards that may impact the Tribes.
- **Exposure Identification:** Estimate the total number of people and properties in the Tribal Service Area that are likely to experience a hazard event if it occurs.
- **Vulnerability Identification and Estimated Losses:** Assess the hazard's potential impact on the Service Area's populations, properties, environment, culture, and critical facilities. The Tribes' capacity to mitigate the hazard effects. Then estimate the potential life and economic losses and possible costs avoided from mitigation actions taken.

*Figure 4-1. Risk: The Relationship Between Hazard, Exposure, and Vulnerability*



CTCLUSI's level of risk is evaluated based on the identified hazards from workshop 1 and the vulnerability and exposure of properties and Tribal Citizens to the hazards. Each hazard profile discusses CTCLUSI's vulnerability and exposure to each of the eight identified hazards. The risk is adjusted to account for the Tribes' existing capabilities to manage the risk. The capabilities assessment is in Section 4.8. This process enables CTCLUSI to develop and prioritize mitigations based on the level of risk to the hazards.

#### 5.2 Methodology

The hazard profiles in Section 6 to 13 used qualitative and quantitative methods to describe and analyze the eight hazards identified by the Emergency Management Team. These profiles included the Service Area's hazard risk, exposure, and vulnerabilities of Tribal Citizens, properties, and critical facilities.

##### 5.2.1 Qualitative Methods – Identifying and Prioritizing Hazards

The Emergency Management Team was asked to identify and prioritize hazards in the Service Area based on the probability, frequency, magnitude, severity, and warning time; definitions for each measure are provided in Table 5-1. The Committee ranked the hazards based on their assumptions of the most-likely and worst-case scenarios. The Emergency Management Team considered the exposure and vulnerability of populations, properties, and critical facilities in the Service Area. The Emergency Management Team reviewed state, Tribal,

#### **44 CFR Section 201.7(c)(2)(i)**

The plan includes a description of the type, location, and extent of all natural hazards that can affect the tribal planning area in each hazard profile. The plan also includes information on previous occurrences of hazard events and the probability of future hazard events for the Service Area.

and local hazard planning documents and historical information on each hazard within the Service Area to inform their decisions.

*Table 5-1. Hazard Ranking Definitions*

Rate	Severity	Magnitude	Frequency	Onset	Duration
<b>1</b>	No injuries or deaths expected. Minimal damage or impacts to natural systems.	Single or limited number of properties impacted.	Less than every 25 years	Greater than 30 days of warning	Only brief moments
<b>2</b>	Between 1 and 5 injuries or deaths. Minimal to moderate damage or impacts to natural systems.	Neighborhood or small community impacted.	10-25 years	5-30 days of warning	1-24 hours
<b>3</b>	Between 5 and 25 injuries or deaths. Moderate damage or impacts to natural systems.	City or town impacted.	5-10 years	1-5 days of warning	Days to weeks
<b>4</b>	Between 25 and 50 injuries or deaths. Extensive damage or impacts to natural systems.	Entire county impacted.	1-5 years	1-10 hours of warning	Weeks to months
<b>5</b>	Greater than 50 injuries or deaths. Catastrophic damage or impacts to natural systems.	State and/or region impacted.	Once per year	No warning	Months to years

The Emergency Management Team identified the following eight hazards for inclusion in the CTCLUSI 2022 HMP, and the results of the hazard ranking survey are reported in tables 5-2 and 5-3 (below).

- Earthquake
- Epidemic/Pandemic/Pandemic
- Flood and Sea-Level Rise (SLR)
- Hazardous Materials
- Mass Earth Movements (includes landslides)
- Tsunami
- Severe Weather Events (includes drought and extreme heat)
- Wildfires

*Table 5-2. Most likely Scenario*

Hazards	Severity	Magnitude	Frequency	Onset	Duration	Average	Rank
<b>Severe Weather (drought &amp; extreme heat)</b>	1.33	2.33	2.75	2.17	2.83	2.282	1
<b>Earthquake</b>	2.5	2.25	2	3.75	2.75	2.65	2
<b>Flood &amp; Sea Level Rise</b>	1.5	2.25	3	2.75	3.75	2.65	3
<b>Tsunamis &amp; Seiches</b>	2.5	2.5	1.25	4	2.75	2.6	4
<b>Mass Movements (landslides)</b>	1.5	2	2.75	3.75	2	2.4	5
<b>Epidemic/Pandemic/Pandemic</b>	2	3.25	1.75	1.75	3.25	2.4	6
<b>Wildfires</b>	1.25	1.5	2.75	3.75	2.5	2.35	7
<b>Hazardous Materials</b>	1.5	1.75	2.25	3	3.25	2.35	8

Table 5-3. Worst-case Scenario

Hazards	Severity	Magnitude	Frequency	Onset	Duration	Average	Rank
Hazardous Materials	4	4.25	4.25	5	5	4.5	1
Epidemic/Pandemic/Pandemic	4.75	5	3.75	4	4.75	4.45	2
Earthquake	4.5	5	2.75	4.75	4.5	4.3	3
Tsunamis & Seiches	5	4.5	2	5	4.75	4.25	4
Severe Weather (drought & extreme heat)	3	3.83	3.83	4.5	4.1	3.852	5
Wildfires	3.75	4	4	5	4	4.15	6
Flood & Sea Level Rise	2.5	4.25	4	3.5	4.5	3.75	7
Mass Movements (landslides)	2.5	3.25	3.5	5	3.25	3.5	8

During the hazard identification and ranking process, the Emergency Management Team decided to consolidate drought and extreme heat into severe weather given the related factors of these hazards; all three were separate in the CTCLUSI 2006 HMP. Additionally, the 2022 CTCLUSI HMP addresses new and emerging hazards that affect the Tribes, including pandemics, hazardous materials, and incorporating SLR in the flood hazard profile. A pandemic profile is included to reflect the impact of the global COVID-19 pandemic on the Tribes.

#### 5.2.2 Quantitative Methods – Map-based Risk Assessment

The CTCLUSI 2022 HMP includes the most current and accurate scientific data available. GIS software and data sets were used to map a hazard's extent where the information existed. However, not all hazards had geospatial data. These spatial data sets were retrieved from federal sources in the Five-County Service Area and other applicable databases as applicable.

#### 44 CFR 201.7(c)(2)(ii)

The plan includes a description of each identified hazard's impact as well as an overall summary of the vulnerability of the tribal planning/service area.

GIS software was used to generate map and tabular outputs to quantify and visualize the exposure and vulnerability of people, property, and critical facilities within the Service Area; the results are available in the hazard profiles of this plan, Sections 6 through 13.

#### Exposure of CTCLUSI Citizens and Structures

The risk assessment analyzed socially and economically vulnerable populations where the data was available; however, this was not the case for all eight hazards. Additionally, the GIS analysis factored in the economic value and the overall hazard exposure of structures in the Service Area.

- **Population Exposure:** CTCLUSI Tribal Government provided population data, which showed that the total enrolled population of Tribal Citizens is 1,313. Out of those Citizens, 507 reside in the Service Area. Socially vulnerable population categories were member age groups for minors and those over 65. Population exposure for each hazard is addressed in the hazard profile sections.
  - **Under 19 years old:** 34 percent of Tribal Citizens in the Service Area
  - **65 years or older:** 13 percent of Tribal Citizens in the Service Area
- **Structural Exposure:** The exposure to each hazard considers 69 facilities in the Service Area. CTCLUSI identified ten critical facilities in the Service Area. A full account of Tribal properties is in Appendix H.



The type of facilities, critical facilities, and sum of the structures are in Table 5-4. The facility exposure for each hazard is addressed in the hazard profile sections.

*Table 5-4. CTCLUSI Facility Types and Counts*

Facility Type	Total Facilities	Critical Facilities
Administration	4	0
Camp	11	0
Casino	3	0
Communication	0	0
Community	3	0
Housing	20	0
Lighthouse	1	0
Maintenance	4	4
Other	14	0
Power	1	1
Ranch	3	0
Water/Wastewater	4	4
<b>Grand Total</b>	<b>69</b>	<b>10</b>

Assessing the hazard-specific risks posed to critical facilities is important for the development and prioritization of mitigation actions. FEMA defines critical facilities as all human-made structures or improvements that due to their function, size, service areas, or uniqueness have the potential to cause serious bodily harm, extensive property damage, or impact socioeconomic activities if the facilities are damaged, destroyed, or vital services are impaired (Federal Emergency Management Agency, 2007). CTCLUSI's critical facilities are spread across the Service Area. The map in Figure 5-2 highlights the two locations in the Service Area where there are critical facilities, with one yellow box around the location in Florence and the other around Coos Bay. Figures 5-3 and 5-4 zoom in on these two locations to clearly show the critical facility sites.

Figure 5-2. CTCLUSI Critical Facilities: Overview

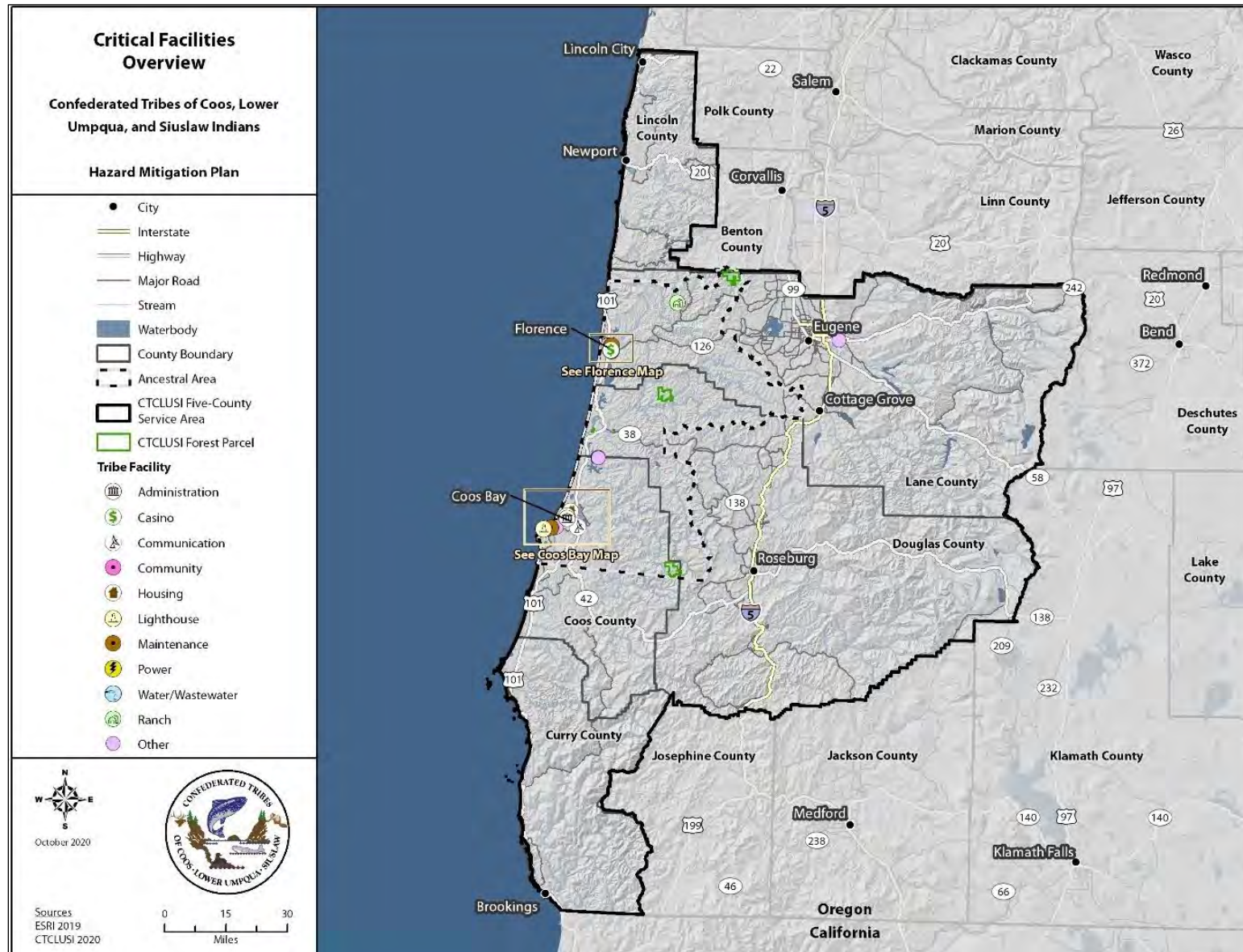


Figure 5-3. CTCLUSI Critical Facilities: Coos Bay

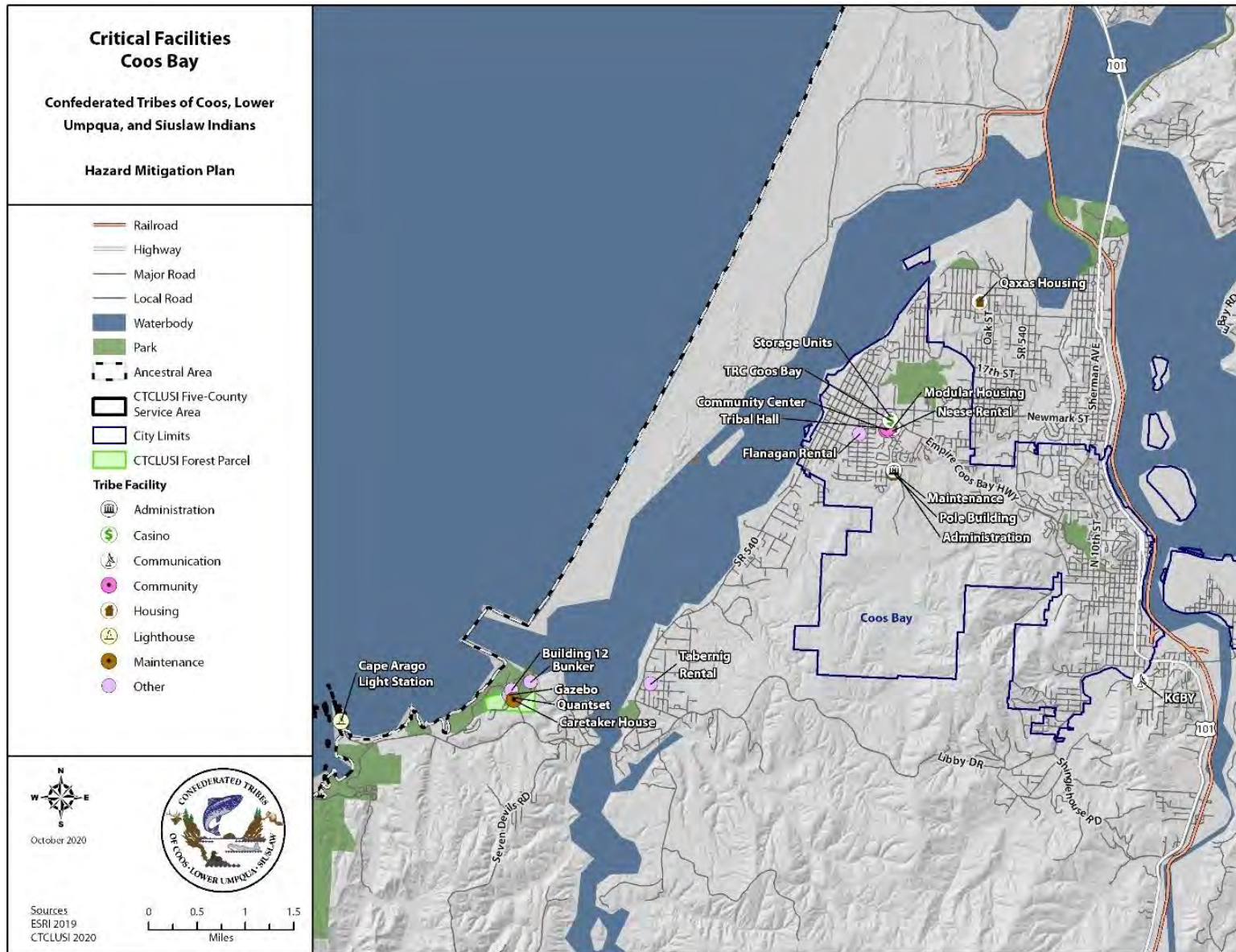
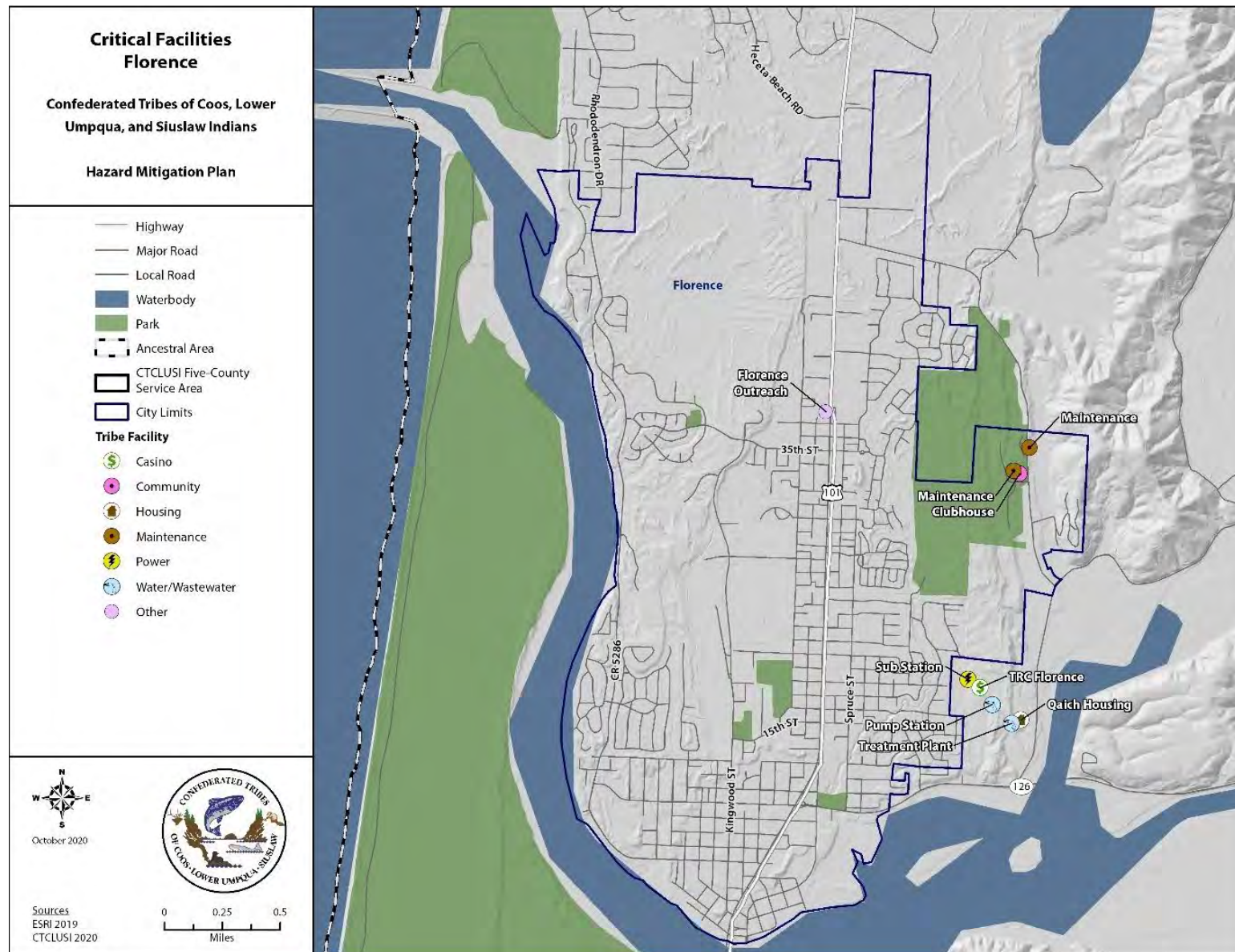




Figure 5-4. CTCLUSI Critical Facilities: Florence



### 5.2.3 Data Sources

Table 5-5 lists all the data and sources used to develop maps and tabular outputs.

*Table 5-5. Geographic Information System Data Sources*

Data	Source
<b>Structures/Critical Facilities</b>	CTCLUSI Tribal Government
<b>Population</b>	CTCLUSI Tribal Government
<b>Earthquake</b>	Oregon Department of Geology and Mineral Industries (DOGAMI) 2013
<b>Weather Events (Drought and Extreme Heat)</b>	US Department of Agriculture Natural Resources Conservation Service, National Oceanic and Atmospheric Administration (NOAA): National Climatic Data Center 2021
<b>Flooding and Sea-Level Rise</b>	FEMA 2020
<b>Wildfire</b>	Oregon Department of Forestry 2018, Wildland Urban Interface (WUI) Oregon Department of Forestry 2010
<b>Tsunami</b>	DOGAMI 2013
<b>Mass Earth Movement (Landslide)</b>	Landslides DOGAMI 2016, and mapped landslide deposits DOGAMI 2019

## 5.3 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 can arise from incomplete scientific knowledge concerning natural hazards and/or their effects on the built environment. CTCLUSI Tribal Citizen data contained only ages and gender, limiting analysis of population exposure and vulnerability.

### 5.3.1 GIS Limitations

GIS data and analysis are limited by the scale of hazards and exposures assessed. For example, buildings are often a point on a map rather than shapes showing their entire footprint (i.e., unlike blueprints or floor plans). Figure 5-6 displays a facility that overlaps a flood zone but would not be identified in that flood zone because the facility's data point is right outside of the flood zone boundary.

Therefore, maps and analysis should be considered a general representation of risk throughout the Service Area and not determine site-specific risks. Potential exposure and loss are also estimated and should be used only to understand relative risk, not absolute risk. The qualitative hazard identification and raking exercise and risk assessment survey completed by the Emergency Management Team and CTCLUSI's survey responses are essential for addressing these limitations and validating the risk assessments.

*Figure 5-5. GIS Data Point Limitation Diagram*



## 6 Earthquake

### 6.1 General Background

Earth's crust is comprised of tectonic plates, constantly moving at a prolonged rate (United States Geological Survey, 2016). As the plates push against each other, they occasionally get stuck, resulting in friction. Earthquakes are the result of the energy from that friction being released and traveling through the ground in waves, resulting in surface shaking (United States Geological Survey, n.d.). Surface shaking can be as short as a few seconds or start with one event followed by several more minor earthquakes over several days, known as tremors. The smaller seismic events that follow a more significant initial earthquake are called aftershocks.

Most seismic hazards occur on well-known active faults (Bolt, 2020). However, determining if a fault is active or potentially active depends on geologic evidence, which may or may not be available. Earthquakes are more likely to occur on faults with these conditions (Bolt, 2020):

- Pressure builds up more rapidly
- There were recent earthquakes
- Past earthquakes caused more significant displacements
- Faults are between plates and can relieve accumulated tectonic stresses

The fault types listed above are typically well documented. Depending on the proximity and depth of the earthquake's epicenter, ground shaking can still feel strong. In contrast, large regional faults can generate moderate magnitudes that result in only moderate shaking because of the epicenter's distance and depth. Lesser-known faults are challenging to predict since there is no historic geological data to inform predictions.

#### 6.1.1 Potential Damage from Earthquakes

Earthquakes can result in changes to the ground surface structure and placement. Ground shaking and displacement from an earthquake can lead to secondary impacts like mass earth movements and cascading effects, such as injuries and death and structural damage to buildings and infrastructure.

Earthquakes can disrupt communications and damage utilities such as electricity, gas, sewer, and water lines. Older facilities and infrastructure built before stringent earthquake codes are particularly vulnerable. After an earthquake, entities must check their structures and utility lines for damage

### DEFINITIONS

**Aftershock:** Lower-magnitude earthquakes that follow an initial primary earthquake.

**Earthquake:** A sudden shaking of the ground caused by seismic waves traveling through the earth.

**Earthquake Magnitude:** The seismic wave/amplitude measured and recorded by seismographs from an earthquake's epicenter. Magnitude is represented by a class name and numerical value from 3 to 8.

**Epicenter (seismology):** The point on the ground's surface directly above the focus point where the fault ruptures.

**Fault:** A fracture in the Earth's crust where compression or tension pressure on causes displacement of soil and rock on the opposite side of the fracture.

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

**Liquefaction:** A loss of soil strength or cohesion that results in the soil behaving like a thick liquid (e.g., quicksand).

**Modified Mercalli Scale:** A measurement of the level of intensity felt on the ground's surface in populated areas, represented by Roman numerals I to X.

**Surface Rupture:** An area of the ground that is offset (raised, lowered, tilted) when a fault rupture reaches the surface of the ground.



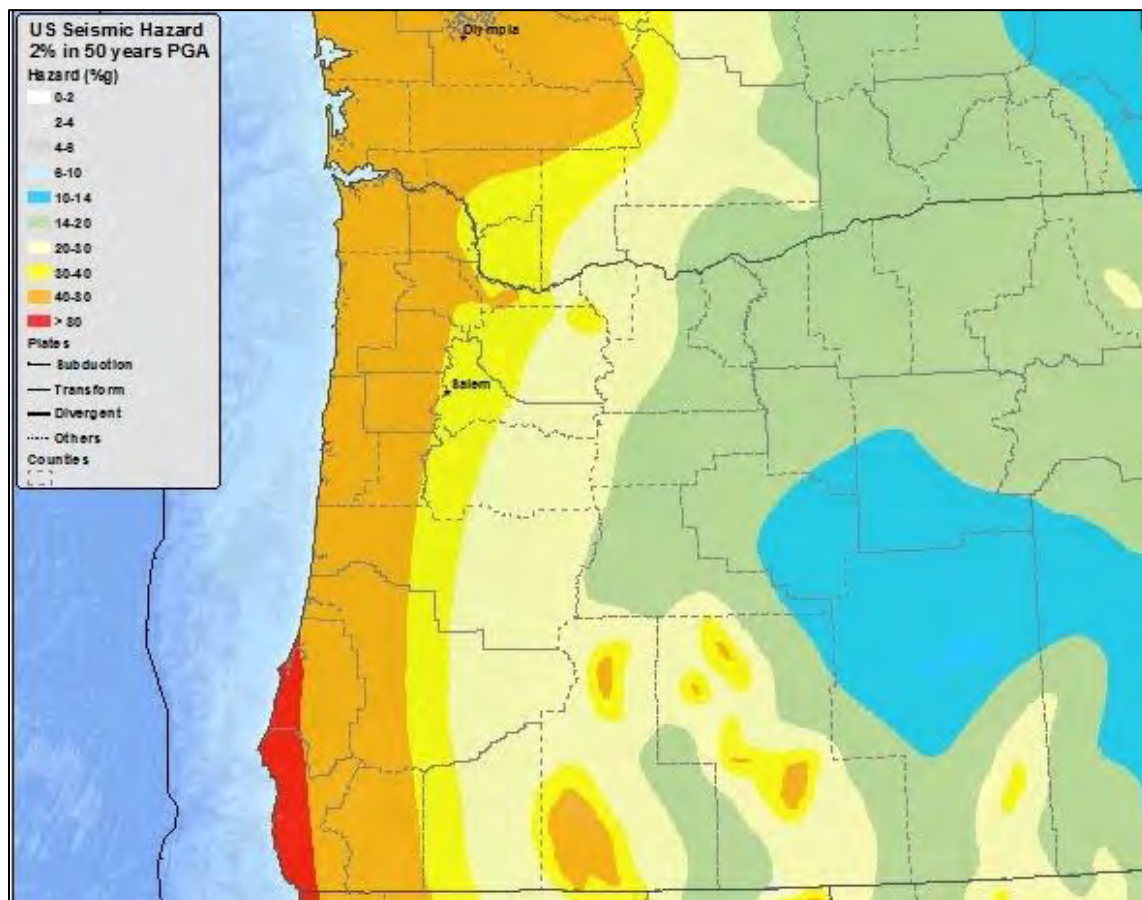
(Committee on Consumers and the Public Interest, 2019). Secondary and cascading impacts from earthquakes are addressed further in Section 6.3.

## 6.2 CTCLUSI Hazard Profile

The most common earthquakes that occur in Oregon are crustal, intraplate, or great subduction earthquakes. In CTCLUSI's Service Area, the Cascadia Subduction Zone (CSZ) generates the most severe earthquake hazards, and damage following a great subduction earthquake is expected to be widespread and severe. The CSZ is a fault line approximately 600 miles long and just off the coast of the Service Area (Confederated Tribes of Coos Lower Umpqua and Siuslaw Indians, 2018). Earthquakes occur from this fault line generally between 400 to 600 years. Figure 6-1 displays the seismic hazards for Oregon and the level of risk from red as the highest and blue as the lowest.

CTCLUSI's coastline is at the highest risk for CSZ earthquake events emanating off the coast, as shown in Figure 6-1. An earthquake registering a scale of 9.0 or higher could trigger a 100-foot tsunami that would inundate the Oregon coast (Confederated Tribes of Coos Lower Umpqua and Siuslaw Indians, 2018). Additionally, seismic hazards in the CSZ region are exacerbated by topography and bedrock geology, local soil profiles, and building practices. Section 6.3.1 explains how geology and soil types can lead to secondary hazards such as mass earth movements. The initial earthquake, after-shocks, and secondary and cascading impacts that follow the seismic event can damage CTCLUSI's structures and Service Area infrastructure. Further secondary hazards and cascading impacts are discussed in Section 6.3.

Figure 6-1. Oregon State Seismic Hazard Color Scale (United States Geological Survey, 2014)





### 6.2.1 Hazard Ranking

The Emergency Management Team completed a hazard ranking survey during the CTCLUSI 2022 HMP update process and assessed hazard-related factors based on worst case and most likely scenarios. Hazard definitions and ranking factors are in Table 5-1. Survey results were prioritized and ranked based on their averaged score. The severity, magnitude, frequency, onset, and duration variables are scored one to five, where one is the lowest and five is the highest. Compared to the other hazards in the survey, earthquakes are the third worst-case scenario and second most likely scenario.

*Table 6-1. Earthquake Hazard Ranking Output*

Severity	Magnitude	Frequency	Onset	Duration	Average	Rank
<b><i>Worst-Case Scenario</i></b>						
4.50	5.00	2.75	4.75	4.50	4.30	3
<b><i>Most Likely Scenario</i></b>						
2.50	2.25	2.00	3.75	2.75	2.65	2

### 6.2.2 Past Events

The most common earthquakes in the Service Area are on crustal faults. They typically occur in the earth's crust at shallow depths of 6 to 12 miles below the surface (State of Oregon Department of Geology and Mineral Industries). Ground shaking from intraplate earthquakes with epicenters outside of Oregon is less common; however, more significant events off the coast can be felt and impact the Service Area (State Interagency Hazard Mitigation Team, 2020). The most recent major earthquake in the CSZ was an estimated 9.0 magnitude earthquake on January 26, 1700. This earthquake caused the US coastline to drop several feet and generated a tsunami that impacted coastal Tribes in the Pacific Northwest. Japanese records indicate that a destructive, distantly produced tsunami also struck their coast on January 26, 1700.

There is no historical record of a federal disaster declared for earthquakes in CTCLUSI's Service Area or major damaging crustal earthquakes in the region in the past 156 years. However, the risk for a catastrophic event that would impact CTCLUSI's Service Area could happen at any time. Table 6-2 lists significant past earthquakes that have affected the Service Area.

*Table 6-2. Significant Past Earthquakes on Oregon's Coast (Federal Emergency Management Agency, 2020)*

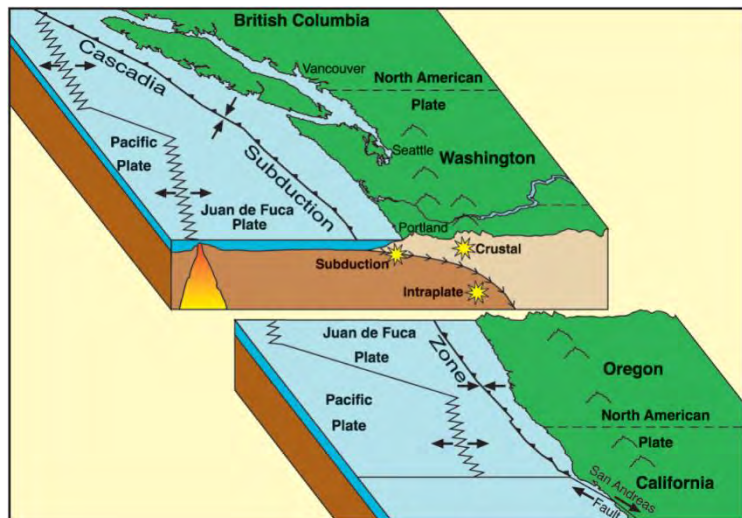
Date	Location	Scale	Details
<b>Estimate: 1400 Before the Common Era (BCE), 1050 BCE, 600 BCE, 400, 750, 900</b>	CSZ (Offshore)	~8.0-9.0	Timeframes are estimated for these events.
<b>January 1700</b>	CSZ (Offshore)	~9.0	This earthquake generated a tsunami that destroyed Native American villages along the coasts of Washington and Oregon and reached Japan.
<b>November 1873</b>	Near Brookings, Curry County	7.3	This intraplate earthquake is thought to have originated in the Juan de Fuca plate offshore. Damage included collapsed chimneys in Port Orford, Grants Pass, and Jacksonville.
<b>November 1962</b>	Portland, Multnomah County	5.2-5.5	This crustal earthquake damaged many homes in the city (chimneys, windows, etc.).

Date	Location	Scale	Details
March 1993	Scott Mills, Marion County	5.6	A crustal earthquake caused approximately \$28 million in damage to homes, schools, businesses, and government facilities. A federal disaster (FEMA-985-DR-OR) was declared in counties outside of the Service Area.
September 1993	Klamath Falls, Klamath County	5.9-6.0	Two crustal earthquakes resulted in two fatalities and approximately \$7.5 million in damage to homes, businesses, and government facilities. A federal disaster (FEMA-1004-DR-OR) was declared in counties outside of the Service Area.
May 8, 2015	Pacific Ocean west of Coos Bay, Coos County (Offshore)	4.4	-
November 29, 2019	Port Orford, Curry County	4.5	-
February 8, 2020	Pacific Ocean west of Coos Bay, Coos County (Offshore)	4.7	-

### 6.2.3 Location

CTCLUSI's Service Area is near the plate boundary between the Juan de Fuca Plate and the North American plate. This boundary is located approximately 50 miles off the entire west coast, running the length of the United States and into Canada, as mapped in Figure 6-2. There are two significant earthquake zones on the plate boundary, the CSZ, and a deep, intra-plate "Benioff" zone. The Service Area is also exposed to deep intraplate, crustal faulting, and volcanic earthquakes, as illustrated in Figure 6-4 (Pacific Northwest Seismic Network).

Figure 6-2. The Cascadia Subduction Zone from British Columbia to Northern California (Barnett, et al., 2009)

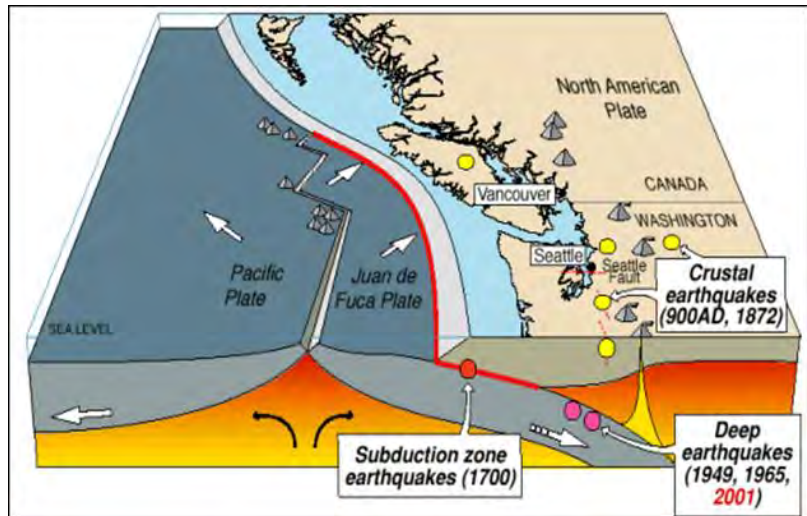


### Cascadia Subduction Zone

The CSZ is a 600-mile fault zone that runs from Northern California to British Columbia, about 60 to 100 miles offshore. More than 90 percent of earthquakes in the Pacific Northwest occur along the CSZ, displayed in Figure 6-3. Earthquakes are generated when the Juan de Fuca Plate moves under the North American Plate in the Pacific Ocean. This interaction results in a north/south compression stress in the crust along the west coast. There were 41 earthquakes in the last 10,000 years within the fault zone. These massive events have occurred between 190 to 1200 years apart.

A great subduction earthquake can be greater than a magnitude 9.0 and produce a tsunami of up to 100 feet in height. Ground shaking produced by a great subduction earthquake would be most severe along the coast but felt throughout the Pacific Northwest (Oregon Office of Emergency Management). A great subduction earthquake has the potential to cause catastrophic damage to structures and critical infrastructure and loss of life in the CTCLUSI's Service Area (United States Geological Survey, 2017). Earthquake generated tsunamis are detailed in Section 12.

Figure 6-3. Earthquake Types Along the Cascadia Subduction Zone



#### Deep Intraplate or Benioff Zone Earthquakes

Deep intraplate Benioff Zone earthquakes occur along subduction zones and are caused by a slip along the subduction zone or the downward movement of an oceanic crustal plate going under a continental plate (Benioff Zone, 2021). The Benioff Zone, which can also be called the Wadati-Benioff Zone, is shown in Figure 6-3 (United States Geological Survey). These zones can produce an earthquake on a subduction zone fault or slip fault. Deep earthquakes can reach a strong to major magnitude (Table 6-3) and typically occur about 40 miles beneath the surface (Oregon State University). Historical deep earthquake events on the CSZ include (Oregon State University):

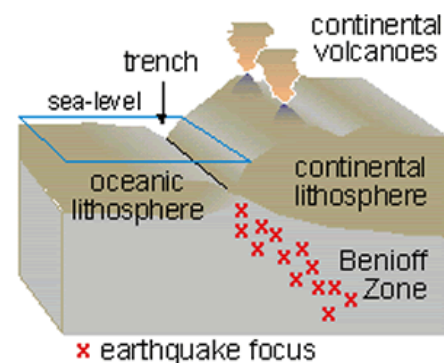
- A magnitude 7.1 in 1949 that caused over \$100 million in damage to the city of Olympia, Washington
- An event in 1965 caused over \$50 million in damage
- The 2001 Nisqually earthquake caused approximately \$2.5 billion

Although these more recent events occurred in Washington, Oregon and the Service Area are in the CSZ and are also subject to Benioff Zone earthquakes.

#### Crustal Zone

Crustal earthquakes typically occur in the upper 16 miles of the earth's crust, oriented east-west and northwest-southeast (State of Oregon Department of Geology and Mineral Industries). In southern Oregon, extensional (tensional) stress can also cause faulting and crustal earthquakes. Past earthquakes have revealed many shallow fault structures, including the Western Rainier Seismic Zone and the Mt. St. Helens Seismic Zone. However, not all active faults have been mapped, and many crustal earthquakes occur on faults that don't reach the earth's surface. Significant crustal earthquakes in the Service Area include the 1993 Scott's Mill (M5.6) and 1993 Klamath Falls (M6.0) earthquakes in Oregon (State of Oregon Department of Geology and Mineral Industries).

Figure 6-4. Cross-Section of the Benioff Zone (United States Geological Survey)



#### 6.2.4 Frequency

Great subduction earthquakes with a magnitude over 9.0 in the CSZ have a return interval of 400 to 600 years, with a 7 to 12 percent chance of occurring in the next 50 years (State Interagency Hazard Mitigation Team, 2020). Smaller CSZ earthquakes with magnitudes between 8.3 and 8.5 have an average return interval of about 240 years. The combined probability of an earthquake in the CSZ in the next 50 years is approximately 37 to 43 percent (University of Oregon, Community Service Center, & Oregon Partnership for Disaster Resilience, 2016).

Crustal earthquakes are the most common and frequent in the Pacific Northwest. There are over 1,000 earthquakes each year with a magnitude 1.0 or greater in Oregon and the Pacific Northwest. Historically, deep intraplate earthquakes in the San de Fuca Plate have occurred every 30 years. The US Geological Survey (USGS) estimates an 84 percent chance of another deep earthquake of magnitude 6.5 or greater in the region in the next 50 years (Pacific Northwest Seismic Network). Crustal zone earthquakes occur in the crust of the North American plate and may register as a magnitude seven or greater. Such earthquakes can cause greater loss of life and property than any other kind of disaster but may occur no more than once every 1,000 years. Ruptures in the North American Plate cause shallow faults in the Pacific Northwest with depths greater than 22 miles.

Benioff deep zone earthquakes can cause 6 to 7.4 magnitude earthquakes (Pacific Northwest Seismic Network). The largest recorded deep zone earthquakes were the 7.1 magnitude Olympia earthquake in 1949 and the 6.8 magnitude Nisqually earthquake in 2001 (Pacific Northwest Seismic Network). Scientists estimate the recurrence interval for this type of earthquake to be 30-40 years for magnitude 6.5, and 50-70 years for magnitude 7.0 (Pacific Northwest Seismic Network).

#### 6.2.5 Severity

As shown in Table 6-2, past crustal earthquakes felt in the Service Area have caused damage ranging from minor structural damage to widespread damage to buildings. CSZ earthquakes are the most severe seismic hazard for the region and are likely to result in widespread, catastrophic damage from ground shaking and subsequent tsunamis (Pacific Northwest Seismic Network). The potential magnitude, in the most extreme scenarios, of earthquakes in the CTCLUSI's Service Area by type are (Pacific Northwest Seismic Network):

- **CSZ:** 9.0+ magnitude for up to four minutes
- **Benioff:** 6.5 or greater with no aftershocks
- **Crustal Zone:** As large as 7.5 with some aftershocks

Scientists and planners use different scales to communicate about earthquake power. The audience receiving the information about earthquake risk and hazard determines which scale is used (i.e., scientists or the general public). The most common earthquake measurement scales for hazard mitigation are the Richter Scale and the Modified Mercalli Intensity (MMI) Scale.

Richter magnitude is recorded on a scale of 1 through 9 (Table 6-3). The Richter magnitude is measured by recording the ground vibrations emanating from an earthquake's source, or epicenter, on a seismograph. The Richter magnitude is an absolute scale, meaning that it will not change with distance from the earthquake epicenter. In recent years, the Richter Scale has been replaced with the Moment Magnitude ( $M_w$ ) scale. The Moment Magnitude scale is a more effective method for measuring earthquakes at larger distances from the epicenter than the Richter Scale. While the Richter scale is

becoming less used, measured Moment Magnitude values are still converted to values comparable to the Richter Scale to determine the earthquake risk.

*Table 6-3. Richter Earthquake Magnitude Classes (United States Geological Survey)*

Magnitude Class	Magnitude Range (in numerical value)
Great	$M > 8$
Major	$7 \leq M < 7.9$
Strong	$6 \leq M < 6.9$
Moderate	$5 \leq M < 5.9$
Light	$4 \leq M < 4.9$
Minor	$3 \leq M < 3.9$
Micro	$M < 3$

The MMI scale is an intensity scale ranging from I to X, where X is the most intense earthquake. The MMI scale measures the damage from earthquake shaking in a particular location. The MMI scale is subjective because it is based solely on observable data rather than measurements (Table 6-4). However, the MMI scale may be more effective when using it as a tool to communicate risk and hazard (USGS 2021).

*Table 6-4 – Modified Mercalli Earthquake Scale and Descriptions (United States Geological Survey)*

Scale	Shaking	Damage Description
<b>I</b>	Not Felt	Felt by very few under the right conditions
<b>II</b>	Weakest	Felt by a few people at rest, most likely on upper floors of buildings
<b>III</b>	Weak	Noticeably felt by people indoors, especially on upper floors. People may not recognize it as an earthquake. Stopped cars may rock slightly. It can feel like a large truck passing.
<b>IV</b>	Light	Many people feel shaking indoors. Can wake people up at night. Loose items can fall, like vases. It can feel like a heavy truck hitting a building. Stopped cars noticeably rock.
<b>V</b>	Moderate	Nearly everyone feels this. It can wake up many people at night. Items can break, like windows. Light and unsecured objects overturn, like small furniture and bookcases.
<b>VI</b>	Strong	Everyone feels this. Can move heavy furniture. Fallen plaster or masonry.
<b>VII</b>	Very Strong	Newer structures built with high seismic standards and basic building standards have negligible damage. While older or poorly built structures can have considerable damage.
<b>VIII</b>	Severe	Slight damage to newer structures with high seismic standards. Considerable damage to structures with basic building standards and possible partial collapse. Chimneys, factory stacks, columns, monuments, and walls can fall. Heavy furniture can overturn.
<b>IX</b>	Violent	Newer structures with high seismic standards can have considerable damage. New structures with basic building standards can substantially damage, partial collapse, and/or shift off foundations. Older buildings can be destroyed.
<b>X</b>	Extreme	Some newer, well-built wood structures can be destroyed. Most older buildings with masonry and frame structures are destroyed. Foundations can be damaged and rails bent.

#### 6.2.6 Warning Time

Earthquakes generally occur with little warning time. However, the Pacific Northwest Seismic Network's ShakeAlert® earthquake early warning system enables the detection of significant earthquakes and issues an alert to people and critical systems up to 30 seconds before shaking arrives at the surface (Oregon Office of Emergency Management, 2021). While the warning time is short, it enables people to seek



shelter and critical infrastructures or facilities to suspend operations (Oregon Office of Emergency Management, 2021).

This notification system can provide seconds to minutes of advanced warning to allow people to move into safe locations and Drop, Cover, and Hold On. There may even be enough time to turn off equipment, stop work, and safely stop vehicles. ShakeAlert® uses the existing regional infrastructure for earthquake monitoring operated by the Pacific Northwest Seismic Network (United States Geological Survey, 2017).

### 6.3 Secondary Hazards and Cascading Impacts

#### 6.3.1 Secondary Hazards

Earthquakes may cause the following secondary hazards in the Service Area:

- Surface ruptures (e.g., rising, tilting, dropping)
- Liquefaction
- Mass earth movements (e.g., landslides, rockslides, debris flows, mudflows)
- Tsunamis and seiches

#### Surface ruptures

Surface ruptures can alter the ground by pushing the ground up, dropping the ground, and tilting the surface's angle. Ruptures vary dramatically in size and depth. There are records of fault displacements ranging from one mile to 200 miles in length; typically, surface ruptures are found between six feet to 1,000 feet from the fault line (United States Geological Survey). Surface ruptures can damage anything on the impacted area before an earthquake changes the ground's shape.

#### Liquefaction

Liquefaction occurs when soils lose their shear strength and flow or turn the ground into a pudding-like liquid. Liquefaction can cause buildings and road foundations to lose load-bearing strength, resulting in structures and infrastructure sinking into quicksand-like soil where it was previously solid ground. The US Department of Agriculture, Natural Resources Conservation Service (NRCS) provides a Web Soil Survey library to determine an area's soil structure and susceptibility to seismic hazards. The NRCS states this library is the single authoritative source for soil information in the US; it contains soil maps and data for more than 95 percent of US counties (United States Department of Agriculture Natural Resources Conservation Service, 2019).

Once the soil composition is determined, the National Earthquake Hazard Reduction Program (NEHRP) soil classification system explains an earthquake's amplifying effect on soft soils. This amplification is the average shear-wave velocity on the upper 100 feet of soil compared to the shaking amplification at the ground's surface (Palmer, et al., 2007). Seismic activity typically does not amplify or reduce B soils. However, earthquakes more easily alter increasingly softer C, D, and E soils. E soils are the most susceptible to liquefaction from seismic activity (Palmer, et al., 2007). Table 6-5 is the NEHRP system.

*Table 6-5 – NEHRP Soil Classification System (Williams, Stephenson, Odum, & Worley, 1997)*

NEHRP Soil Type	Description	Mean Shear Velocity to 30 m (m/s)
<b>A</b>	Hard Rock	1,500
<b>B</b>	Firm to Hard Rock	760-1,500
<b>C</b>	Dense Soil/Soft Rock	360-760
<b>D</b>	Stiff Soil	180-360

NEHRP Soil Type	Description	Mean Shear Velocity to 30 m (m/s)
E	Soft Clays	< 180
F	Special Study Soils (liquefiable soils, sensitive clays, organic soils)	

### Mass Earth Movements

An earthquake can trigger mass earth movements, such as debris flows/mudslides, landslides, rockslides, and liquefaction. When the ground shakes, it can shift the earth, causing the surface to become unstable and fall or flow. The most common earthquake-caused movements are rockfalls (United States Geological Survey). The extent of a mass earth movement depends on several factors, including the magnitude, focal depth of the epicenter, soil or ground composition, and duration of the shaking (United States Geological Survey). Mass earth movements and their risk to the Service Area are covered more in Section 9.

### Tsunamis and Seiches

Depending on the location, earthquakes can also trigger tsunamis and seiches. Seismic seiches are waves generated by earthquakes on lakes, reservoirs, ponds, and rivers (United States Geological Survey). A seismic seiche impact is limited to the area around the water body; although, the waves can cause erosion, flooding, and damage or destroy earthen dams and levees. Shallow marine thrust earthquakes that displace the seafloor are the most likely combination of factors to cause a tsunami; however, major strike-slip earthquakes have occasionally triggered small tsunamis (United States Geological Survey). Tsunamis and their potential impact on CTCLUSI's Service Area are discussed further in Section 12. Service Area risks from flooding, coastal erosion, and SLR are in Section 8.

#### 6.3.2 Cascading impacts

An earthquake and the secondary hazards can cause further cascading impacts. The shaking ground from a seismic event can directly damage or destroy structures and infrastructure with the ground's movement. Horizontal seismic motion generally causes more damage to structures than vertical movement (United States Geological Survey). Surface ruptures, mass earth movements, and liquefaction can all directly cause structural damage to anything directly over or very near the ground displacement.

All types of earthquake impacts can affect CTCLUSI Citizens. Cascading effects can also directly and indirectly, impact the Service Area's properties and environment. Continuing cascading impacts from the structural damage caused by earthquakes and their secondary impacts. One, or a combination of, these impacts pose a risk of injury or death to people. These issues can include, but are not limited to:

- **Utility failures or outages:** electricity, sewer, stormwater, transportation routes, systems, etc.
- **Hazardous materials spill:** from storage facilities, along transportation routes, etc.
- **Fires:** caused by broken gas and/or power lines (primarily if broken water lines feed hydrants)

It is important to note that private, local, and State critical facilities and infrastructure, such as roads and utilities also are vulnerable to damage during an earthquake. Critical services would likely be disrupted following an earthquake. Damage to facilities storing hazardous materials is also a concern. During an earthquake, damage to hazardous materials storage facilities and containment structures can release these materials into the surrounding air, soils, and waters, potentially impacting Tribal lands and surrounding estuaries. Hazardous material risks to the Service Area are in Section 9.



## 6.4 Potential Impacts from Future Climate Conditions

The impacts of climate change on earthquakes is unknown; however, severe droughts, significant groundwater pumping from underground aquifers, and changes in reservoir levels have the potential to change stresses on the earth's surface and contribute to seismic activity. In 1975, several earthquakes occurred near the Oroville Dam after water in Lake Oroville was drawn down to its lowest level since it was initially constructed to facilitate repairs. Studies of these earthquakes concluded that fluctuations in water levels and corresponding changes in the weight of the reservoir changed stress loads on a nearby fault, triggering the earthquakes. While these studies and observations indicate a potential link between climate factors and increased earthquake activity, more research needs to be done to understand the full effects of climate change on earthquakes (Buis, 2019).

Additionally, secondary hazards and cascading impacts from earthquakes can be magnified or increase the probability of occurrence due to climate change factors (Mauger, Lee, & Won, 2018). For example, earthquakes can instigate fires, as indicated in the section above; this could lead to a significant wildfire event if it is compounded by climate change-influenced droughts. In addition, after an earthquake, mass earth movements may be more likely due to climate change, with increasing factors such as (Mauger, Lee, & Won, 2018):

- Increased wildfires depleting hillside vegetation
- Soil saturation from unusually high precipitation level
- Changes in river hydrology from more frequent and/or intense severe weather
- Weakened coastal slope stability due to SLR
- Increase the extent of tsunami inundation zones

## 6.5 Exposure and Vulnerability

As shown in Figure 6-2, the CTCLUSI Service Area intersects with the CSZ, this exposes the entire area to a potentially catastrophic earthquake and Tribal Citizens and properties exposed to a CSZ earthquake.

### 6.5.1 Population

#### Exposure

The entire population within the CTCLUSI Service Area is exposed to earthquakes. Additionally, transportation corridors, bridges, and utility corridors along the coast can be damaged, potentially isolating Tribal Citizens. Table 6-6 shows Tribal Citizens exposed to perceived ground shaking.

*Table 6-6. Exposure to Ground Shaking During a Great Subduction Earthquake (United States Geological Survey)*

Perceived Ground Shaking (Potential Damage)	Peak Ground Acceleration (PGA) in Percent Gravity	Population
<b>Strong (Light Damage)</b>	10 – 15	31
<b>Strong – Very Strong (Light – Moderate Damage)</b>	15 – 20	88
	20 – 25	31
	25 – 30	6
	30 – 35	32
<b>Severe (Moderate – Heavy Damage)</b>	35 – 40	103
	40 – 45	136
<b>Total</b>		<b>427</b>

### Vulnerability

The CTCLUSI's Service Area is in a region that is highly likely to experience the damaging effects of a great subduction earthquake. Nearly half of the Tribal Citizens are minors and those over 65 years of age. These vulnerable populations are at a higher risk during and after a significant earthquake as they may require extra care and resources.

#### 6.5.2 Property

##### Exposure

Property damage from a great subduction earthquake is likely to be severe and widespread. Tables 6-7 to 6-9 show the exposure of Tribal facilities, forest stands, and parcels to peak ground acceleration over 25 percent gravity during a great subduction earthquake. As shown in Tables 6-7 and 6-8, nearly all of the Tribes' facilities and parcels would be exposed to PGA greater than 25 percent gravity with very strong to severe shaking with potential moderate to heavy damage.

*Table 6-7. Exposure of Tribal Facilities to Earthquake Hazards*

Facility Type	Total Facilities	PGA > 25 Percent Gravity
Administration	4	4
Camp	11	11
Casino	3	3
Community	3	3
Housing	20	20
Lighthouse	1	1
Other	14	13
Ranch	3	3
<b>Total</b>	<b>59</b>	<b>58</b>

*Table 6-8. Exposure of Tribal Parcels to Earthquake Hazards*

Parcel Type	Total Parcels/Acreage	PGA > 25 Percent Gravity
Fee	51/430	51
Reservation	13/14,758	13
Trust	19/124	18
<b>Total</b>	<b>83/15,312</b>	<b>82</b>

Table 6-9 below indicates a total of 304 of the Tribes' timber stands are exposed to greater than 25 percent gravity and very strong to severe ground shaking. An earthquake may damage timber stands less; however, secondary hazards such as landslides can cause more damage and economic impacts.

*Table 6-9. Exposure of Forest Tracts to Earthquake Hazards*

Forest Tract	Total Stands	PGA > 25 Percent Gravity
Coos Head	1	1
Macy	1	1
Talbot	1	1
Tioga	133	133

Forest Tract	Total Stands	PGA > 25 Percent Gravity
Umpqua Eden	1	1
Upper Lake Cr.	118	19
Upper Smith	148	148
<b>Total</b>	<b>403</b>	<b>304</b>

### Vulnerability

All Tribal buildings and parcels may be exposed to some degree of ground shaking during an earthquake. The intensity depends on the earthquake magnitude and location of the epicenter. Facilities and parcels within tsunami inundation zones are also more vulnerable to an earthquake caused tsunami.

#### 6.5.3 Critical Facilities

Critical facilities for CTCLUSI include communication, maintenance, power, and water/wastewater facilities. Table 6-10 shows the exposure of these facilities to peak ground acceleration over 25 percent gravity in the event of a great subduction earthquake. As shown in the table, all of the Tribes' critical facilities are exposed to peak ground acceleration over 25 percent gravity and very strong to severe ground shaking. High hazard areas include Coos Bay and Florence. In Florence, the five critical facilities include two maintenance buildings, the substation, CTCLUSI's treatment plant, and the pump station. One critical facility, a maintenance facility, is located in Coos Bay.

*Table 6-10. Exposure of Tribal Critical Facilities to Earthquake Hazards*

Critical Facility Type	Total Number	PGA > 25 Percent Gravity
Communication	1	1
Maintenance	4	4
Power	1	1
Water/Wastewater	4	4
<b>Total</b>	<b>10</b>	<b>10</b>

### Vulnerability

All CTCLUSI facilities and critical facilities are exposed and vulnerable to a earthquake in the CSZ. Damage to these facilities during a major earthquake can result from the initial ground shaking and any secondary hazards and cascading impacts.

#### 6.5.4 Environment

Environmental effects resulting from an earthquake can be numerous and severe. Secondary hazards will likely have the most damaging effects on the environment; these include earthquake-induced landslides impacting the surrounding environment and changes to water quality and ground water systems. There is also a possibility that streams fed by groundwater sources will dry up because of changes in underlying geology. Additionally, hazardous materials released from facilities and transportation infrastructure can occur during an earthquake. For example, natural gas or oil pipelines may be damaged, releasing their contents into the surrounding soils, water, and air.

### 6.6 Development Trends

The most recent development has occurred on Tribal properties within the population centers of Florence, North Bend, and Coos Bay. According to the Tribes' 2010 Long Range Transportation Plan, limited future

development is planned in these areas and other Tribal properties near the coast (CTCLUSI 2010). These areas may be exposed to very strong to severe ground shaking during a great subduction earthquake or major crustal earthquake, and areas immediately along the coast may be exposed to tsunami hazards. Enforcement of Tribal and State building standards and seismic performance measures will reduce the vulnerability of new development and Tribal Citizens to earthquake hazards.

### 6.7 Issues

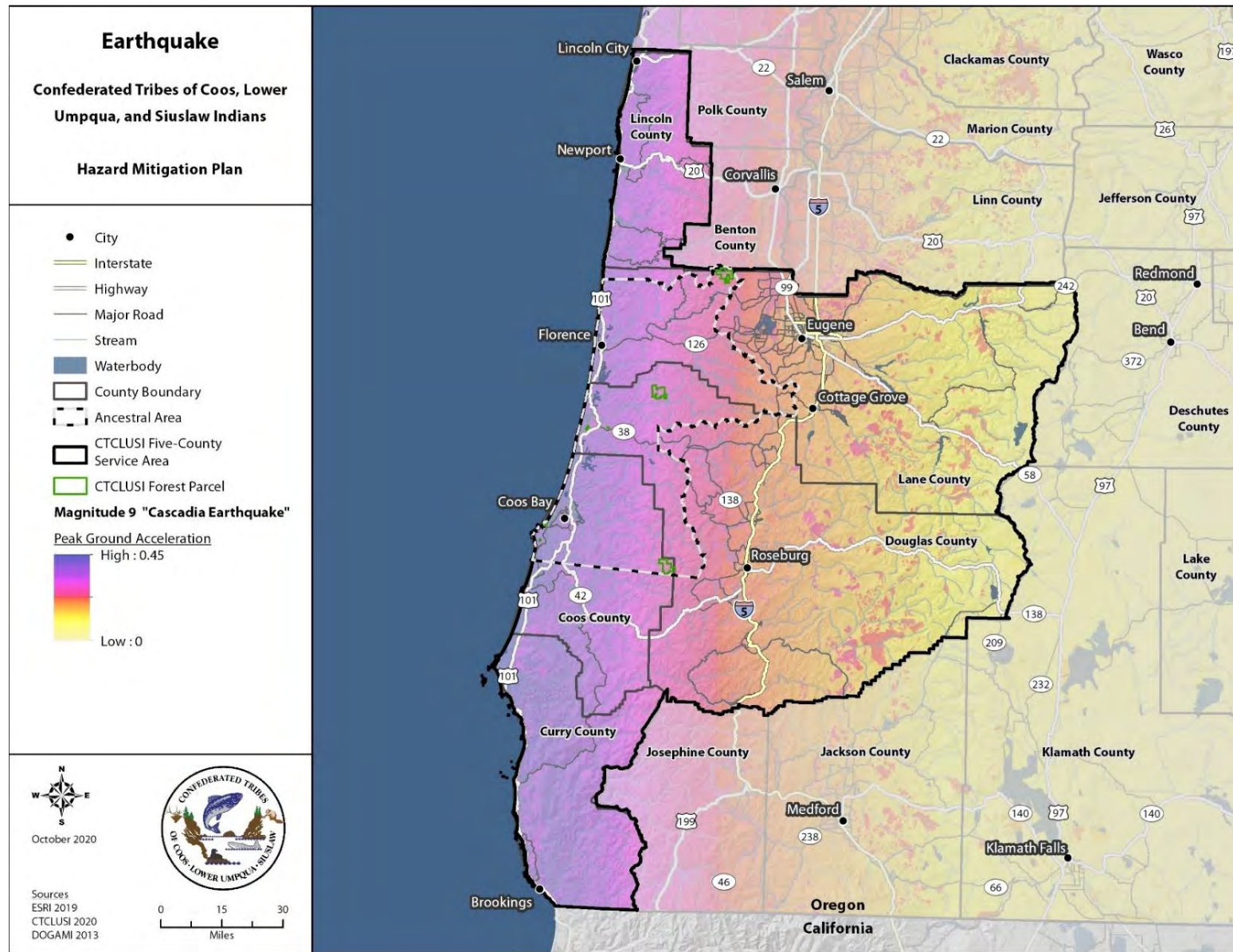
Issues associated with an earthquake include but are not limited to the following:

- A need to increase public education and resources related to earthquake preparedness, including hazard areas for tsunamis and liquefiable soils, home and business retrofits, and emergency kits for homes, workplaces, and cars.
- Earthquakes can trigger other natural hazards such as mass earth movements, wildfires, or tsunamis, which would impact Tribal Citizens and properties.

### 6.8 Hazard Maps

The earthquake hazard map is in Figure 6-4 on the next page.

Figure 6-5. Earthquake Zones Map





## 7 Epidemic/Pandemic

### 7.1 General Background

Infectious diseases significantly contribute to illness, disability, and death (Office of Disease Prevention and Health Promotion, 2020). Over the last few decades, outbreaks, epidemics, and pandemic events have increased, spreading faster and farther; this includes re-emerging diseases and recently discovered diseases (World Health Organization, 2018). An epidemic is a significant and unexpected increase in disease cases. An outbreak is like an epidemic, but it is limited to a geographic area or group. Pandemics occur when a disease crosses multiple countries and infects a large number of people. For example, COVID-19 started in China in 2019 and spread rapidly across the world, resulting in a global pandemic from 2019 to 2021 (Centers for Disease Control and Prevention, 2020).

Infectious disease-causing agents can be viruses, bacteria, parasites, fungi, or parasites (Mayo Clinic Staff, 2019). Communicable diseases can be spread by direct contact from animal to person or person to person, indirect contact by touching a contaminated surface or object, insect bites, contaminated food or water, or inadequate medical sanitation (Mayo Clinic Staff, 2019). Chemicals or toxins can also cause outbreaks, such as “Jamaican ginger paralysis,” and on occasion, the cause of a disease is unknown (World Health Organization).

An individual can be at risk from an infectious disease or chemical/toxic agent from ingestion, inhalation, or direct skin contact; radiation is the only exposure that can be external, traveling to the individual (Agency for Toxic Substances and Disease Registry, 2005). Some agents have multiple means of spreading, others only by bodily fluids.

Infectious diseases can be seasonal, such as influenza. In contrast, others may be rare but have a high mortality rate, like Ebola and hemorrhagic fevers (Cole, 2014). Some diseases occur after a disaster due to contaminated food and water, such as E. coli (Centers for Disease Control, 2019). Unfortunately, it is rare to eradicate diseases, and new ones are continually discovered (World Health Organization, 2018).

#### 7.1.1 Potential Impacts from Epidemic/Pandemics

Epidemics and pandemics can significantly impact mortality rates, social and mental health, the economy, and disrupt travel operations (Madhav, et al., 2017). Diseases and mortality rates can disproportionately affect vulnerable populations. These populations can include younger people who have not built up

### DEFINITIONS

**Communicable Disease:** An illness transmitted from an infected agent to an animal or individual through direct or indirect contact.

**Disease Vector:** An agent that carries and transmits infectious diseases, such as an insect, fungus, or animal.

**Epidemic:** Happens when there is a significant and unexpected increase in disease cases.

**Essential Workers:** Individuals that work in roles that are critical to infrastructure operations.

**Herd Immunity:** When enough of the population becomes resistant to a disease by recovering from the illness or vaccination.

**Infectious Diseases:** Medical conditions/illnesses caused by organisms like bacteria, viruses, fungi, or parasites.

**Mortality Rate:** A mathematical measure of the frequency that individuals die in a defined population during a specific period of time.

**Outbreak:** Similar to an epidemic but limited to a specific geographic area or group of people.

**Pandemic:** Occur when a disease crosses multiple countries and infects a large number of people.

immunity, older individuals and people with underlying health conditions that lower their immune systems, and low-income or non-citizens who do not have access to affordable medical care (Madhav, et al., 2017). The disproportional impact can exacerbate the over-taxed emergency response and healthcare communities. A single outbreak can overrun a local emergency response and healthcare systems' resources and staff. Additionally, overwhelmed medical facilities reduce non-infectious disease medical and mental care (Bloom, Cadarette, & Sevilla, 2018).

An infectious disease event can also have societal impacts that affect individuals and the economy. Infection control measures can temporarily close schools and businesses and reduce transportation and public services (Bloom, Cadarette, & Sevilla, 2018). These measures and infectious diseases can cause general stress to an affected community and more severe mental health issues for some individuals. The stress can trigger concerns about a person or loved one's health, changes in sleep and eating, difficulty sleeping or concentrating, chronic medical and/or mental health problems increasing, and increased use of mood-altering substances (e.g., tobacco, alcohol, illegal drugs) (Centers for Disease Control, 2020).

## 7.2 CTCLUSI Hazard Profile

Epidemics, pandemics, and disease outbreaks do not need to start in the Service Area to affect the Tribes. The Service Area's neighboring cities, including Eugene, along the coast and in the Willamette Valley, visitors to the region, and everyday social interactions between Tribal Citizens and members of surrounding local communities could introduce diseases into the Tribe. The entire Service Area is at risk from known-preventable diseases and newly introduced or reemergent diseases that do not have vaccines yet. Childhood vaccination percentages are a strong indicator of community resilience to known-preventable diseases and a cost-effective method for preventing these dangerous diseases (Office of Disease Prevention and Health Promotion, 2020). Orange County's childhood vaccination statistics are a good representation of vaccine percentages in the Service Area.

Decreases in vaccination rates can also increase community vulnerability to diseases that may cause epidemics/pandemics. In the State of Oregon, 93 percent of students in kindergarten through 12<sup>th</sup> grade had received all required vaccines in 2019, while 5.6 percent had a nonmedical exemption, and 0.1 percent had a medical exemption. County nonmedical exemption rates for students in kindergarten through 12<sup>th</sup> grade ranged from 1 percent in Morrow County to 11 percent in Josephine County. There were 108 schools with ten or more students that had zero nonmedical exemptions. The highest nonmedical exemption rate in a school with ten or more students was 80 percent (Oregon Public Health Division, 2020).

In 2013, Oregon had the highest kindergarten vaccine exemption rate in the US. In 2015, the first year post-implementation of the new 2013 law, Oregon's kindergarten nonmedical exemption rates increased each year up to 7.5 percent in 2018. In 2019, the rate leveled off at 7.5 percent (Oregon Public Health Division, 2020). Overall school state non-medical exemption (NME) rate from 2019 is at 5.6 percent (Oregon Public Health Division, 2020):

- Curry County: has the highest at 9.0%
- Douglas County: 5.7%
- Lane County: 5.6%
- Coos County 4.1%
- Lincoln: with the lowest rate at 3.7%



Localized disease outbreaks also can be caused by contaminated food and environmental factors. Outbreaks of salmonella and other gastrointestinal pathogens have been linked to imported foods. Warmer than usual water can contribute to more bacterial growth in ocean waters, contaminating shellfish and increasing chances of an outbreak (Washington Emergency Management Division, 2018).

### 7.2.1 Hazard Ranking

The Emergency Management Team completed a hazard ranking survey during the CTCLUSI 2022 HMP update process and assessed hazard-related factors based on worst case and most likely scenarios. Hazard definitions and ranking factors are in Table 5-1. Survey results were prioritized and ranked based on their averaged score. The severity, magnitude, frequency, onset, and duration variables are scored one to five, where one is the lowest and five is the highest. Compared to the other hazards in the survey, epidemics/pandemics are the second worst-case scenario and sixth most likely scenario.

Table 7-1. Epidemic and Pandemic Hazard Ranking Output

Severity	Magnitude	Frequency	Onset	Duration	Average	Rank
<b>Worst-Case Scenario</b>						
4.75	5.00	3.75	4.00	4.75	4.45	2
<b>Most Likely Scenario</b>						
2	3.25	1.75	1.75	3.25	2.4	6

### 7.2.2 Past Events

Historically, tribes in the Service Area were significantly affected by epidemics and pandemics of European diseases against which they had no developed immune response. Contagious diseases such as smallpox, measles, and influenza circulated throughout initial contact with European settlers to the region and resulted in high rates of death that devastated tribes. Some European illnesses, such as tuberculosis, became endemic and affected tribes into the 1900s (Center for the Study of the Pacific Northwest). Since 2000, communities in Oregon have been affected by three recorded epidemics and pandemics, the novel strain of the influenza virus (H1N1), pertussis (or whooping cough), and COVID-19.

#### COVID-19

During the timeframe of this HMP update, the world was experiencing the novel corona virus 2019 (COVID-19) pandemic. An in-depth review of COVID-19, its effects, and lessons learned will be included in the 2026 HMP update.

In 2009 and 2010, H1N1 a caused the first influenza pandemic of the 21<sup>st</sup> century. Influenza, or the flu, is characterized by fever, cough, sore throat, headache, muscle aches, and fatigue. While the flu is endemic to many populations, flu seasons can be severe, and the emergence of new strains increases the likelihood of an outbreak or epidemic/pandemic. The H1N1 pandemic resulted in increased deaths from the flu and a more significant than expected number of deaths among people younger than 65. Nearly 90 percent of deaths resulting from H1N1 occurred among people younger than 65. In Oregon between April 2009 and May 2010, 1,315 flu hospitalizations and 67 flu-associated deaths (Oregon Health Authority Public Health Division, 2010).

In 2010, an epidemic/pandemic of pertussis was recorded in Oregon, with 285 reported cases. Because pertussis often goes undiagnosed in children and adults, the actual number of cases was likely much higher. Pertussis is a highly contagious, acute infection of the respiratory tract caused by the *Bordetella pertussis* bacteria. The disease is most severe in infants and young children, who can experience intense

coughing ending in a characteristic “whoop.” Despite immunization, pertussis remains endemic in the United States, and epidemic/pandemics occur on average every three to five years. During the 2010 epidemic/pandemic, 46 cases of pertussis were reported in infants. One-third of these cases required hospitalization; however, no infants died of the disease (Oregon Health Authority Public Health Division June 2011).

Cases of pertussis in the State have been rising over the last several decades. A pertussis epidemic was recorded with 910 cases in Oregon in 2012; it is the highest number of annual cases reported since 1953. While the total number of State cases decreased in 2013, large community pertussis outbreaks were recorded in Klamath, Josephine, Lane, and Coos counties (Oregon Health Authority Public Health Division, 2014).

Oregon state and local health departments investigated 349 acute and communicable disease outbreaks in 2018, down 15 percent from 409 in 2017 (Oregon Health Authority, 2018):

- Calicivirus gastroenteritis outbreak: 104 cases
- Foodborne outbreaks: 27 cases
- Respiratory outbreaks: 137 cases
- Person-to-person transmission outbreaks: 116 cases
- Animal contact outbreaks: 2 cases
- Waterborne outbreak: 1 case
- Other mode of transmission outbreaks: 4 cases
- Transmission was undetermined outbreaks: 62 cases
- Sharing of respiratory secretions caused outbreaks:
  - influenza: 100 cases
  - pertussis: 12 cases
  - respiratory syncytial virus: 10 cases
  - measles: 2 cases

Although these outbreaks did not reach epidemic or pandemic levels, there is a chance that any outbreak can become an epidemic or pandemic if it is not quickly caught and properly treated.

#### 7.2.3 Location

All Tribal Citizens are susceptible to epidemics and pandemics. Diseases can spread from outside the region to affect CTCLUSI Citizens in and outside of the Service Area. While it is difficult to anticipate where an epidemic or pandemic may spread, contact tracing is helpful for mapping out the locations and persons infected with a contagious disease. New techniques with statistical modeling and analysis of the factors contributing to the spread of a virus can potentially give some advanced warning of locations that may be affected (Oregon Health Authority Public Health Division, 2019).

#### 7.2.4 Frequency

Historical events indicate that epidemics and pandemics are happening more frequently and spreading farther over the past century. This increase is likely due to multiple factors, such as increased global travel, economic globalization, urbanization, and increased population growth in natural environment areas (Madhav, et al., 2017). The probability of an epidemic or pandemic occurring is increasing due to many factors, including globalization, air travel, population growth, and climate change.

On the other hand, the frequency of epidemics and pandemics in a local area is difficult to establish. In the past 20 years, the state of Oregon has experienced four historical epidemics or pandemics, including the COVID-19 pandemic in 2020. Based on these recent occurrences, CTCLUSI may be affected by epidemics or pandemics on average once every five years.

### 7.2.5 Severity

The severity of an epidemic or pandemic varies for numerous reasons, such as how it is transmitted (e.g., airborne or skin-to-skin contact), how contagious the disease is, how long it can live on surfaces, and how long an individual is contagious before showing symptoms. The CDC's Pandemic Severity Index describes a loss of life in five categories:

- **Category 1:** less than 90,000
- **Category 2:** 90,000 < 450,000
- **Category 3:** 450,000 < 900,000
- **Category 4:** 900,000 < 1.8 million
- **Category 5:** > 1.8 million

Figure 7-1. CDC Workplace and Community Recommendations by Pandemic Severity Category (Centers for Disease Control)

Interventions by Setting	Pandemic Severity Index		
	1	2 and 3	4 and 5
<b>Workplace/Community</b>			
<b>Adult social distancing</b>			
–decrease number of social contacts (e.g., encourage teleconferences, alternatives to face-to-face meetings)	Generally not recommended	Consider	Recommend
–increase distance between persons (e.g., reduce density in public transit, workplace)	Generally not recommended	Consider	Recommend
–modify, postpone, or cancel selected public gatherings to promote social distance (e.g., stadium events, theater performances)	Generally not recommended	Consider	Recommend
–modify workplace schedules and practices (e.g., telework, staggered shifts)	Generally not recommended	Consider	Recommend

The Centers for Disease Control (CDC) has provided category-specific actions to mitigate the severity of a pandemic/epidemic (Figure 6-1). Additionally, the CDC developed a Pandemic Severity Assessment Framework (PSAF) for public health officials to determine the seriousness of an infectious disease (Centers for Disease Control, 2016). There are two steps for health officials to follow, an initial assessment early on during a pandemic and a refined evaluation that happens when more information becomes available (Centers for Disease Control, 2016). The federal, state, and local public health agencies will provide instructions to all organizations and individuals based on the severity of a pandemic and the infectious diseases' transmission methods.

### 7.2.6 Warning Time

Warning time for an epidemic or pandemic varies between a few hours to a few months, depending on the disease type, CTCLUSI's proximity to the outbreak's origin, and the disease's contagious properties. The CDC explains that an outbreak will often start in countries with little medical resources. Then highly contagious diseases can spread from remote communities to major urban areas around the globe in as little as 36 hours, growing from a localized outbreak to a pandemic (Centers for Disease Control, 2020).

To manage potential pandemics in the initial phase, the CDC operates the Health Alert Network (HAN) to share public health information. The network is accessible to government and tribal organizations and furnishes critical data to plan and respond to public health issues (Centers for Disease Control, 2020). The CDC sends and receives vital epidemic and pandemic data from state and local public health departments.

## 7.3 Secondary Hazards and Cascading Impacts

### 7.3.1 Secondary Hazards

There are no apparent secondary hazards that an epidemic or pandemic could cause. However, epidemic/pandemics can interfere with mitigation actions for other risks. For example, organizations may prioritize prevention methods and emergency response actions during a concurrent natural hazard or natural hazard season (Quigley, Attanayake, King, & Prideaux, 2020). Organizations may need to balance difficult decisions between pandemic control and protective measures and natural hazard prevention, such as clearing dry vegetation for wildfire fuel management. For example, an epidemic/pandemic can challenge fuel load management to mitigate wildfires due to reduced on-site staff capacity.

Services provided by the CTCLUSI have been disrupted as a result of the COVID-19 pandemic. For example, regular controlled burns to manage fuel loads around the Tribes' critical infrastructure have been canceled to manage risks to the personnel involved in these operations.

### 7.3.2 Cascading Impacts

Like secondary hazards, cascading impacts may result from diminished staff capacity. Impacts caused by an epidemic, pandemic, or outbreak can be economically damaging, reducing workforce and labor hours. Due to unemployment or high absenteeism, reductions in the workforce can also cause disruptions in services such as transportation and supply chains, resulting in shortages of food, water, medical resources, or other supplies and materials.

## 7.4 Potential Impacts from Future Climate Conditions

Climate and land use are significant factors influencing where disease-carrying insects live (Centers for Disease Control, 2020). Even slight temperature differences affect where insect populations live and what diseases they carry. Insects such as fleas, ticks, and mosquitoes can carry diseases like Lyme, West Nile, malaria, Zika, etc. Temperature increases predicted for the Service Area are in Section 9.

As temperatures in the Service Area rise, these insects carrying diseases will likely migrate in increasing numbers. There are also ideal temperatures where certain diseases effectively spread; malaria spreads best at 78 degrees and Zika at 84 degrees (Jordan, 2019). The World Health Organization (WHO) identified potential climate change factors that would increase the number of infectious disease outbreaks and types of diseases that could occur in the Service Area (World Health Organization):

- Increased use of dams, canals, and irrigation to manage water flow changes can increase the risk of schistosomiasis, malaria, and helminthiasis
- As annual average temperatures change, new agricultural areas can succumb to infestation, increasing the risk of malaria and Venezuelan hemorrhagic fever
- Deforestation and populations spreading into wildland interurban areas can cause a rise in insect populations bringing malaria, oropouche, and visceral leishmaniasis
- Conversely, reforestation to combat tree loss can increase the risk of Lyme disease

## 7.5 Exposure and Vulnerability

### 7.5.1 Population

All Tribal Citizens and local community members are exposed when they come into contact with infectious diseases. A widespread or highly infectious epidemic or pandemic with a high morbidity rate could have devastating effects on CTCLUSI. People with compromised immune systems, children, and elders are

especially vulnerable to infectious diseases making them more likely to contract the disease and subject to more severe symptoms.

#### 7.5.2 Property

Epidemics and pandemics do not typically impact property directly. However, secondary impacts on the economy and persons can influence property management and operations, such as epidemics/pandemics, making hazard prevention methods more challenging, as discussed in Section 6.3.1. Adjustments can be made to existing buildings and new projects, such as improving Heating Ventilation and Air Conditioning (HVAC) system ventilation and air filtration, increase cleaning and sanitizing procedures and frequency, allowing more space for social distancing, and delaying construction projects (Megahed & Ghoneim, 2020). Additionally, CTCLUSI can consider situational adjustments for concurrent natural hazard prevention with epidemic/pandemic safety procedures.

#### 7.5.3 Critical Facilities and Infrastructure

During the COVID-19 pandemic, CTCLUSI implemented safety accommodations to reduce exposure and spread risks for their facilities and citizens. The mitigation measures did not require significant changes to the structures. CTCLUSI can consider building these epidemic and pandemic safety measures, such as updated HVAC systems, into future developments where applicable.

### 7.6 Development Trends

Epidemics and pandemics can significantly impact development and community growth, although the impacts are likely temporary, lasting only as long as the infectious disease continues to spread (Derven, 2020).

### 7.7 Issues

Pandemic and Epidemic considerations in the Service Area:

- CTCLUSI can provide or support the state and counties with preventative healthcare education, including vaccinations
- A system should be established to inform the Tribal Citizens of the risks, using clear messages and facts about the disease, spread, prevention, testing, and care facilities and options
- COOPs can include procedures for epidemics and pandemics, considering critical workers, remote work, social distancing, Personal Protective Equipment (PPE), and other measures as appropriate

### 7.8 Hazard Maps

There is no spatial data available for epidemics/pandemics in the Service Area; therefore, there is no map.

## 8 Flood and Sea Level Rise

### 8.1 General Background

Floods are the most common hazard in the US, occurring when water overflows onto naturally or altered dry lands (Ready.gov, 2020). Climate change is the primary cause of SLR. Erosion is the natural process of removing surface ground material (soil, sand, rocks, etc.) from one area and transferring the material to another location, usually by wind or water (Editors of the Encyclopedia Britannica, 2020).

Rain, snow, coastal storms, storm surges, damaged dams and levees, or other damaged water control systems can all cause floods (Ready.gov, 2020). A flood can develop over time, such as during an unusually stormy season, or occur rapidly with little warning, like when a levee breaks and releases all the stored water at once. Depending on the extent of the event that triggers a flood, effects can be localized to a single neighborhood or block or extend as far as an entire region affecting multiple states.

Riverine flooding and urban drainage can cause flash floods, depending on the geography and the event triggering the flood. It is the most dangerous type of flood due to the high water flow velocity and large debris the water can carry (Federal Emergency Management Agency).

Flooding categories include (Federal Emergency Management Agency):

- **Riverine Flooding:** This happens when water overtops the banks of a river, lake, or stream and spills onto the adjacent land and is the most common type of flooding. Typically caused by excessive or prolonged rains and can include flash floods, dam and levee failures, and alluvial fan flooding.
- **Urban Drainage:** A physical and natural system used to eliminate surface water and stormwater runoff as quickly as possible by directing it into closed water management systems. Flooding can happen when these systems back up or when the incoming water exceeds the system's capacity.
- **Coastal Flooding and Cliff Erosion:** Floods occur by seawater and coastlines, often caused by severe weather events. When a coastal flood coincides with a high tide, it is called a storm surge. Strong waves from storms can significantly increase the rate of cliff erosion.
- **Ground Failures:** Subsidence and liquefaction can cause flooding in the immediate area, while mass earth movements can release or carry water with a mudslide, mudflow, or debris flow. These mass earth movements with flooding can be exceptionally damaging due to the water and ground material's force and the debris they can carry.

### DEFINITIONS

**100-Year Floodplain:** An area inundated by a flood with a 1 percent chance of being equal or greater each year.

**500-year Floodplain:** An area inundated by floodwaters that has a 0.2 percent chance of being equal or greater each year.

**Coastal Flood:** Occur by seawater and coastlines, often due to severe weather events and cause coastline erosion.

**Flash Flood:** A rapid rise in water with a high flow velocity that carries debris. Flash floods have enough force to pull up and carry significant amounts of large debris (e.g., cars and trees).

**Floodplain:** An area of land neighboring a waterway or waterbody that is known to be flood-prone.

**Stormwater Management:** Physical and natural systems used by people to control and regulate the flow of surface and stormwater runoff.

**Storm Surge:** When a coastal flood happens at the same time as a high-tide, causing the coastal flood to reach farther and bring more water than it would during a lower tide.



- **Fluctuating Lake Levels:** This can be a seasonal process with standard weather patterns or caused by unusual heavy rainfalls.

SLR is affected by melting ice sheets and glaciers, and average annual temperatures bring an influx of water into the oceans, raising seawater levels (Administration, 2020). As sea levels rise, extreme coastal events (e.g., storm surges) can become more frequent and severe (Pörtner H. O., et al., 2019). Additionally, as SLR continues, water that connects to the oceans spreads farther inland, resulting in expanded fluvial flooding (Pörtner H. O., et al., 2019).

Erosion occurs when the movement of water removes the ground and carries it to another location. Water can erode coastlines, bluffs, cliffs above a waterway or body, along rivers and creeks, and anywhere the water movement can remove and transport loose material. The motion and force of sea waves along a coast can significantly alter the shore's shape (Editors of the Encyclopedia Britannica, 2020). Flooding can cause unexpected or increased erosion due to the force of the water's flow and water in unusual locations. Wind erosion is most common in deserts and arid lands where the wind picks up and moves loose ground material (Editors of the Encyclopedia Britannica, 2020).

#### 8.1.1 Potential Impacts from Floods and Sea Level Rise

Several factors influence the type and severity of flood damage, such as a floodwater's depth, length of time inundated, contents carried in the floodwater, and how rapidly the water moves (Federal Emergency Management Agency). Flood severity is discussed further in Section 8.2.5. Structures often suffer compounding damage the longer they are in the water; wood and carpet are especially susceptible. Structures in standing water can grow mold and fungi quickly and attract insects. These growths and insects can carry infectious diseases, which are covered more in Section 8.3.1. It can also be difficult to tell how deep the flood water is; cars can be submerged even by slow-moving water when it washes away the road or ground beneath.

Rapidly moving water carries momentum and force that can damage structures, infrastructure, and injure or cause loss of life from the water impact or the debris carried in the water. Even six inches of fast-moving water can knock a person down, and a foot of water can move a car (Ready.gov, 2020). Erosion and flooding can impact waterways, causing higher than normal water levels for extended periods, harming people, structures, and infrastructure.

## 8.2 CTCLUSI Hazard Profile

The CTCLUSI's Service Area is impacted by riverine flooding, flash flooding, and coastal flooding from high tides, wind-driven waves, and tsunami flooding. Low-lying areas adjacent to rivers and streams, bays, or the ocean are more susceptible to flooding, which can be intensified by high tides and expected SLR (United States Climate Resilience Toolkit, 2019).

- **Riverine Flood:** In the Service Area, this typically occurs in winter and late spring. The most severe flooding typically occurs between December and February and is caused by winter storms that bring heavy rain and warm temperatures and cause rapid snowmelt (State Interagency Hazard Mitigation Team, 2020). If soils are already saturated or the ground is frozen, most of this snowmelt drains into rivers and streams and can cause widespread flooding. As much as 4 to 6 inches of rain can fall in 24 hours over high elevations. Prolonged heavy rain can cause flooding along rivers and streams for three to four days or longer. Flooding can be particularly severe in low-lying coastal areas if riverine flooding

coincides with high tide or coastal storm surges (URS, 2006) (State Interagency Hazard Mitigation Team, 2020).

- **Coastal Flood:** Low-lying coastal areas are vulnerable to flooding from wind-driven waves during the winter, El Niño events, and during spring higher than average high tides. Strong winds and low pressure combined with high spring tides can cause elevated sea levels that come to shore (storm surge) in estuaries and other low-lying areas. Coastal flooding coupled with high tides or storm surges can lead to widespread and dangerous lowland flooding. The water in rivers and streams cannot discharge into the ocean when coastal water levels are elevated (URS, 2006) (State Interagency Hazard Mitigation Team, 2020).
- **Flash Flood:** Flash floods in the CTCLUSI's Service Area typically are caused by slow-moving storms that can generate a rapid rise in water levels in streams and other drainages that are generally dry or wildfire burn scars that are unvegetated. Flash floods can quickly reach high velocities and often carry debris as large as boulders or trees. They can strike a community with little to no warning, bringing up to 10 to 20 feet of water (URS, 2006).

The rate of SLR is predicted to increase in the future, globally and in the Service Area. As SLR continues, wave action at higher elevations along the coast increases coastal erosion. Constantly expanding erosion can threaten the integrity of dunes and other natural or built breakwaters that generally provide some protection to coastal homes and facilities. Infrastructure at the coast, such as Highway 101 and the Cape Arago Light Station in Coos Bay, is also more exposed to damage during coastal storms and high tides.

### 8.2.1 Hazard Ranking

The Emergency Management Team completed a hazard ranking survey during the CTCLUSI 2022 HMP update process and assessed hazard-related factors based on worst case and most likely scenarios. Hazard definitions and ranking factors are in Table 5-1. Survey results were prioritized and ranked based on their averaged score. The severity, magnitude, frequency, onset, and duration variables are scored one to five, where one is the lowest and five is the highest. Compared to the other hazards in the survey, flood and SLR are the seventh worst-case and third most likely scenarios.

*Table 8-1. Flood and Sea Level Rise Hazard Ranking Output*

Severity	Magnitude	Frequency	Onset	Duration	Average	Rank
<b><i>Worst-Case Scenario</i></b>						
2.5	4.25	4	3.5	4.5	3.75	7
<b><i>Most Likely Scenario</i></b>						
1.5	2.25	3	2.75	3.75	2.65	3

### 8.2.2 Past Events

Heavy winter rains and melting snow can combine to produce devastating floods because of the region's topography, proximity to the coast, and abundance of rivers and streams. The NOAA National Centers for Environmental Information recorded 719 flood events affecting the counties in the CTCLUSI's Service Area between 1970 and 2020 (National Oceanic and Atmospheric Administration). Numerous past events resulted in federal disaster declarations for the five counties in the Service Area, as shown in Table 8-2. Several of these highly destructive floods impacted Tribal properties as well.



*Table 8-2. Federal Disaster Declarations for Flood Events within the CTCLUSI's Five-County Service Area (Federal Emergency Management Agency, 2020)*

Year	Counties Affected	Event Type	Disaster Number
1964	Coos, Curry, Douglas, Lane, Lincoln	Heavy rains and flooding	DR-184-OR
1972	Coos, Douglas, Lane, Lincoln	Severe storms and flooding	DR-319-OR
1974	Coos, Curry, Douglas, Lane, Lincoln	Severe storms, snowmelt, and flooding	DR-413-OR
1996	Coos, Douglas, Lane, Lincoln	High winds, severe storms, and flooding	DR-1099-OR
1996	Coos, Douglas, Lane	Flooding, landslides, mudslides, high winds, severe storms	DR-1149-OR
1997	Coos, Douglas, Lane	Severe winter storms and flooding	DR-1160-OR
2006	Coos, Curry, Douglas, Lincoln	Severe storms, flooding, landslides, and mudslides	DR-1632-OR
2006	Lincoln	Severe storms, flooding, landslides, and mudslides	DR-1672-OR
2006	Lincoln	Severe winter storms and flooding	DR-1683-OR
2007	Coos, Curry, Lincoln, CTCLUSI	Severe storms, flooding, landslides, and mudslides	DR-1733-ORR
2011	Douglas, Lincoln	Severe winter storms, flooding, mudslides, landslides, and debris flows	DR-1956-OR
2012	Coos, Curry, Douglas, Lane, Lincoln	Severe winter storms, flooding, landslides, and mudslides	DR-4055-OR
2015	Coos, Curry, Douglas, Lane, Lincoln	Severe winter storms, straight-line winds, flooding, landslides, and mudslides	DR-4258-OR
2016	Lane	Severe winter storms and flooding	DR-4296-OR
2019	Coos, Curry, Douglas, Lane	Severe winter storms, flooding, landslides, and mudslides	DR-4432-OR
2019	Douglas, Curry	Severe storms, flooding, landslides, and mudslides	DR-4452-OR

In December 1964, nearly every river in the state exceeded its flood stage following record precipitation. The Christmas Flood triggered debris flows, bridge failures, and flooding that caused thousands to evacuate and closed airports, railways, and hundreds of miles of roads across the state. Widespread flooding caused more than \$157 million in damage and killed 20 people (URS, 2006).

The winter storms of 1996 and 1997 resulted in heavy damage across Oregon, including the CTCLUSI's Service Area. In February 1996, almost every county in the state received a disaster declaration due to a combination of warm temperatures, heavy snowpack, and four days of record-breaking rain. Many areas had already received above-average rainfall, meaning that rivers were at or were reaching their flood stages. Flooding and landslides destroyed hundreds of homes, caused widespread power outages, and caused thousands of people to evacuate to public shelters. Five people died due to this flooding event, and estimated flood-related damage exceeded \$1 billion (URS, 2006).

Beginning in November 1996 and continuing into January 1997, record-breaking precipitation again caused extensive flooding and landslides that caused power outages, damaged homes and businesses, and closed roads. The flooding resulted in a federal disaster declaration (URS, 2006). A severe winter storm in January 2012 caused riverine flooding, landslides, and mudslides in Coos, Curry, and Lincoln counties. Later that year, in November, heavy precipitation caused riverine and surface water floods that caused over \$4 million in damages to Curry and Josephine counties (State Interagency Hazard Mitigation Team, 2020).

### 8.2.3 Location

Flooding frequently occurs in the CTCLUSI's Service Area during periods of heavy rainfall. Rivers and streams subject to flooding are listed in Table 8-3. Figure 8-2 shows mapped 100-year and 500-year floodplains in the Service Area. The entire Pacific coastline, including bays and estuaries, is vulnerable to coastal flooding and erosion.

*Table 8-3. Rivers and Streams within the CTCLUSI's Five-County Service Area Subject to Flooding (University of Oregon, Community Service Center, & Oregon Partnership for Disaster Resilience, 2016) (Douglas County Planning Department and Emergency Management, 2016) (Lane County Hazard Mitigation & Emergency Management Steering Committee, 2018)*

County	River/Stream
<b>Coos</b>	Coquille River, Willicoma River, Ten Mile Creek, Palouse Creek, Larson Creek, Pony Creek, Kentucky Slough, Coalbank Slough, and the Willanch Slough
<b>Curry</b>	Chetco River, Elk River, Pistol River, Rogue River, Sixes River, Winchuck River, and Hunter Creek
<b>Douglas</b>	South Umpqua River, North Umpqua River, Umpqua River, Deer Creek, Cow Creek, Steamboat Creek, Calyapooya Creek, Elk Creek, Lookingglass Creek
<b>Lane</b>	Willamette River (Main Stem, Middle, and Coast Forks), McKenzie River (including the South Fork), Siuslaw River (including the North Fork), Row River, Lake Creek, Mohawk River, Long Tom River, Fall Creek, Little Fall Creek, Camp Creek, Horse Creek, Coyote Creek, Mosby Creek, Poodle Creek, Siltcoos River, and Tenmile Creek
<b>Lincoln</b>	Salmon River, Siletz River, Yaquina River, Alsea River, Little Elk Creek, Big Creek, Depoe Creek/Slough, Devils Lake, Drift Creek, Olalla Creek/Slough, Red River, Schooner Creek, Siletz Bay, and Yachats River

Figures 8-3 through 8-10 shows CTCLUSI's vulnerability to projected SLR zoomed into a observable scale for Lincoln County, Newport, Lane County, Douglas County, Coos Bay, southern Coos County and northern Curry County, central Curry County, and southern Curry County. These maps are based on a predicted SLR of 1 foot by 2040 and 2 feet by 2060. The Siuslaw River at lower elevations near Florence is expected to be significantly affected by SLR. In Coos Bay and North Bend, SLR is predicted to impact Pony Slough, islands in Coos Bay and the northern shoreline of the Eastside district, and a bay tributary that borders the city to the southeast. Additionally, SLR affects the rivers and streams east and south of these communities.

Based on NOAA data, predicted SLR is expected to affect areas of the river shoreline that are primarily undeveloped. However, developed properties immediately along the river shoreline may be affected by increased erosion. While no Tribal facilities are in projected inundation areas, facilities including the Tribes' treatment plant and pump station and the Qaich housing community may become more exposed to damage from flooding and coastal storms as sea levels continue to rise.

#### 8.2.4 Frequency

Flooding in the CTCLUSI's Service Area occurs the most often during the rainy season, from November through February. Flooding can also occur annually based on past events within the CTCLUSI's Service Area over the past 50 years (between 1970 and 2020). Flood events that cause extensive damage are less frequent. Based on federal disaster declarations within the Service Area since 1953, widespread, severe flooding is likely to occur approximately once every three years.

La Niña and El Niño cycles in the Pacific Ocean can influence the occurrence and severity of flooding along the Oregon coast. La Niña conditions tend to increase the frequency and intensity of storm events in the Pacific Ocean that can cause flooding along the Oregon coast. El Niño conditions are known to temporarily raise sea levels and increase the frequency and extent of lowland flooding along the Oregon Coast (URS, 2006). La Niña and El Niño are opposite phases of a global climate pattern across the Pacific Ocean and occur on average every three to seven years (National Oceanic and Atmospheric Administration Climate.gov Staff, 2016).

SLR which will increase flooding, is currently occurring at varying rates worldwide. This rate is expected to increase as the rate of ice loss from the Greenland and Antarctic ice sheets increases (Pörtner H. O., et al., 2019). The faster rates of ice loss and increased thermal expansion in the world's oceans are expected to cause an additional six inches of SLR in the next 16 years and result in SLR on Oregon's coast (SeaLevelRise.org).

#### 8.2.5 Severity

The severity of flooding depends on the amount, velocity, and area covered by the water's inundation. FEMA states that rivers are the most common source and often costliest type of flooding (Federal Emergency Management Agency). Heavy rains can build up vast amounts of water in the mountains and pick up incredible velocity down mountainsides, coastal cliffs, or other steep slopes (Federal Emergency Management Agency). This rapid influx of water can result in dangerous flash floods and debris/mudflows.

The National Weather Service (NWS) characterizes flood severity as (David Ford Consulting Engineers & Riverside Technology Inc., 2004):

- **Minor Flooding:** Minimal or no property damage, but possibly some public threat or inconvenience
- **Moderate Flooding:** Some inundation of structures and roads near streams and evacuations in high-hazard flood areas
- **Major Flooding:** Significant inundation of structures and roads with more extensive evacuations
- **Record Flooding:** Flooding which equals or exceeds the highest flood recorded at a location

#### 8.2.6 Warning Time

Flooding events can occur quickly or over days to weeks, and the warning time can range from a few minutes to a few days in advance depending on the flood's source. The cause of the flood dictates the length of warning time. For example, there is minimal warning time for flash floods, but slow-moving rainstorms can build up surface water over days and weeks, eventually resulting in flooding (Ready.gov, 2020). Alternatively, SLR and cliff erosion take years to accumulate significant impacts. The NWS issues watches, warnings, or advisories when flooding is possible or occurring.

Table 8-4 defines the different types of notifications. Riverine and coastal flooding can often be predicted based on forecasted weather conditions, existing water levels, and soil conditions. While conditions that

may produce flash floods can be predicted, it is difficult to predict the exact timing and location of a flash flood, which may develop within minutes. There are no emergency notifications for SLR or erosion.

*Table 8-4. National Weather Service Flood Watches, Warnings, and Advisories (National Weather Service)*

Notification	Description
<b>Flood Watch</b>	Conditions are favorable for flooding. A watch does not mean that flooding will occur, but flooding is possible.
<b>Flood Warning</b>	Flooding is imminent or occurring.
<b>Coastal Flood Watch</b>	Moderate to major coastal flooding is possible, potentially posing a serious risk to life and property.
<b>Coastal Flood Warning</b>	Moderate to major coastal flooding is imminent, posing a serious risk to life and property.
<b>Coastal Flood Advisory</b>	Minor or nuisance coastal flooding is occurring or imminent.
<b>River Flood Watch</b>	River flooding is possible at one or more forecast points along a river.
<b>River Flood Warning</b>	River flooding is occurring or imminent at one or more forecast points along a river.
<b>Flash Flood Watch</b>	Conditions are favorable for flash flooding. A watch does not mean that flash flooding will occur, but flooding is possible.
<b>Flash Flood Warning</b>	Flash flooding is imminent or occurring.

## 8.3 Secondary Hazards and Cascading Impacts

### 8.3.1 Secondary Hazards

Flooding, SLR, and cliff erosion can all cause secondary hazards. Slopes destabilized by water inundation can erode and result in mass earth movements (e.g., landslides, mudslides, and debris flow), particularly on steep slopes and in areas with less vegetation after a wildfire. Mass earth movements are discussed further in Section 10 of this plan. Structures exposed to water for a long time can be prone to growing mold, fungi, and attract insect populations. An outbreak or epidemic can occur due to infectious disease-carrying agents in contaminated water or food, increased insect populations that breed in waterways like creeks and ponds, and mold growing in damp structures. Epidemics and Pandemics are in Section 7.

### 8.3.2 Cascading Impacts

Floods can damage infrastructures such as roads, railroads, ports, docks, and other structures, disrupting transportation and other critical utilities and services. Traffic accidents as a result of flooding also can result in road closures and transportation disruptions. Major floods can cause economic impacts during the recovery period if businesses are temporarily or permanently displaced and stock, materials, or resources are damaged or destroyed.

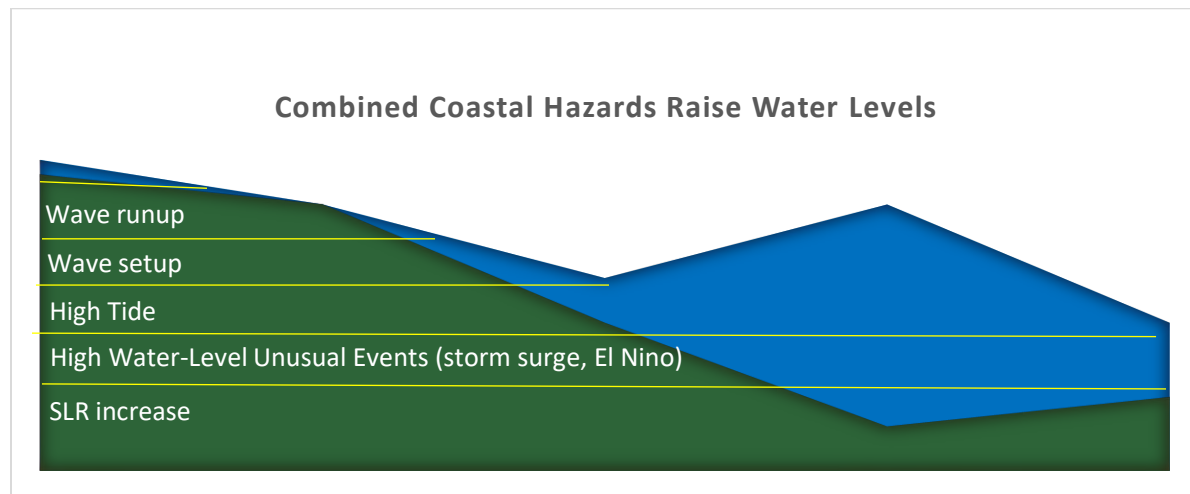
## 8.4 Potential Impacts from Future Climate Conditions

Climate change will likely escalate flood risks for CTCLUSI, including storm intensity and frequency that will expand flooding areas and depths (Hazen, 2019). It is expected to impact extreme precipitation events and extreme river flows, driven not only by increased precipitation but by other conditions like soil moisture, water table height, and snowmelt patterns. More frequent and severe storms will also raise the risk of river flooding and associated secondary hazards in the Service Area. Climate change's impact on storms and SLR combine to expand risks from coastal flooding and erosion.

NASA's 2018 research study conservatively predicts that by 2100, sea levels will increase by 26 inches due to climate change (Weeman & Lynch, 2018). On the other hand, SLR predictions vary even between government agencies depending on the climate modeling technology and data sets they use. Although the exact amount of SLR by year is impossible to predict, even a one-foot increase by 2100 will impact the Service Area, as shown in Figures 8-3 to 8-10. A two to three-foot increase would obviously be more significant, indicated by these SLR maps.

Any SLR caused by climate change will permanently expand coastal lines and flooding boundaries, and further erode land along the coast. While the projected likelihood of extreme precipitation and extreme river flows varies by region, some degree of increase is expected across Oregon. Additionally, the Pacific Ocean can produce significantly high waves during storms; in conjunction with SLR and/or heavy precipitation, storms can easily lead to 100-year storm surge inundation levels. An example of combined water-level events is in Figure 8-1 below.

*Figure 8-1. Example of Water-Levels with Combined Coastal Hazards*



## 8.5 Exposure

### 8.5.1 Population

Table 8-5 shows the number of Tribal Citizens residing in mapped floodplains, and Table 8-6 lists populations at risk from predicted SLR. 5.4 percent of all Tribal Citizens reside in mapped 100-year floodplains. An additional 2.3 percent of Tribal Citizens are in mapped 500-year floodplains. It is important to note that residents within the 100-year floodplain also would be exposed to a 500-year flood.

*Table 8-5. Tribal Citizens Residing in Mapped Floodplains*

Floodplain		Population	
100-Year Floodplain		23	
500-Year Floodplain		10	
None		393	
Total		426	

Table 8-6. Tribal Citizens in Predicted Sea-Level Rise Inundation Zones

Predicted SLR	Population
1 Foot	3
2 Feet	4
<b>Total</b>	<b>7</b>

### Vulnerability

Vulnerable groups such as the elderly, young children, and low-income households can be disproportionately impacted by flood events. These communities could have limited access to personal vehicles for emergency evacuation or live on properties without flood insurance. Additionally, economically vulnerable populations are less likely to have additional funds to make their dwellings flood-resistant (e.g., elevated or fortified), putting them at further risk. Flooded streets and transit delays can challenge the ability of public transit users to access employment, education, or healthcare.

#### 8.5.2 Property

Table 8-7 through 8-9 shows the exposure of Tribal facilities, forest tracts, and parcels to flood and SLR hazards. Only one Tribal facility, part of Camp Easter Seal, is located in a mapped floodplain. Because of its location, this camp facility also is vulnerable to predicted SLR between 2020 and 2040. Two forest stands, one at Coos Head and one at Umpqua Eden, are located within the 100-year floodplain; one stand at Umpqua Eden is exposed to a predicted SLR of 1 foot. No other stands are exposed to the predicted SLR of two feet by 2060.

While most existing facilities are outside of flood and SLR hazard areas, there are more Tribal parcels exposed to these hazards, listed in Table 8-9. GIS analysis indicates a total of 22 parcels, which is 26.5 percent of CTCLUSI's parcels, are within mapped 100-year floodplains. A total of 15 parcels are in areas exposed to a predicted SLR of 1 foot, and one parcel is exposed to a predicted SLR of 2 feet.

Table 8-7. Exposure of Tribal Facilities to Flood and Sea Level Rise Hazards

Facility Type	Total Facilities	100-Year Floodplain	SLR 1 Foot (2040)	SLR 2 Feet (2060)
Administration	4	0	0	0
Camp	11	1	1	0
Casino	3	0	0	0
Community	3	0	0	0
Housing	20	0	0	0
Lighthouse	1	0	0	0
Other	14	0	0	0
Ranch	3	0	0	0
<b>Total</b>	<b>59</b>	<b>1</b>	<b>1</b>	<b>0</b>

Table 8-8. Exposure of Forest Tracts to Flood and Sea Level Rise Hazards

Forest Tract	Total Stands	100-Year Floodplain	SLR 1 Foot (2040)	SLR 2 Feet (2060)
Coos Head	1	1	0	0
Macy	1	0	0	0
Talbot	1	0	0	0



Forest Tract	Total Stands	100-Year Floodplain	SLR 1 Foot (2040)	SLR 2 Feet (2060)
Tioga	133	0	0	0
Umpqua Eden	1	1	1	0
Upper Lake Cr.	118	0	0	0
Upper Smith	148	0	0	0
<b>Total</b>	<b>403</b>	<b>2</b>	<b>1</b>	<b>0</b>

Table 8-9. Exposure of Tribal Parcels to Flood and Sea Level Rise

Parcel Type	Total Parcels/Acres	100-Year Floodplain	SLR 1 Foot (2040)	SLR 2 Feet (2060)
Fee	51/430	11	9	1
Reservation	13/14,758	6	4	0
Trust	19/124	5	2	0
<b>Total</b>	<b>83/15,312</b>	<b>22</b>	<b>15</b>	<b>1</b>

### Vulnerability

A GIS analysis estimated which structures would be affected by flooding, looking at flooding depth and the type of structure. The analysis is summarized in Tables 8-7 to 8-9, show the 100-year and 500-year flood risks for facilities, forest tracts, and parcels. Additionally, Tribal properties and their contents are vulnerable to damage or destruction during floods.

#### 8.5.3 Critical Facilities

Critical facilities and infrastructure for CTCLUSI include communication, maintenance, power, and water/wastewater facilities. Table 8-10 shows the exposure of these facilities to flooding and SLR hazards.

Table 8-10. Exposure of Tribal Critical Facilities to Flood and Sea Level Rise Hazards

Critical Facility	Total Number	100-Year Floodplain	SLR 1 Foot (2040)	SLR 2 Feet (2060)
Communication	0	0	0	0
Maintenance	4	0	0	0
Power	1	0	0	0
Water/Wastewater	4	0	0	0
<b>Total</b>	<b>10</b>	<b>1</b>	<b>1</b>	<b>1</b>

### Vulnerability

Flooding and inundation from SLR can damage critical facilities or render them uninhabitable and disrupt critical utilities and services. Other critical infrastructure serving Tribal Citizens, such as roadways and electrical and water utilities, may be damaged during a flood, isolating citizens and disrupting businesses.

#### 8.5.4 Environment

Environmental changes can be natural or human-made and can shift the frequency, location, and severity of flooding, SLR, and cliff erosion. Environmental influences on these hazards can affect the Service Area in the short and long term, especially structures and infrastructure in the hazards' immediate zone. An impaired or modified environment, including land development, can flood new or less common areas, increase coastal and bank erosion, and cause more severe flooding. Additionally, flood control systems can increase coastal erosion, and rivers and streams migrate permanently, changing flood patterns.

Prolonged flood or SLR inundation can kill vegetation, altering ecosystems at the landscape scale. While this is a natural process, these changes can damage or destroy timber stands, cultural and recreational resources, and businesses (Alberta Water Portal Society, 2014). SLR can push saltwater into groundwater aquifers and fresh-water locations, impacting coastal ecosystems and drinking water supplies. Snowpack is projected to melt faster and earlier in the spring season, causing significant changes in the timing of runoff and the amount of water available in the watershed. Increased runoff due to faster snowmelt could also result in increased sedimentation and stream scouring, altering stream morphology, increasing nutrient runoff, and increasing the severity of winter floods.

## 8.6 Development Trends

Tribal development is planned in the Service Area population centers of Florence, Coos Bay, and North Bend (Confederated Tribes of Coos, Lower Umpqua, and Siuslaw, 2010). Most existing Tribal development in these communities is outside of mapped floodplains and areas expected to be inundated by 2060 due to SLR. However, multiple Tribal parcels along the coast are expected to be exposed to SLR hazards. SLR and flooding hazards should be evaluated for any proposed development along the coast or in mapped floodplains during the planning phase.

Another development factor is urban expansion in flood-prone areas; this increases the impervious surface areas, preventing water from being absorbed by the ground. Rerouted water from hard surfaces increases the likelihood of flood events and expands flood zones (Konrad, 2016). This condition is exacerbated by peak rain events when the ground around the impervious surfaces is quickly saturated, increasing the storm-runoff rate (Konrad, 2016).

## 8.7 Issues

Flood, SLR, and coastal erosion considerations in CTCLUSI's Service Area:

- More detailed mapping is needed to support flood risk assessments and guide future development on Tribal parcels.
- Need updated Flood Insurance Rate Maps (FIRMs) to provide accurate estimates of future risk due to climate change.
- Damage data from past and future floods, such as high-water marks on structures and preparation of damage reports, can help inform future mitigation projects.
- CTCLUSI does not currently participate in the NFIP; this is a mitigation consideration in the mitigation actions Table 14-1.
- Residents in a floodplain need access to flood maps, be notified of flood risks, and be educated on flood preparedness and mitigation measures.

## 8.8 Hazard Maps

The hazard maps for flood and SLR are in Figures 8-2 to 8-10, starting on the next page.

Figure 8-2. Flood Zone Map for CTCLUSI's Service Area

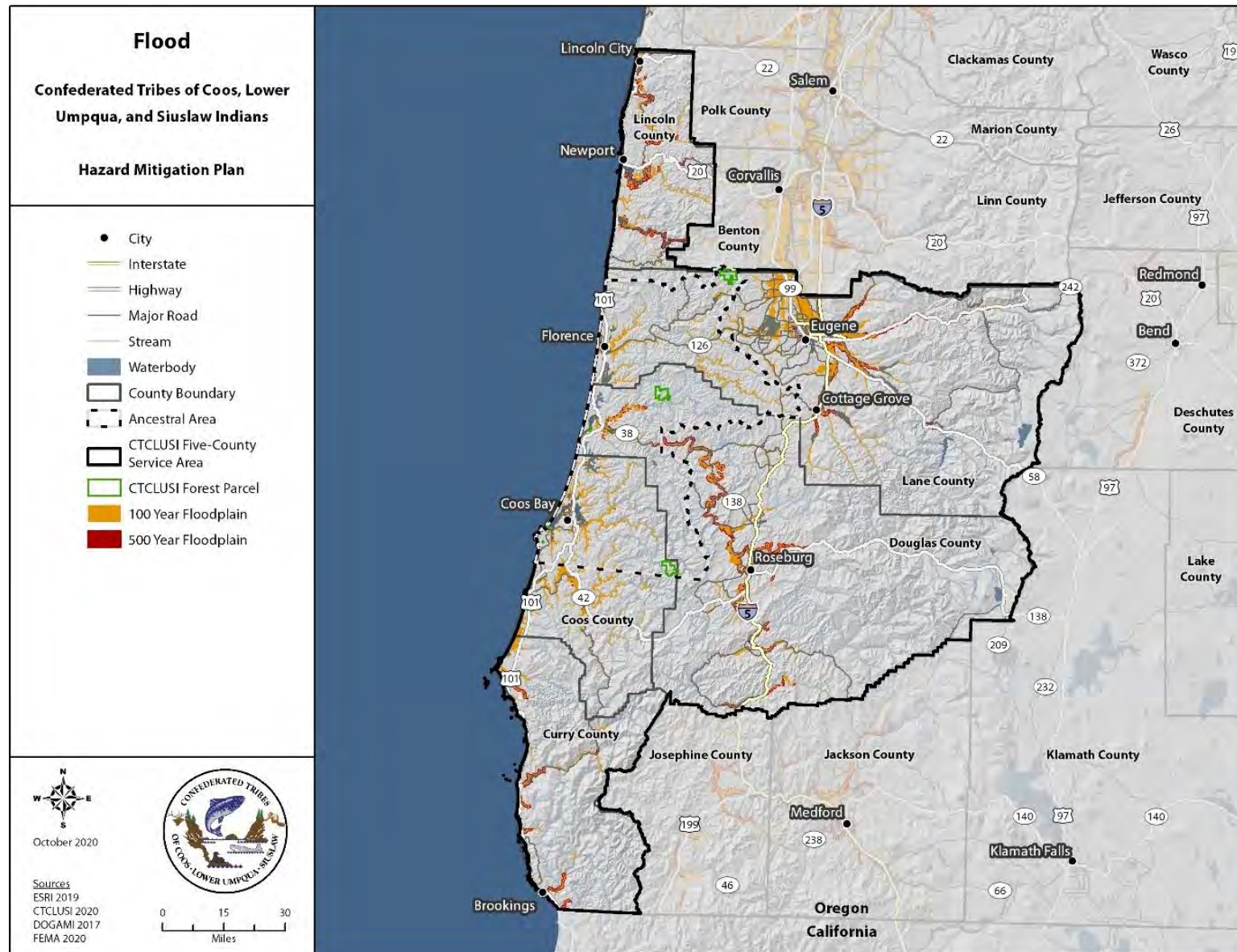




Figure 8-3. Sea Level Rise Map for Lincoln County

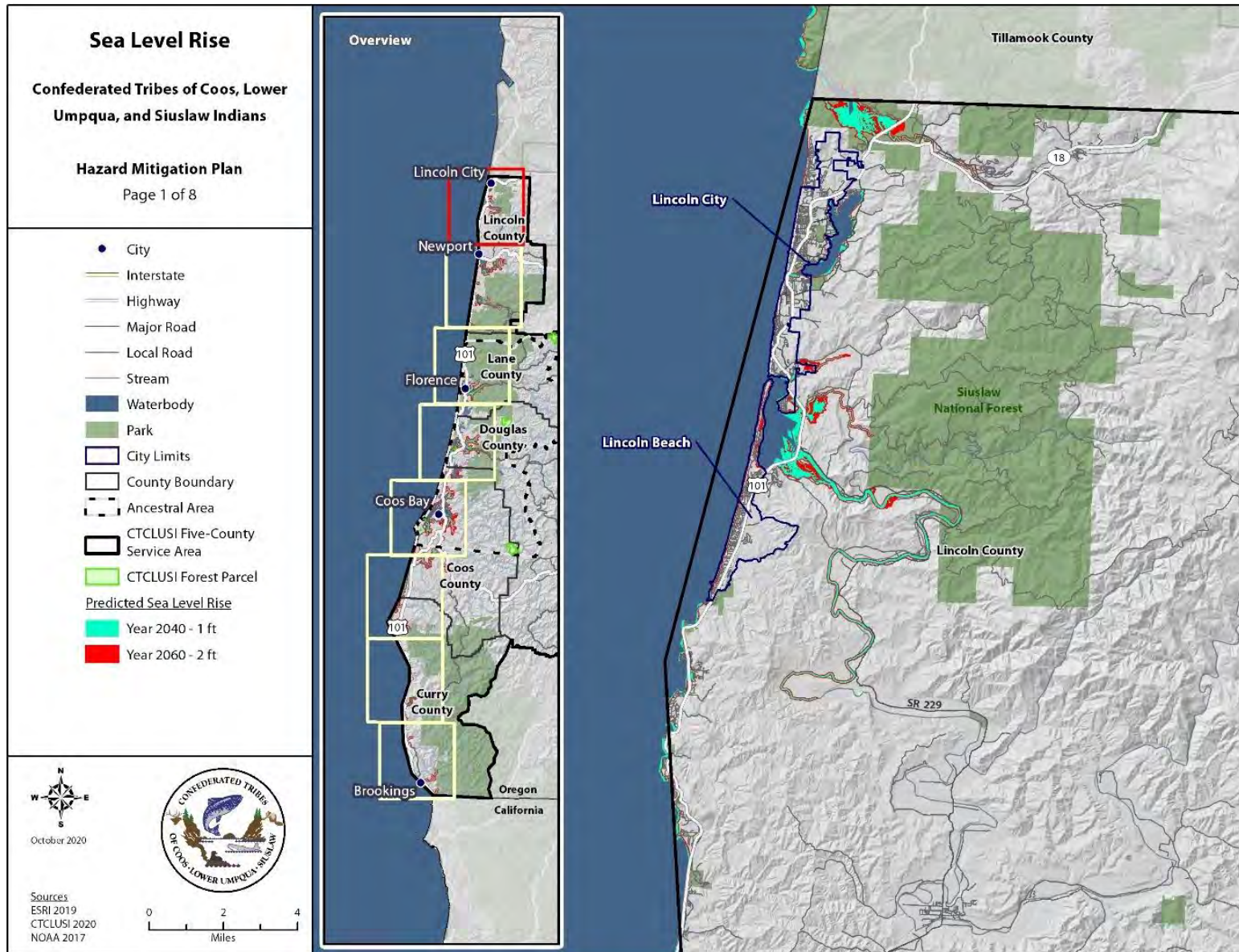




Figure 8-4. Sea Level Rise Map for Newport

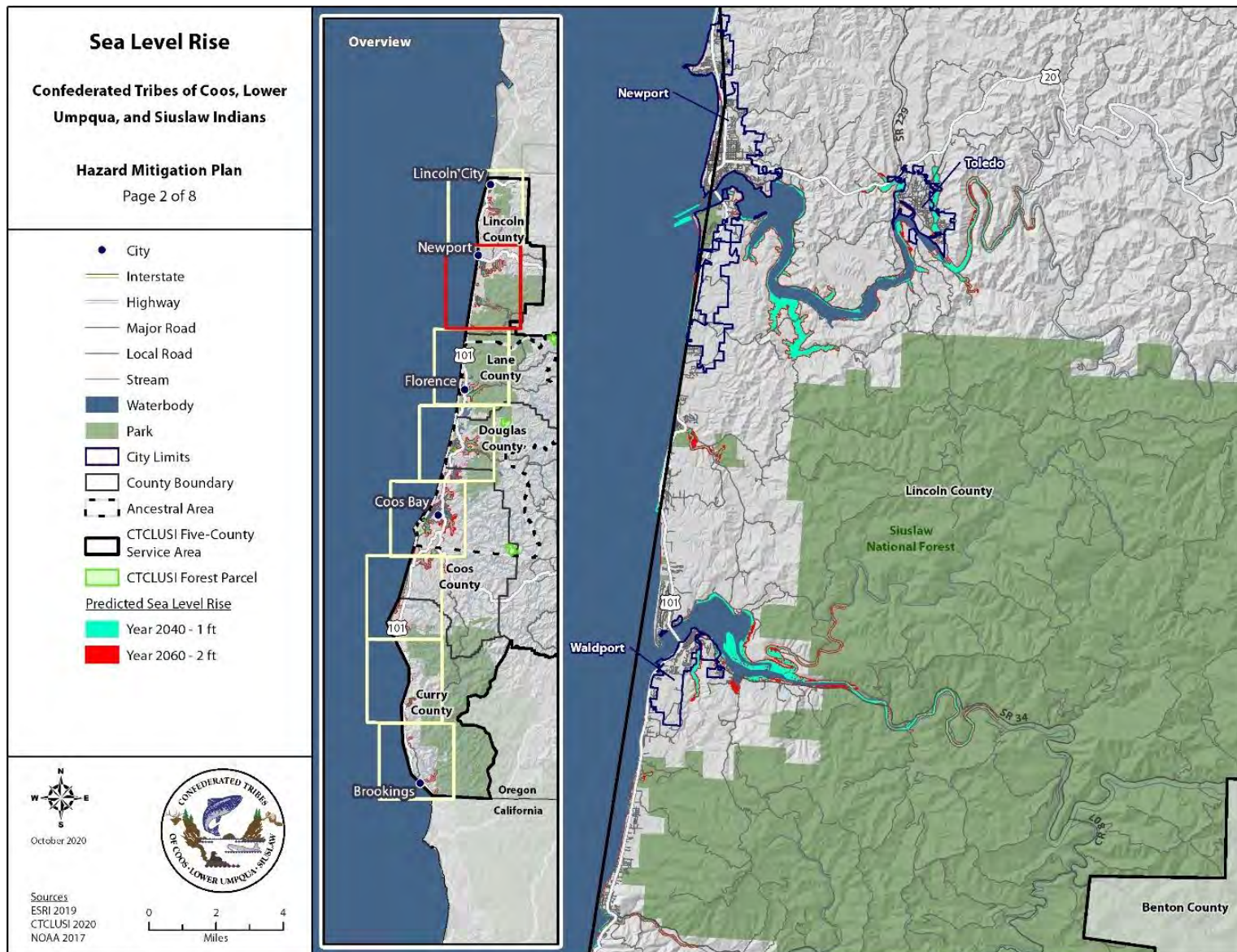




Figure 8-5. Sea Level Rise Map for Lane County

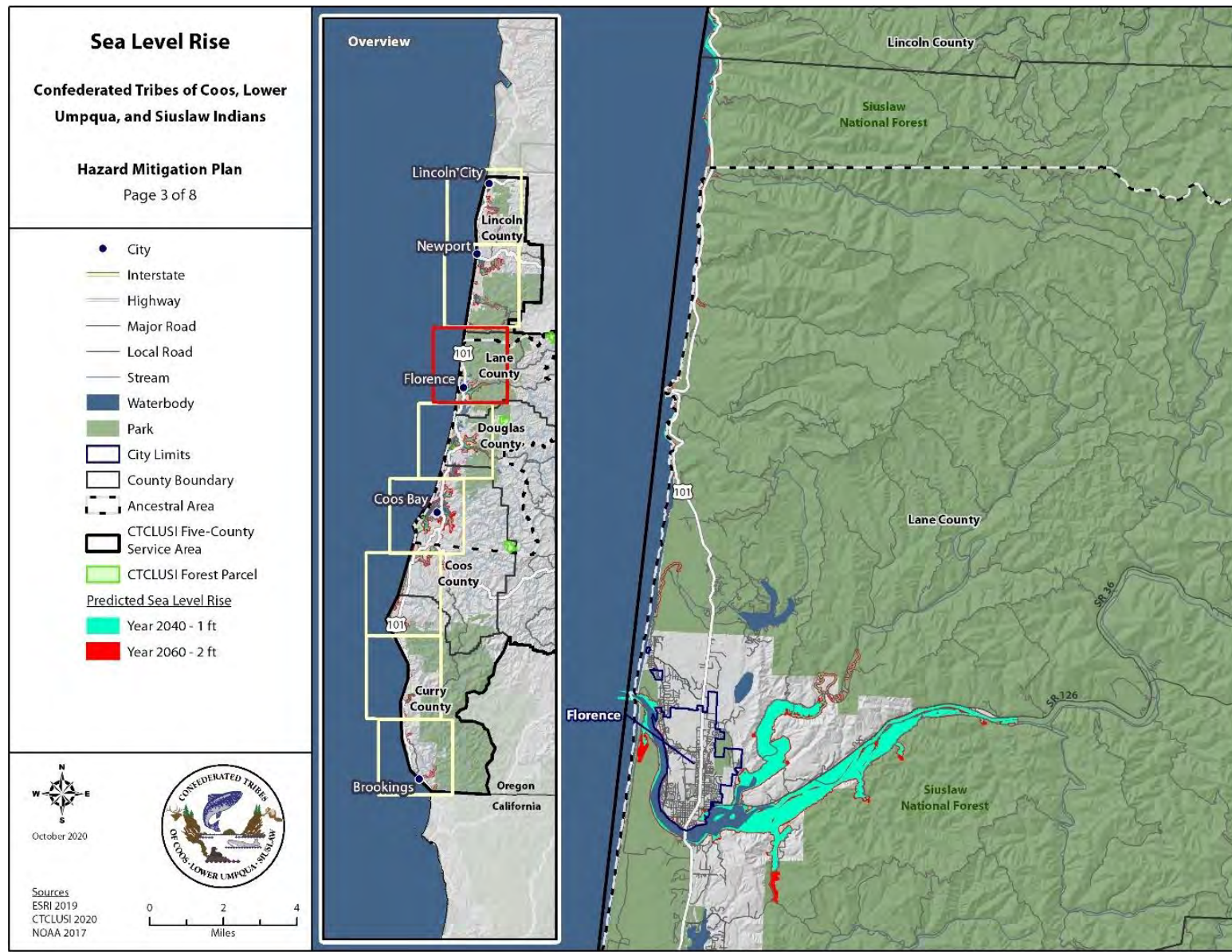




Figure 8-6. Sea Level Rise Map for Douglas County

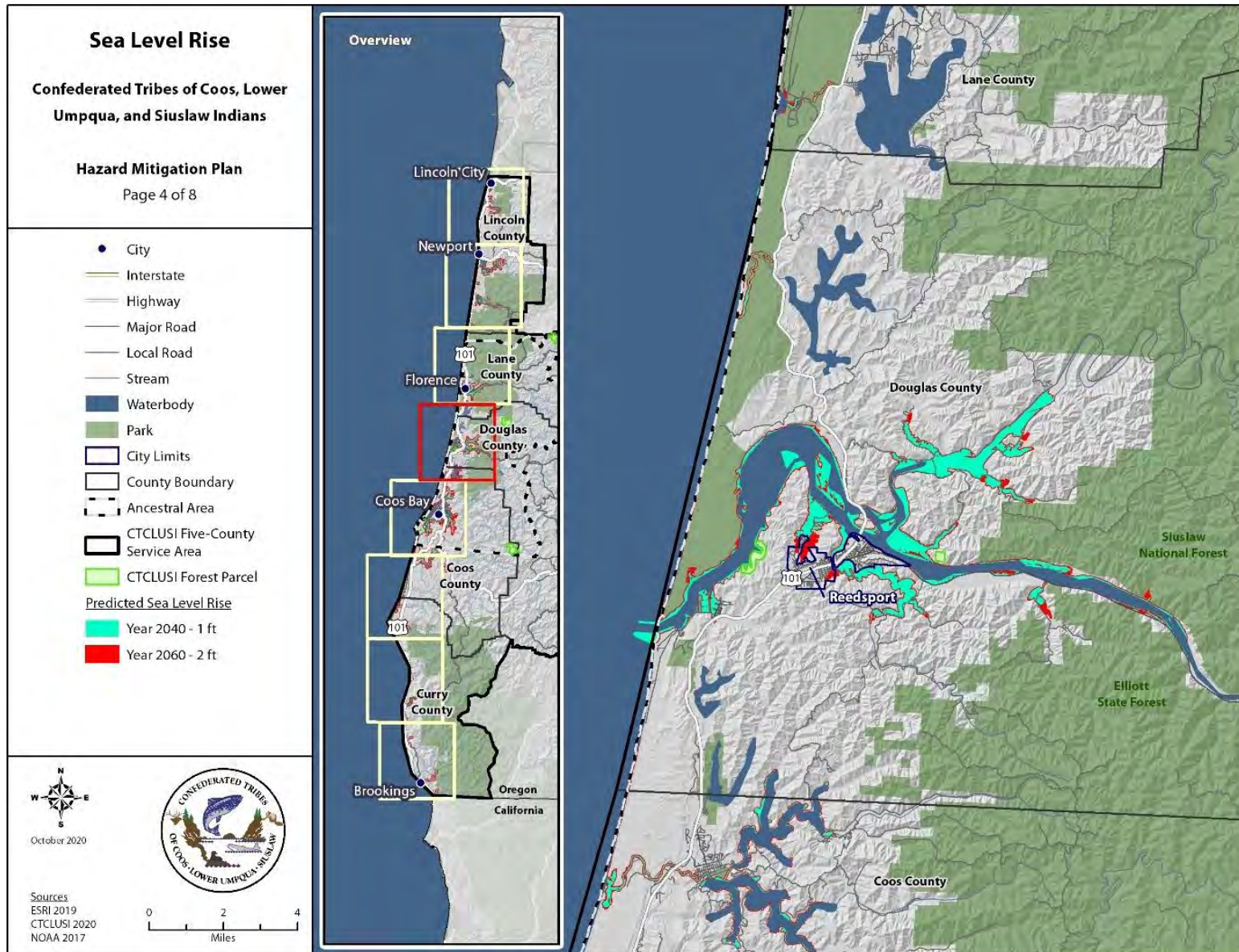




Figure 8-7. Sea Level Rise Map for Coos Bay

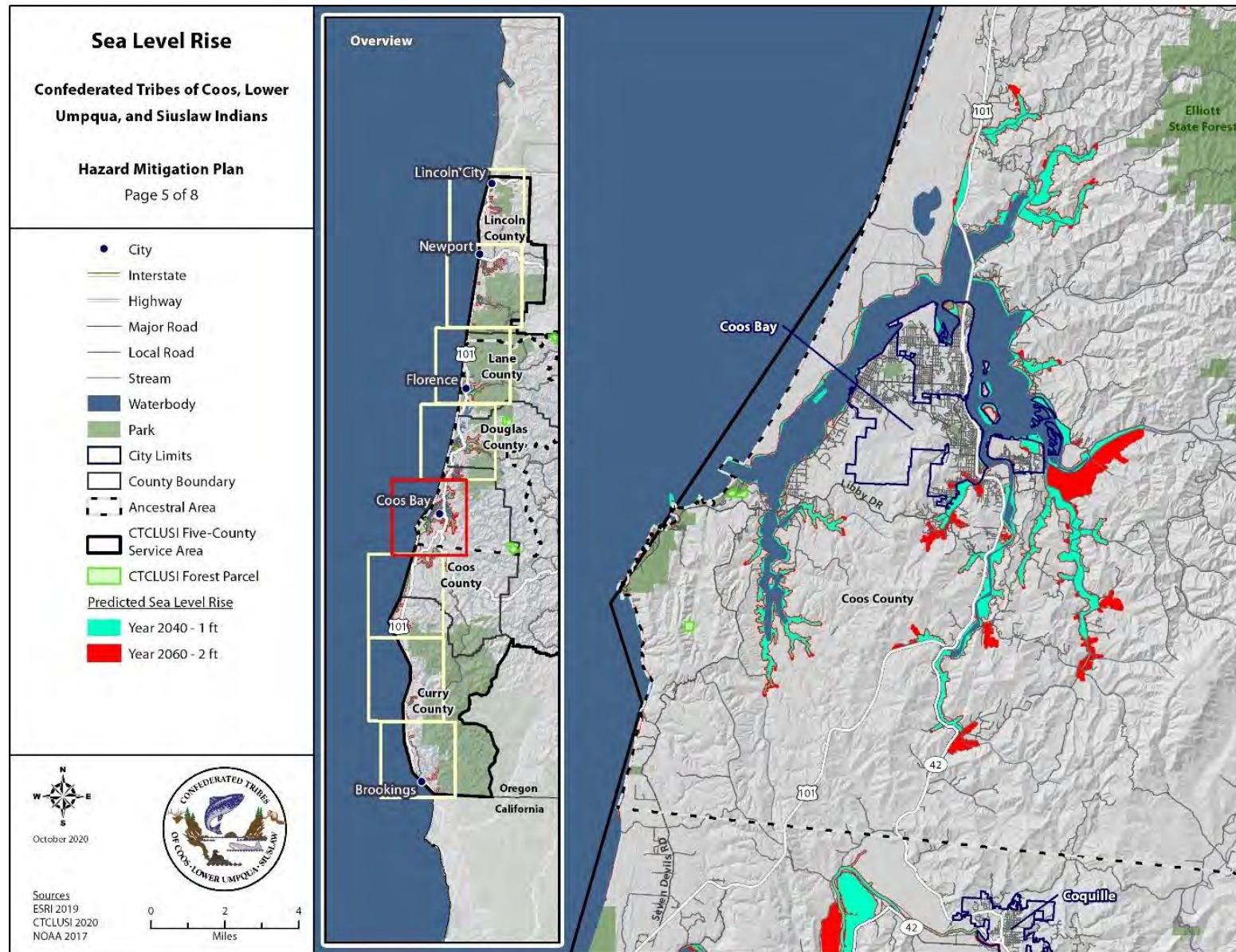




Figure 8-8. Sea Level Rise Map for Southern Coos County and Northern Curry County

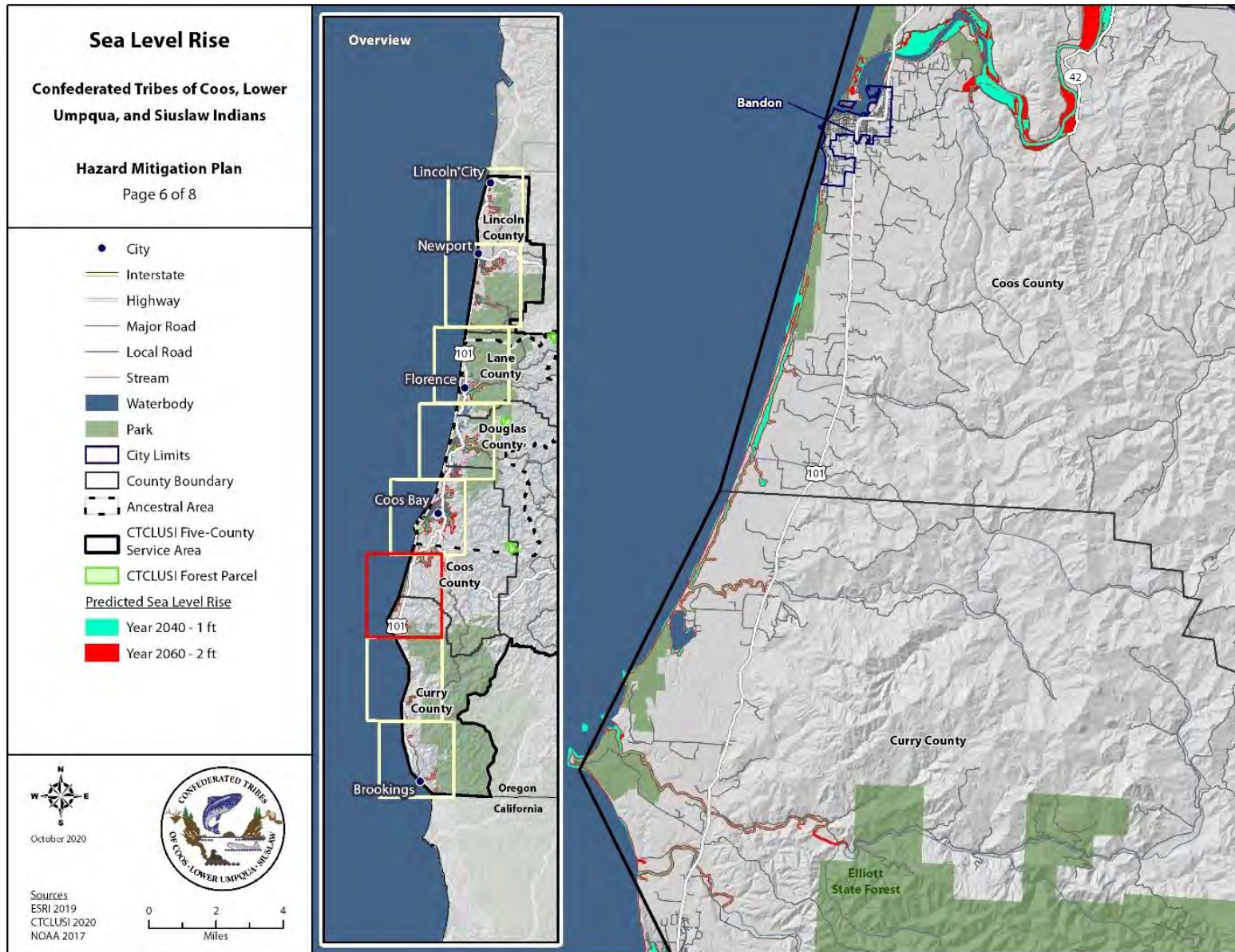


Figure 8-9. Sea Level Rise Map for Central Curry County

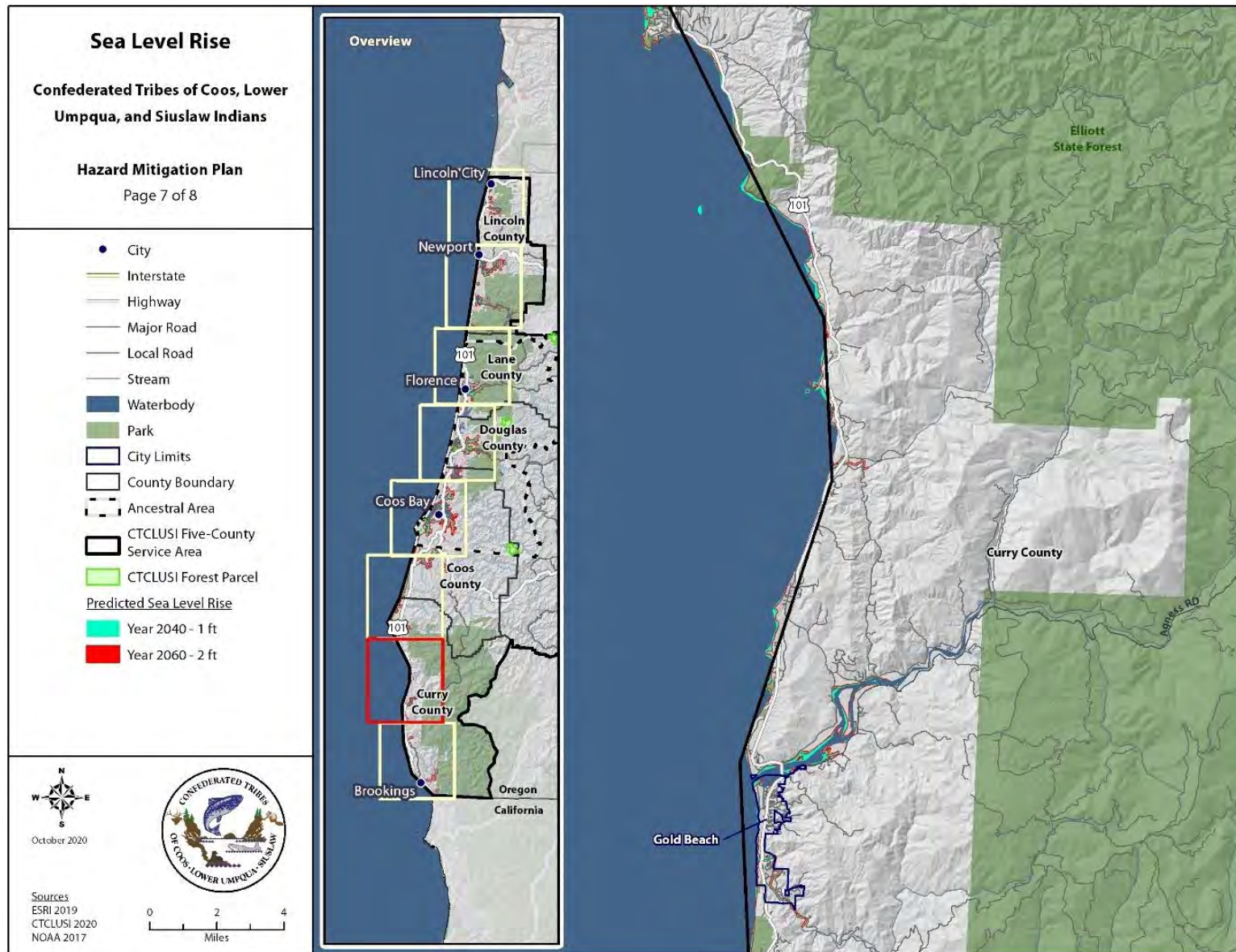
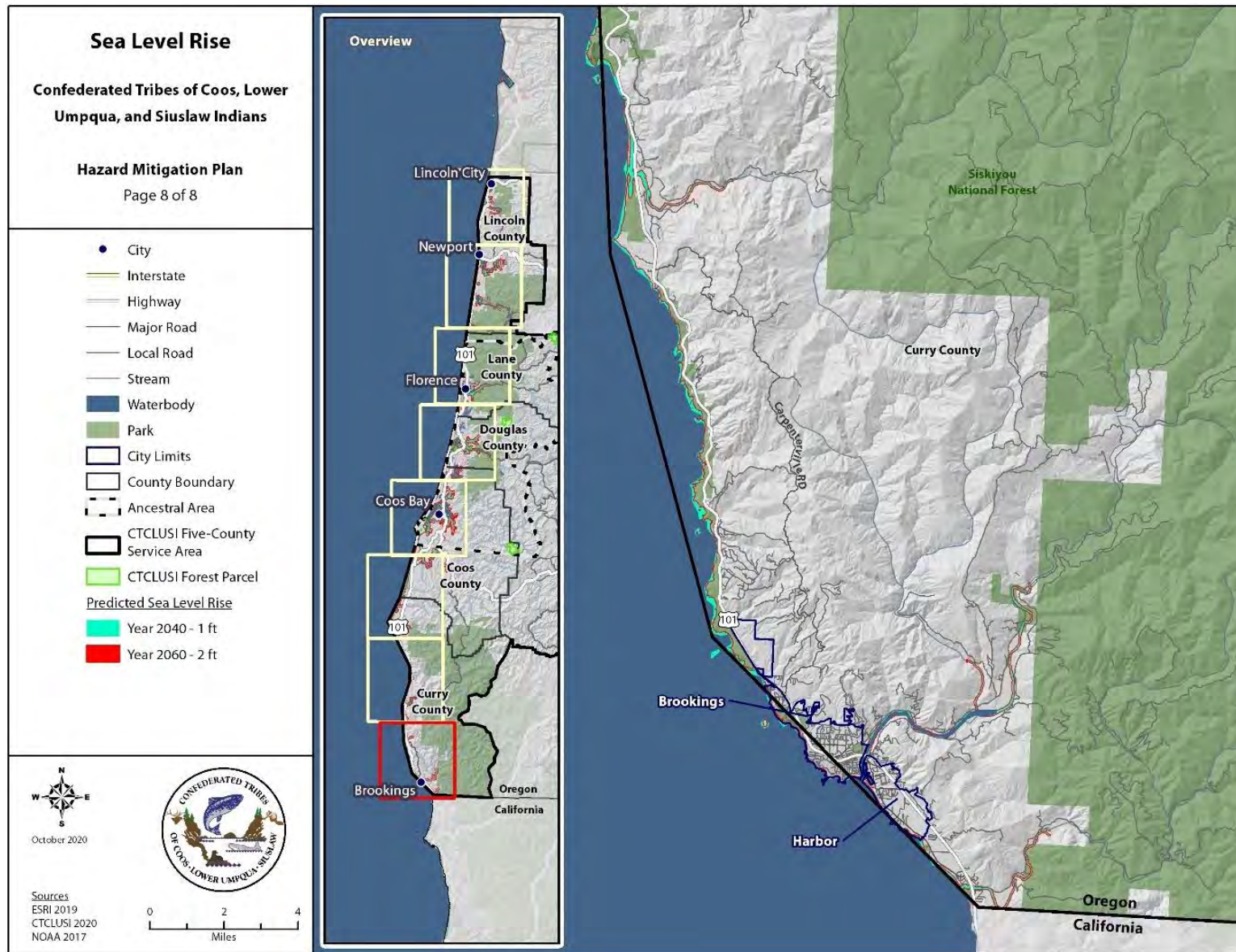




Figure 8-10. Sea Level Rise Map for Southern Curry County



## 9 Hazardous Materials

### 9.1 General Background

A hazardous material incident, intentional or accidental, can cause damage to people, property, and the environment (i.e., soil, water, air). In smaller quantities, hazardous materials (HAZMAT) are used and stored in homes. Public and private organizations can have varying amounts of HAZMAT depending on the services provided. Dangerous HAZMAT is any substance or chemical that is a health or physical hazard. These can be in three categories of chemicals (US General Services Administration):

- **Toxic and Carcinogenic:** Toxic/highly toxic agents, reproductive toxins, irritants, corrosives, hepatotoxins, nephrotoxins, neurotoxins, hematopoietic agents, and agents that attack the lungs, skin, eyes, or mucous membranes
- **Ignitable and Combustible:** Combustible liquids, compressed gases, explosives, flammable liquids, flammable solids, organic peroxides, oxidizers, pyrophoric, unstable or water-reactive
- **Materials that can be Released in Normal Handling or Storing:** Produce or release dust, gases, fumes, vapors, mists, or smoke that can impact human health and safety in one of the ways listed in the above bullet points (e.g., a running gasoline-powered vehicle)

In 1986, the EPA initiated the Emergency Planning and Community Right-to-know Act (EPCRA), requiring certain industries to report the locations and quantities of chemicals stored on-site. The Environmental Protection Agency makes this information available to the public via the *Toxic Release Inventory* database. The database provides information on releasing and transferring toxic chemicals from facilities to specific business sectors and industries (Environmental Protection Agency, 2020).

HAZMAT can pose an immediate and severe risk to health, safety, and the environment when regulations are not followed and materials are accidentally or intentionally released. The EPA focuses on the risks to the environment. In parallel, the US Department of Labor (DOL), Occupational Safety and Health Administration also oversees the Occupational Safety and Health Administration (OSHA) HAZMAT regulations, primarily to mitigate risks to humans and their health (Occupational Safety and

### DEFINITIONS

**Corrosive Material:** A liquid or solid that causes irreversible damage to skin on contact over a certain amount of time.

**Explosive:** A substance, article, or device that functions by exploding, or chemical reaction that causes an explosion, including pyrotechnic substances.

**Flammable Liquid:** A liquid with a flashpoint at or above 100°F that is headed and transported at or above its flashpoint in bulk packaging.

**Flammable Gas:** A substance that has a boiling point and is a gas at 68°F or less.

**Flammable Solid:** Any substance that is flammable in a solid form.

**Hazardous Materials:** Any substance or chemical that is a health or physical hazard to humans or the environment.

**Hazardous Waste:** A dangerous waste product of a hazardous material.

**Miscellaneous Hazardous Material:** A material that only poses a risk when transported.

**Oxidizer or Organic Peroxide:** A substance that, by yielding oxygen, can enhance or cause the combustion of other materials.

**Radioactive Material:** Any material containing radionuclides when the activity concentration and total activity exceeds specified values.



Health Administration, 2013). Entities can store these materials and transport them via ground, water, and air following federal and state regulations. There are additional regulations for transporting HAZMAT:

- **Department of Transportation:** Hazardous Materials Regulations (49 CFR 100-180)
- **International Maritime Organization:** International Maritime Dangerous Goods (IMDG) Code
- **International Air Transport Association:** Dangerous Goods Regulations
- **International Civil Aviation Organization:** Technical Instructions
- **Air Force "INTERSERVICE" Manual:** Preparing Hazmat for Military Air Shipments (AFMAN 24-204)

HAZMAT has nine classes and several subsections that determine the material's qualities and risks to people, property, and the environment:

Federal HAZMAT regulations for human health and safety fall under 29 CFR part 1910 subpart H. There are also federal Acts that apply to specific types of hazardous materials, such as the Clean Air Act and Superfund Amendments and reauthorization Act. 18 US Code, Section 2332a for criminal use of HAZMAT, including weapons of mass destruction.

*Table 9-1. Hazardous Material Classes, Subclasses, and Descriptions (Federal Aviation Administration, 2021)*

Hazard Class	Subclasses and Descriptions
<b>Class 1: Explosives</b>	<ul style="list-style-type: none"> <li>▪ Mass explosion</li> <li>▪ Projectile</li> <li>▪ Minor blast/projectile/fire</li> <li>▪ Insensitive and very insensitive explosives</li> </ul>
<b>Class 2: Compressed Gases</b>	<ul style="list-style-type: none"> <li>▪ Flammable</li> <li>▪ Non-flammable compressed</li> <li>▪ Poisonous</li> </ul>
<b>Class 3: Flammable Liquids</b>	<ul style="list-style-type: none"> <li>▪ Flammable with a flashpoint below 141°F</li> <li>▪ Combustible with a flashpoint between 141-200°F</li> </ul>
<b>Class 4: Flammable Solids</b>	<ul style="list-style-type: none"> <li>▪ Flammable solids</li> <li>▪ Spontaneously combustible</li> <li>▪ Dangerous when wet</li> </ul>
<b>Class 5: Oxidizers and Organic Peroxides</b>	<ul style="list-style-type: none"> <li>▪ Oxidizers</li> <li>▪ Organic Peroxides</li> </ul>
<b>Class 6: Toxic Materials</b>	<ul style="list-style-type: none"> <li>▪ Poisonous materials</li> <li>▪ Infectious agents</li> </ul>
<b>Class 7: Radioactive Material</b>	<ul style="list-style-type: none"> <li>▪ Level I</li> <li>▪ Level II</li> <li>▪ Level III</li> </ul>
<b>Class 8: Corrosive Material</b>	<ul style="list-style-type: none"> <li>▪ Human skin destruction</li> <li>▪ Corrodes steel 0.25 inches per year</li> </ul>
<b>Class 9: Miscellaneous</b>	<ul style="list-style-type: none"> <li>▪ A material that is only hazardous during transportation</li> </ul>

#### 9.1.1 Potential Impacts from Hazardous Materials

Depending on the type, amount, extent of the contamination, and environmental factors, even a minor HAZMAT release can significantly damage people, property, and the environment. The level of HAZMAT release risk depends on the nature of the hazardous materials, how it is stored, how it is transported, and

if it is a high-target for theft or destruction. Many releases are small, quickly contained, and cleaned up properly with little to no environmental damage. However, significant events do occur and can be widespread and highly dangerous; these releases can have considerable consequences for areas affected in terms of financial cost and the health of humans, animals, and the environment.

Public health impacts of a release can vary from temporary skin irritation to death. Exposure can pose short- and long-term toxicological threats to humans, terrestrial and aquatic plants, and land and marine wildlife. Materials released may seep through the soil and eventually into the groundwater, making water supplies unsafe to drink. Gas HAZMAT can collect faster in closed spaces like houses and businesses, as hazardous gasses are heavier than air and can build up in low-lying areas, inside and outside. In these situations, it can be challenging to clear out the air for those exposed and rescue workers.

## 9.2 CTCLUSI Hazard Profile

The EPA defines the role of tribes under the EPCRA and the Clean Air Act (CAA). Understanding the regulations and tribal roles in HAZMAT preparedness and response helps CTCLUSI and Tribal Citizens to understand the chemical risks in the Service Area and how to manage those risks, and to answer questions like:

- What precautions are already in place to avoid a chemical release?
- Is a facility storing chemicals near a medical facility or in a highly trafficked area?
- What are emergency alert procedures developed to notify and assist Tribal Citizens affected by a HAZMAT release?
- Do the local fire departments coordinate with HAZMAT facilities to determine the best response procedures for that location and type of hazard?
- If CTCLUSI needs additional fire department support, are there mutual aid agreements in place?

CTCLUSI identifies Tribal-level HAZMAT risks and provides response prevention and response procedures for oil spills and HAZMAT releases in their estuaries in the 2018 *Estuary Response Plan*. HAZMAT releases that could impact CTCLUSI's citizens, property, and environment can include but are not limited to petroleum spills or releases, toxic chemicals, gases, and other hazardous materials. Point sources include (Oregon Department of Transportation, 2021):

- **Transportation Methods:** highways, railroads, air/flight paths, pipelines, and waterways
- **Stored in Buildings:** Homes, businesses, or other facilities
- **Significant Roads in the Service Area:** Interstate-5 (I-5), US 101, and State Routes 99, 58, and 42
- **Railroad Lines in the Service Area:** Union Pacific, Portland and Western Railroad, Central Oregon and Pacific, and the Coos Bay Rail Line

### 9.2.1 Hazard Ranking

The Emergency Management Team completed a hazard ranking survey during the CTCLUSI 2022 HMP update process and assessed hazard-related factors based on worst case and most likely scenarios. Hazard definitions and ranking factors are in Table 5-1. Survey results were prioritized and ranked based on their averaged score. The severity, magnitude, frequency, onset, and duration variables are scored one to five, where one is the lowest and five is the highest. Compared to the other hazards in the survey, hazardous materials ranked the first worst-case scenario and the eighth most likely scenario.

Table 9-2 – Hazardous Materials Hazard Ranking Output

Severity	Magnitude	Frequency	Onset	Duration	Average	Rank
<b>Worst-Case Scenario</b>						
4	4.25	4.25	5	5	4.5	1
<b>Most Likely Scenario</b>						
1.5	1.75	2.25	3	3.25	2.35	8

### 9.2.2 Past Events

Hazardous materials incidents have occurred in the Service Area. The State provides hazardous substance storage information and incident reports within the State. Table 9-3 below lists some examples of events in or near the Service Area that occurred in 2021.

Table 9-3. Hazardous Materials Releases in 2021 around the Service Area (Office of the State Fire Marshal, 2021)

Incident City	Date	Number	Type	Property Use
Eugene	1/2/21	HM-02-2020	HAZMAT investigation, no release	1-2 family dwelling
Eugene	6/6/21	HM-02-0014	Chemical spill or leak	1-2 family dwelling
Corvallis	8/21/21		Chemical spill or leak	1-2 family dwelling
Coos Bay	2/16/21		Chemical hazard (no spill or leak)	

The US Department of Transportation (DOT) Pipeline and Hazardous Materials Safety Administration (PHMSA) reporting database indicates that counties in the Service Area have experienced 457 hazardous materials releases since 1989 along transportation corridors (Pipeline and Hazardous Materials Safety Administration, 2020). PHMSA's transportation corridors include air terminals and routes, water routes, highways, and rail lines.

### 9.2.3 Location

The Service Area has no Tier II facilities or EPA-designated Superfund National Priorities List sites. Tier II facilities are high-risk locations that store hazardous materials meeting or exceeding the Occupational Safety and Health Administration's threshold for materials stored and level of hazard. Without Tier II facilities there is a reduced risk for a severe release event in the Service Area.

However, HAZMAT is stored in every community to some extent, inside homes, hospitals, factories, and other businesses. These materials can be transported by air, ground, and waterways (e.g., oceans, seas, major rivers like the Mississippi, etc.). Releases are more likely to occur in areas surrounding fixed-site facilities and along major transportation routes. HAZMAT events can be small-scale, localized to the incident site, or affect larger areas if the spill is extensive, such as a gas being carried through the air or toxins that get into waterways (Federal Emergency Management Agency, 2019).

### 9.2.4 Frequency

Hazardous materials incidents occur each year in the Service Area, though most are small and result in minor environmental, personal, or property damage. Tribal, federal, state, and local rules and regulations continue to become more stringent and lower the chances for a serious incident. However, increased transportation along major roadways, raises the likelihood that the CTCLUSI could be affected by a hazardous material incident on arterial transportation routes.

### 9.2.5 Severity

Hazardous material release severity depends on the type of material, its effects, and the volume released. Some HAZMAT can affect someone after one exposure; this is called an acute toxicity event. On the other hand, some types of HAZMAT are toxic over prolonged exposure, which is called chronic toxicity (Environmental Protection Agency). The extent of a hazardous material release depends on whether the substance is released from a fixed (e.g., building) or mobile (e.g., vehicle) source, the size of the impacted area, the toxicity and properties of the substance, the duration of the release, and environmental conditions. Conditions that may worsen a release include weather effects on buildings and terrain, storage facilities, and transportation equipment failures.

Other factors that determine the severity of a potential incident include quick and solid decision-making by emergency officials, evacuation and shelter-in-place needs and communication, public health concerns, and relevant economic considerations. While most incidents are generally brief, the resulting recovery and cleanup can require a substantial amount of time and money.

### 9.2.6 Warning Time

Hazardous material incidents usually offer little to no warning time before the incident occurs. People in the immediate vicinity have the least amount of warning and response time. Community members outside of the immediately exposed area will usually have more time to shelter in place or evacuate.

## 9.3 Secondary Hazards and Cascading Impacts

### 9.3.1 Secondary Hazards

Generally, a HAZMAT release will not cause a secondary hazard. They do not impact earthquakes, floods or SLR, tsunamis, or epidemics, and pandemics. However, under certain conditions, combustible hazardous materials can ignite wildfires. There is also a potential for explosive chemicals to destabilize mass earth movement-prone slopes.

### 9.3.2 Cascading Impacts

HAZMAT release incidents can cause cascading impacts, such as health effects and impacts on the environment that can be temporary or long-term. Health effects can range from mild to permanent injury or even loss of life, depending on the release sources. Long-term environmental impacts can also cause negative economic impacts to tourism, fishing, agriculture, and other natural and cultural resources (Environmental Protection Agency). Large-scale incidents can require costly, long-term public health and environmental monitoring to monitor impacts on people and the environment.

## 9.4 Potential Impacts from Future Climate Conditions

HAZMAT is not likely to be effected by climate change factors, although facilities and infrastructure exposed to expanded flooding and increased temperatures could be at a higher risk for releases if climate change is not considered during building and renovation. Structures built in locations exposed to more intense and frequent storms and wildfires, new flood zones, or SLR may not have measures in place to address these climate change increased risks. Changes in weather patterns can also fluctuate risks for HAZMAT that is affected by higher temperatures and cause releases to travel farther by wind or water during major storm events.

## 9.5 Exposure

Exposure and vulnerability from hazardous materials are difficult to quantify due to a range of factors including the natural and built environments, human effects, and hazardous materials use. The sections below provide qualitative analysis of exposure and vulnerability for Tribal Citizens and the Service Area.

### 9.5.1 Population

The Service Area's entire population is potentially exposed to a HAZMAT incident due to widespread use, storage, and transportation along the I-5 corridor. Individuals, especially at risk, are transportation carriers, Tribal Citizens, first responders, and healthcare workers (Federal Emergency Management Agency, 2019). Health hazards for people can include (Environmental Protection Agency):

- Behavioral Abnormalities
- Cancer
- Genetic Mutations
- Psychological Malfunctions (e.g., reproductive impairment, kidney failure, etc.)
- Physical Deformations
- Birth Defects

There are six types of harm that could impact Tribal Citizens in a release (Federal Emergency Management Agency, 2019):

Health Risks	Description
<b>Asphyxiation</b>	HAZMAT that reduces oxygen levels long enough or in a closed space that can result in asphyxiation (e.g., carbon dioxide and methane). Many of these materials that cause asphyxiation are odorless and tasteless, increasing the health risks for those in the incident area.
<b>Chemical Harm</b>	Exposure to chemicals such as poisons and corrosives, the extent of harm is dependent on the toxicity of the chemical, length of time exposed, and the amount of HAZMAT released. Their potential severity classifies these chemicals. The Department of Health and Human Services (HHS) and Chemical Hazards Emergency Medical Management website have more information on each type of hazardous chemicals (e.g., biotoxins, blister agents, opioids, pesticides, and nerve agents, etc.).
<b>Biological (Etiological) Harm</b>	Exposure to biological HAZMATs such as bacteria, viruses, and biological toxins. This type of HAZMAT can take time to generate symptoms and become apparent.
<b>Mechanical Harm</b>	Exposure to scattered debris, such as a pressure release, explosion, or boiling liquid that expands and explodes. The extent depends on the site of the explosion and its proximity to the incident source. This form of HAZMAT release is exceptionally dangerous to humans and can easily cause injuries and, in the worst-case, loss of life. Sources of mechanical harm include: <ul style="list-style-type: none"> <li>▪ <b>Fragmentation and Flying Debris:</b> most common source of injury is an explosion that can impale, fracture, and eviscerate</li> <li>▪ <b>Blast Overpressure:</b> when a gas expands rapidly and increases air pressure, which can cause ruptures to eardrums, blood vessels, and organs; also torn organs and lung collapse</li> <li>▪ <b>Secondary Blast Injuries:</b> when an individual is thrown into other objects by an over-pressure explosion; this can cause spinal injuries, and bone and skull fractures/breaks</li> </ul>

### Vulnerability

People with preexisting health conditions, people without access to emergency notification systems, children, and people over 65 are particularly vulnerable to a hazardous materials event. These people may require additional help to evacuate hazardous areas or shelter in place.

#### 9.5.2 Property

Tribal properties may be vulnerable to a HAZMAT incident during transportation or use of hazardous products. It is difficult to quantify potential losses related to properties, although potential losses may include transportation route inaccessibility, temporary loss of utility services, property contamination, and structural loss if an explosion occurs. All of CTCLUSI's properties in Tables 9-4 through 9-6 are at risk from damage or destruction from HAZMAT incidents.

*Table 9-4. CTCLUSI Facilities Exposed to Hazardous Materials Incidents*

Facility Type	Total Facilities
Administration	4
Camp	11
Casino	3
Communication	1
Community	3
Housing	20
Lighthouse	1
Maintenance	4
Other	13
Power	1
Ranch	3
Water/Wastewater	4
<b>Grand Total</b>	<b>68</b>

*Table 9-5. Tribal Parcels at Risk from a Hazardous Materials Incident*

Parcel Type	Total Parcels	Acres
Fee	51	430.3
Reservation	13	14758.2
Trust	18	123.7
<b>Grand Total</b>	<b>82</b>	<b>15312.2</b>

*Table 9-6. Forest Tracts at Risk from a Hazardous Materials Incident*

Forest Tract	Total Stands	Sum of Acres
Coos Head	1	47.2
Macy	1	37.3
Talbot	1	36.6
Tioga	133	4565.5
Umpqua Eden	1	135.4



Forest Tract	Total Stands	Sum of Acres
Upper Lake Cr.	19	647
Upper Smith	148	4934.8
<b>Total</b>	<b>304</b>	<b>10403.8</b>

### Vulnerability

It is difficult to determine potential losses and vulnerabilities to properties due to the variable nature and amount of hazardous materials being stored. HAZMAT incidents can pose a serious long-term threat to property in the event of a large spill or release.

#### 9.5.3 Critical Facilities and Infrastructures

The CTCLUSI's critical facilities may be vulnerable to a hazardous material incident due to transportation or use of hazardous materials. Although, it is difficult to quantify potential impacts to critical facilities due to the wide variability of a HAZMAT event.

*Table 9-7. Critical Facilities at Risk from a Hazardous Materials Incident*

Critical Facility Type	Total Number	Sum of Acres
Communication	1	1
Maintenance	4	4
Power	1	1
Water/Wastewater	4	4
<b>Total</b>	<b>10</b>	<b>10</b>

### Vulnerability

Critical facilities may store hazardous materials, increasing vulnerability and likelihood of an incident. Lifeline transportation routes, such as Interstate-5, are regularly used to move hazardous materials, making the surrounding areas vulnerable to HAZMAT after an accidental or intentional release.

#### 9.5.4 Environment

Hazardous material incidents can contaminate air, water, and soils, leaving lasting short- and long-term exposure and health risks for plants, animals, and people. As materials soak into the soil, they can kill microorganisms and nutrients that contribute to ecosystem health (Environmental Protection Agency). Plants and animals can be affected directly causing immediate health problems, or over time through reproductive complications (Environmental Protection Agency). Some types of HAZMAT can travel through soil or by waterways, eventually reaching groundwater aquifers and contaminating drinking water if they are not quickly and properly contained.

### 9.6 Development Trends

The number and types of hazardous chemicals stored in and transported through the Service Area could increase as population and business growth along critical transportation corridors increases. This growth could extend the exposure further into surrounding communities. Proper enforcement of federal, state, and local hazardous materials rules and regulations will help ensure safe handling, transportation, and storage procedures, reducing the probability of a HAZMAT release.

## 9.7 Issues

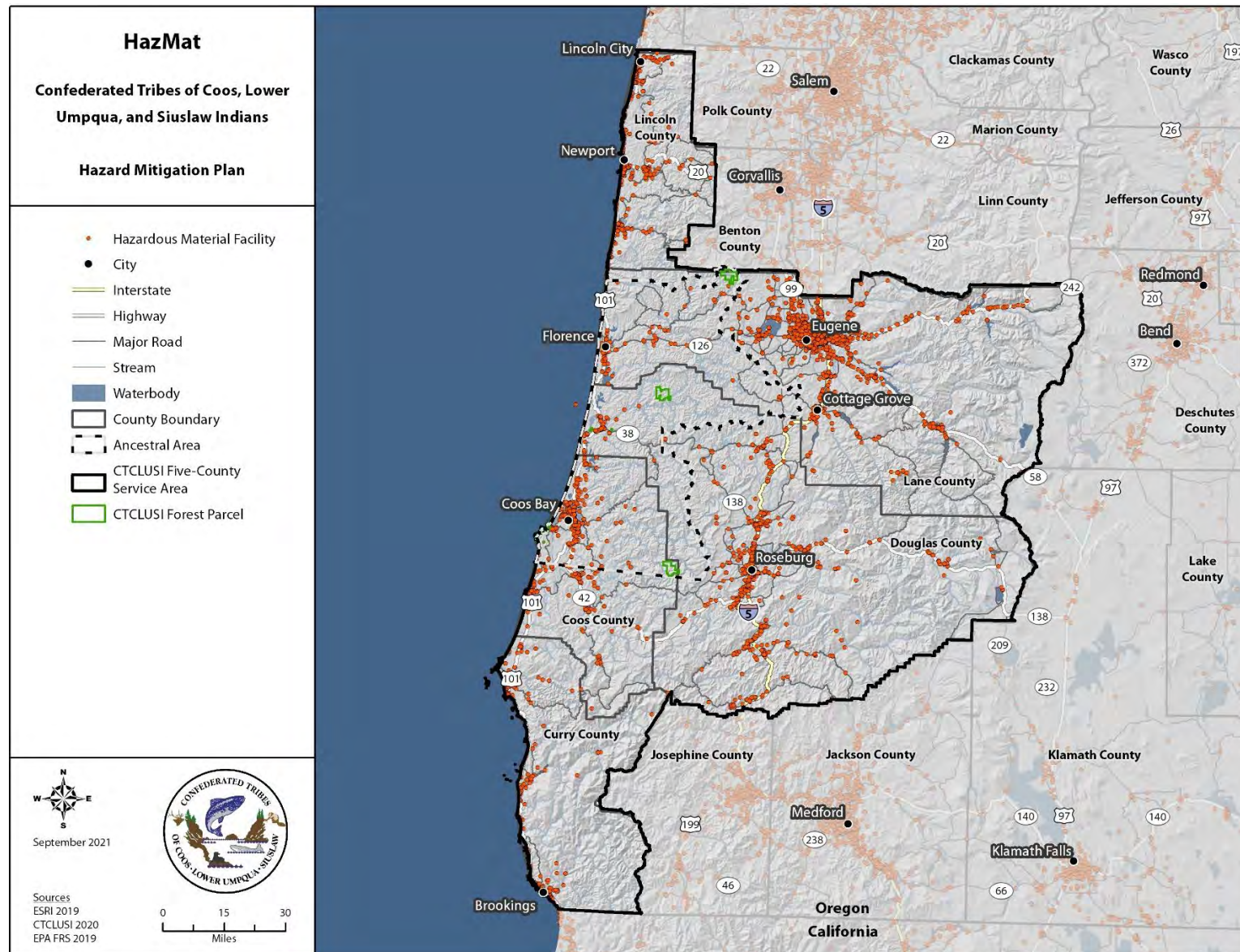
HAZMAT considerations in CTCLUSI's Service Area:

- Continue HAZMAT emergency preparedness efforts, including training for police, emergency planning, and Tribal education and outreach programs.
- HAZMAT facilities must follow regulations:
  - Placards and labeling of containers
  - Emergency plans and coordination
  - Standardized response procedures
  - Notification of the types of materials being transported through the Service Area
  - Random inspections of transporters
  - Installation of mitigating techniques along with critical locations
  - Routine hazard communication initiatives
  - Consideration of using safer alternative products
- Work with Tribal enterprises to create, exercise, and maintain Business Continuity Plans in an emergency.
- Maintain an emergency services information line that the public can contact 24 hours a day during a HAZMAT incident.

## 9.8 Hazard Maps

The Service Area HAZMAT risk map is on the next page.

Figure 9-1. CTCLUSI Hazardous Materials Risk Map



## 10 Mass Earth Movements

### 10.1 General Background

A mass earth movement is defined as a landslide, mudslide, rockfall, sinkhole, or debris flow, and generally occurs for two reasons (United States Geological Survey):

- When up-slope ground material does not have the strength to overcome the downslope gravity pull
- When a force acts on the material (e.g., water, avalanche, earthquake), causing it to detach from the slope and move downhill

Several other hazards can trigger mass earth movements, such as severe weather, SLR, flooding, earthquakes, tsunamis, and wildfires (Editors of Encyclopedia Britannica, 2015). Natural changes to the environment can destabilize slopes and influence mass earth movements, such as surface water levels, stream erosion, groundwater movement, or any combination of these factors (United States Geological Survey). Humans can also generate mass earth movements by modifying the environment by removing vegetation and trees, destabilizing them.

There are three types of geologic materials, bedrock, debris and earth, and five forms of slope movements; examples of these forms are in Figure 10-1 (United States Geological Survey, 2004):

- **Flow:** Includes debris flows, debris avalanches, earth flows, mudflows, and creeps
- **Topples:** Characterized by a rotation of the materials around a pivot point as they move downward
- **Slides:** Refers to an area of weakness where the unstable layer separates from the stable underlying layer
- **Spreads:** Unique because the material moves laterally on gentle slopes or flat ground, caused by liquefaction
- **Fall:** An abrupt down-slope movement of large materials (e.g., rocks and boulders) off steep slopes

#### 10.1.1 Potential Damage from Mass Earth Movement

Mass earth movements can damage or destroy infrastructure, structures and cause human injury or loss of life. Mass movements that occur quickly and without warning are the most dangerous and deadly, as people do not have time to react or evacuate the hazard area (Ready.gov, 2020). They can travel several miles from the point of origin and grow as debris is collected and added to the mass movement (Ready.gov, 2020). Displaced ground material can dam waterways, such as rivers, and result in flooding. Blocked or broken roads will delay emergency responders and critical supply shipments. An event can occur with little to no warning, increasing the likelihood of damage from such an event.

### DEFINITIONS

**Debris Flow:** A form of rapid mass movement in which loose soil, rock and sometimes organic matter combine with water to form a slurry that flows downslope.

**Landslide:** A large amount of rock, debris, or earth that travels down a slope.

**Mass Earth Movement:** A collective term for landslides, debris flows, falls and sinkholes.

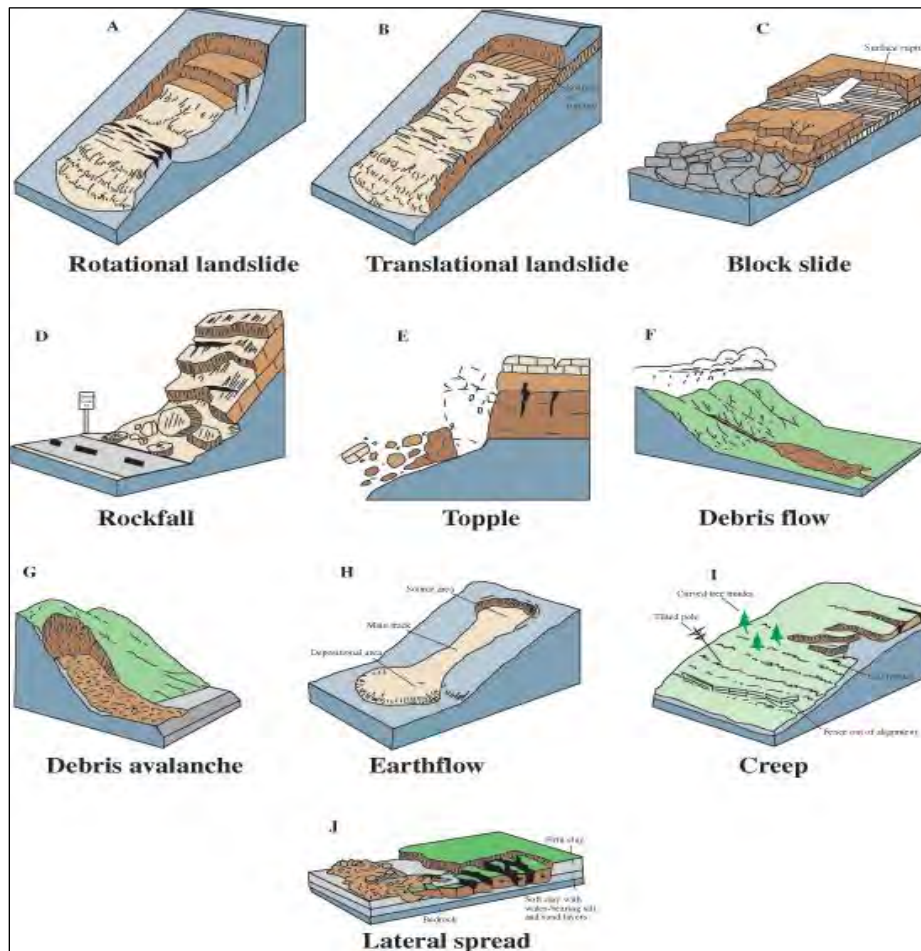
**Mudslide (or Mudflow):** A river of rock, earth, organic matter, and other materials saturated with water.

**Sinkhole:** A collapse depression in the ground with no visible outlet. Its drainage is subterranean. It is commonly vertical-sided or funnel-shaped.

**Slope Failures:** Occur when the strength of the soils forming the slope is exceeded by the pressure, such as weight or saturation, acting upon them.



Figure 10-1. Diagrams of Mass Movement Forms (image from US Geological Survey Department of the Interior/USGS)



## 10.2 CTCLUSI Hazard Profile

Mass earth movements have occurred across CTCLUSI's Service Area. Figure 10-2 shows the locations of historic landslide deposits within the Service Area. Oregon's coast and nearby Mountain Range have a very high record of landslides and other mass earth movements (Department of Land Conservation and Development, n.d.). Steeper slopes, weaker geology, and higher annual precipitation increase the probability of slope failure and mass earth movements (Councils and Committees, 2021). Figure 10-3 displays the Service Area's landslide susceptibility.

Occasionally, major mass earth movements block vital US and state transportation life-lines, like Highway 101. Mass earth movements that block and damage these critical routes can cause temporary to long-term disruptions until the ground material can be removed and infrastructure repaired. The disruption can lead to secondary hazards and cascading impacts; these are covered further in Section 10.4. It is less common for mass earth movements to result in loss of life (Councils and Committees, 2021). However, increasing population growth and home development have put more homes in mass earth movement risk areas, including along the coast, on hillsides, and around lakes and rivers. These locations are often highly desirable to prospective homeowners for their scenic qualities (University of Oregon's Community Service Center 2015).

DOGAMI maintains the Statewide Landslide Information Database for Oregon (SLIDO), which includes the locations and types of historic landslides identified by published maps (Oregon Department of Geology and Mineral Industries, 2020). SLIDO serves as a resource for tribes, local policymakers, planners, engineers, geologists, and others who play a role in identifying and mitigating geologic hazards.

### 10.3 Hazard Ranking

The Emergency Management Team completed a hazard ranking survey during the CTCLUSI 2022 HMP update process and assessed hazard-related factors based on worst case and most likely scenarios. Hazard definitions and ranking factors are in Table 5-1. Survey results were prioritized and ranked based on their averaged score. The severity, magnitude, frequency, onset, and duration variables are scored one to five, where one is the lowest and five is the highest. Compared to the other hazards in the survey, mass earth movements were the tenth worst-case scenario and fifth-most likely scenario.

*Table 10-1. Mass Earth Movement Hazard Ranking Output*

Severity	Magnitude	Frequency	Onset	Duration	Average	Rank
<b>Worst-Case Scenario</b>						
2.5	3.25	3.5	5	3.25	3.5	10
<b>Most Likely Scenario</b>						
1.5	2	2.75	3.75	2	2.4	5

#### 10.3.1 Past Events

Multiple federally declared mass earth movement-related disasters have happened in CTCLUSI's Service Area. These events generated damaging movements across all the counties in the Service Area, as shown in Table 10-2. In recent history, the most significant damage was caused by winter storms in February 1996, November 1996, and late December 1996 through early January 1997. These winter storms caused more than 9,095 landslides in the region, resulting in two presidential disaster declarations, DR-1149-OR and DR-1160-OR. These combined hazards produced extensive damage to property, natural resources, and in the worst cases, loss of life (University of Oregon's Community Service Center 2015).

*Table 10-2. Federal Disaster Declarations for Mass Earth Movements and Landslides within the CTCLUSI's Five-County Service Area (Federal Emergency Management Agency, 2020)*

Year	Counties Affected	Event Type	Disaster Number
1996	Coos, Douglas, Lane	Flooding, land, mudslides, high winds, severe storms	DR-1149-OR
1997	Coos, Douglas, Lane	Severe winter storms, land and mudslides, flooding	DR-1160-OR
2006	Coos, Curry, Douglas, Lincoln	Severe storms, flooding, landslides, and mudslides	DR-1632-OR
2006	Lincoln	Severe storms, flooding, landslides, and mudslides	DR-1672-OR
2007	Coos, Curry, Lincoln, CTCLUSI	Severe storms, flooding, landslides, and mudslides	DR-1733-OR
2011	Douglas, Lincoln	Severe winter storm, flooding, mudslides, landslides, and debris flows	DR-1956-OR
2012	Coos, Curry, Douglas, Lane, Lincoln	Severe winter storm, flooding, landslides, and mudslides	DR-4055-OR



Year	Counties Affected	Event Type	Disaster Number
2015	Coos, Curry, Douglas, Lane, Lincoln	Severe winter storms, straight-line winds, flooding, landslides, and mudslides	DR-4258-OR
2019	Coos, Curry, Douglas, Lane	Severe winter storms, flooding, landslides, and mudslides	DR-4432-OR

Since 1950, other documented mass earth movements in the Service Area that resulted in damages or injuries are included in Table 10-3. Many past events blocked multiple sections of Highway 101, some sections of this critical highway were damaged on more than one occasion. The most significant events listed Table 10-3 resulted in major infrastructure and property damage, disruption to transportation, and ten individuals that lost their life.

*Table 10-3. Recent Past Landslides and Mass Earth Movements in the CTCLUSI's Five-County Service Area (Douglas County Planning Department and Emergency Management, 2016) (Lane County Hazard Mitigation & Emergency Management Steering Committee, 2018) (University of Oregon, Community Service Center, & Oregon Partnership for Disaster Resilience, 2016)*

Year	Location	Event Summary
1953	Curry County, near Harbor Hills	A landslide near Harbor Hills southeast of Brookings damaged home and closed Highway 101.
1972	Coos County	A landslide caused by heavy rains caused approximately \$28,000 in damage.
1974	Douglas County, near Canyonville	A rapidly moving landslide killed nine men working along the I-5 Freeway. During the five days before the landslide, the area had experienced 11 inches of rain.
1993	Curry County	The "Arizona Inn Slide" blocked Highway 101 for two weeks. Previous slides affected Highway 101 in the county in 1938, 1954, 1978, and 1981.
1993	Douglas County, near Klamath Falls	Earthquakes in 1993 caused a rockfall that killed a motorist.
1994-1995	Curry County, near Gold Beach	The Gold Beach – Hooskaneden slide blocked Highway 101 18 miles south of Gold Beach.
1999	Curry County	A landslide on Highway 101 at Reinhart Creek caused over \$1.3 million damage to the highway and 80 Acres Rd.
2001	Curry County	A landslide on Highway 101 at Slide Creek caused approximately \$1.1 million in damage. A second landslide at Humbug State Park near Bear Trap Creek caused \$175,000 in damage.
2002	Lincoln County	The most recent significant movement of the Johnson Creek landslide occurred in 2002, affecting Highway 101. The landslide, a result of coastal processes, is located along the Oregon coast south of Cape Foulweather. This gradual slide has a long history of causing damage to Highway 101. The total movement of the slide is estimated at over 90 feet horizontally and almost 20 feet vertically.
2004	Coos County	A landslide covered the only paved road providing access to the city of Powers, isolating the city.
2006	Curry County, near Port Orford	The Curry County – Gregory Point landslide blocked Highway 101 about 2.2 miles south of Port Orford.

Year	Location	Event Summary
2006	Northern Lincoln County	A 17 to 18-acre landslide affected Immonen Road, a county road. This landslide was still active as of 2015 and has caused extensive damage to the road.
2008	Curry County, near Harbor Hills	Heavy rains caused a slide of approximately 3,000 tons of mud and debris that blocked access to several homes along Harbor Heights Road in the Harbor Hills area.
2008	Lane County, south of Oakridge	A massive 60-acre landslide in the Willamette National Forest south of Oakridge closed the Union Pacific's railroad line for western Oregon, destroying the rail bed and tearing out the tracks in several locations.
2011	Coos County, Curry County, and others	Winds and heavy rains caused flooding, mudslides, and landslides in 13 counties. Damage to state highways was estimated at over \$5.8 million.
2012-2017	Lane County, along Highway 101	Multiple landslides damaged the section of Highway 101 north of Florence and south of Yachats.
2012	Coos County at Coos Bay	Heavy rains caused fill land on the Johnson Rock property to slide into Coos Bay's Coalbank Slough.
2015	Douglas County	A landslide closed Highway 42 for several weeks.
2016	Douglas County	A large rockslide blocked Tyee Road, cutting off access from Tyee to Umpqua.
2017	Lane County, along Highway 36	Highway 36 between Junction City and Mapleton was closed by two landslides between January 18 and 27, 2017. A total of 2,600 cubic yards of debris was removed from the sites of the two slides.

### 10.3.2 Location

The map in Figure 10-2 shows previous landslide deposits scattered across the Service Area. These highlighted sections are at a higher risk for reoccurring mass earth movements. CTCLUSI has high landslide susceptibility in 58 percent of the Service Area, and 7 percent of the area is in a very high susceptibility location, as mapped in Figure 10-3. Areas of very high susceptibility exist along the coastline, including north of Florence, south of Newport, and from the southern end of Coos County into Curry County. Inland, very high susceptibility areas are east of Eugene, in the Roseburg foothills, throughout the Cascade Mountains, and steep slopes located northeast of Eugene.

### 10.3.3 Frequency

Mass earth movements are often triggered by other natural hazards, such as earthquakes, heavy rain, floods, and vegetation loss after a recent wildfire. In general, the frequency of mass earth movement is related to the frequency of these other hazards, which can occur at any time of year. Based on past severe storms in the CTCLUSI's Service Area, mass earth movements occur on average, annually. Although, severely damaging mass earth movements and landslides are more rare.

### 10.3.4 Severity

Mass earth movements that occur with little or no warning tend to be the most destructive, as it may not be possible to evacuate the area or prepare for the impact. Other factors contributing to the severity of mass earth movement events include a slope's steepness (which impacts the rate of travel), the amount and size of debris transported, and the population density of the area affected (Ready.gov, 2020). Debris flows are usually the most dangerous type of mass earth movement as they often start rapidly and may carry large objects like boulders, vehicles, homes, and trees (United States Geological Survey).

### 10.3.5 Warning Time

The warning time associated with mass earth movements depends on the rate of travel. As noted in the severity section above, the most dangerous movements have a rapid onset since there is little or no warning time. Heavy rains and recent wildfires that make slopes more prone to movement are strong indicators of a possible movement. Movements with the longest warning time happen over an extended period, such as creeps and erosion that move in inches per year (United States Geological Survey, 2004).

Warnings are issued through the NWS (National Weather Service, 2021). There can be approximately 3 and 48 hours of warning before precipitation is significant enough to cause debris flows. This time allows CTCLUSI and local agencies to notify people in affected areas (Oregon Department of Forestry & Oregon Department of Geology and Mineral Industries, 2007).

To support preparedness in the Service Area, the USGS lists the following mass earth movement signs (United States Geological Survey):

- Springs seeps, or saturated ground in areas that are not typically wet
- New cracks or unusual bulges in the ground, streets, or sidewalks
- Soil moving away from foundations
- Building add-on structures like decks and patios tilting or moving away from the building
- Concrete floors and foundations tilting or cracking
- Broken water lines or other underground utilities
- Leaning telephone poles, trees, retaining walls, or fences
- Offset fence lines
- Sunken or displaced roadbeds
- Creek water levels rapidly increasing or suddenly decreasing even though rain is falling or recently stopped falling
- Sticking doors and windows
- Unusual sounds, such as trees cracking, boulders are knocking together, or a faint rumbling that increases in volume

## 10.4 Secondary Hazards and Cascading Impacts

### 10.4.1 Secondary Hazards

Following a mass earth movement, the most common secondary hazard is flooding from fallen materials blocking waterways such as rivers (United States Geological Survey). Risks from flooding in CTCLUSI's Service area are covered in Section 8, including lists of the water channel in the area. Mass earth movement materials that get into drinking water supplies can also reduce the quality of drinking water.

### 10.4.2 Cascading Impacts

Mass earth movements can have several cascading impacts. Falling debris can block waterways, resulting in flooding, reduced water quality, and damaging fisheries and spawning habitats. Slides can affect the Service Area by destroying or limiting transportation services and infrastructure, utilities, and buildings, and cause injuries and loss of life. Additionally, blocked roads can potentially isolate Tribal Citizens, disrupt critical services, delay supplies, or disrupt resources needed for business operations.

Additional cascading impacts can be utility damage or destruction, which can result in power communication loss. Further more, energized downed powerlines and broken gas lines can start building fires and lead to structural damage, injuries, or loss of life. Mass earth movements can even carry large

debris like vehicles and buildings; if there is HAZMAT inside this can potentially release the dangerous materials into the area and environment. There is also a risk of destabilizing structural foundations; therefore, it is essential to have a qualified person inspect affected buildings before the Tribes consider reentering affected structures (Ready.gov, 2020).

### 10.5 Potential Impacts from Future Climate Conditions

Climate change could cause more mass earth movements due to increased frequency and severity of storms, SLR, erosion, and wildfires, all of which raise the likelihood of mass earth movements (United States Geological Survey). Along CTCLUSI's coastline, storms, SLR, and erosion can combine to put coastal cliffs at high risk for landslides. Unlike erosion, which happens slowly over time, these cliff mass movements can happen suddenly, releasing large amounts of ground material at once. An increase in SLR will not only increase wave heights and erosion along the coast but can also mean more flooding and inundation that may exacerbate incidences of landslides further inland in the Service Area (Oregon Department of Transportation, 2012)

Wildfires are expected to become more frequent and intense across the State and in the Service Area due to warmer average temperatures, less snowmelt with shortened snow seasons, and lower annual precipitation levels. Longer periods of warm weather and droughts raise the risk of wildfires, which in turn increases the occurrence and duration of mass earth movements. For example, wildland fires in the Service Area can remove critical vegetation that helps support steep slopes. Areas that have been burned are more vulnerable to flooding and subsequent landslides, and debris flow with less precipitation than usually is needed (Oregon Department of Transportation, 2012).

### 10.6 Exposure

#### 10.6.1 Population

Mapped landslide exposure is in areas with known and recorded landslide features; CTCLUSI's are shown in Figure 10-2. Landslide features include deposits, sources; deposits indicate where previous slides left debris at the end of the flow. These sources and other signs in the soil layers show where previous landslides came from or started (United States Geological Survey). Table 10-4 shows the Service Area populations exposed to the risks of mass earth movements at varying levels. Figure 10-3 is a map of the landslide susceptibility locations overlaying CTCLUSI's Service Area. These locations of historic mass earth movements are more prone to another event in the future.

*Table 10-4. Exposure of Tribal Citizens to Landslide Hazards (Oregon Department of Forestry & Oregon Department of Geology and Mineral Industries, 2007)*

Landslide Risk Zones		Population
Low Suceptibility Zone	193	
Moderate Suceptibility Zone	137	
High Suceptibility Zone	78	
Very High Suceptibility Zone	17	
Mapped Landslide Zone	18	
<b>Total</b>		<b>443</b>

### Vulnerability

All Tribal Citizens are at risk from some level of mass earth movement. Citizens residing in areas more susceptible to landslides are exposed to higher risks including property destruction, injury, and possible loss of life. There are 232, or 54 percent, of Tribal Citizens living in moderate to very high-risk locations.

#### 10.6.2 Property

Tables 10-6 to 10-8 list the exposure of landslide and mass earth movement hazards to Tribal facilities, forest stands, and parcels. 76 percent of CTCLUSI facilities are in areas with moderate or greater landslide susceptibility, and none of the facilities are in areas with historical landslide debris.

*Table 10-5. Exposure of Tribal Facilities to Landslide and Mass Earth Movement Hazards*

Facility Type	Total Facilities	Landslide Susceptibility Areas	Landslide Deposits
Administration	4	0	0
Camp	11	11	0
Casino	3	1	0
Community	3	3	0
Housing	20	20	0
Lighthouse	1	1	0
Other	13	5	0
Ranch	3	3	0
<b>Total</b>	<b>58</b>	<b>44</b>	<b>0</b>

Table 10-7 lists CTCLUSI's forest stands are located in areas with moderate or greater landslide susceptibility. Approximately ten percent of the forest stands are located in areas of historical landslide debris.

*Table 10-6. Exposure of Forest Tracts to Landslide and Mass Earth Movement Hazards*

Forest Tract	Total Stands	Landslide Susceptibility	In Landslide Deposits
Coos Head	1	1	0
Macy	1	1	0
Talbot	1	1	0
Tioga	133	133	1
Umpqua Eden	1	1	0
Upper Lake Cr.	118	118	0
Upper Smith	148	148	39
<b>Total</b>	<b>403</b>	<b>403</b>	<b>40</b>

Table 10-8 lists 76 parcels, 92 percent, owned by CTCLUSI are in areas with greater landslide susceptibility. Four parcels, 5 percent of the total parcels, are in areas with historical landslide debris.

*Table 10-7. Exposure of Tribal Parcels to Landslide and Mass Earth Movement Hazards*

Parcel Type	Total Parcels/Acreage	Landslide Susceptibility Areas	In Landslide Deposits
Fee	51/430	47	1
Reservation	13/14,758	13	3



Parcel Type	Total Parcels/Acreage	Landslide Susceptibility Areas	In Landslide Deposits
Trust	19/124	16	0
<b>Total</b>	<b>83/15,312</b>	<b>76</b>	<b>4</b>

### Vulnerability

Many of CTCLUSI's facilities and parcels, including Tribal housing, are located in areas with moderate or greater landslide susceptibility. There is a greater risk of landslides or other mass earth movements in these areas, especially during or following severe storms or prolonged rainfall. Landslides can damage or destroy structures and alter the local topography so that the parcels become unusable. Landslides also can damage or destroy timber resources, which would cause economic impacts to the Tribes.

#### 10.6.3 Critical Facilities

Table 10-9 shows the CTCLUSI's critical facilities located in landslide susceptibility areas or historical landslide deposits. As shown in the table, half of the Tribes' critical facilities are in areas that are more susceptible to landslide and mass earth movement hazards; however, there are no critical facilities in historical landslide deposits areas.

*Table 10-8. Exposure of Tribal Critical Facilities to Landslide and Mass Earth Movement Hazards*

Critical Facility	Total Number	Landslide Susceptibility Areas	In Landslide Deposits
Communication	1	1	0
Maintenance	4	2	0
Power	1	0	0
Water/Wastewater	4	2	0
<b>Total</b>	<b>10</b>	<b>5</b>	<b>0</b>

### Vulnerability

The definition of exposure and vulnerability in the GIS data includes buildings and critical infrastructure within even a moderate landslide hazard zone. Table 10-9 shows CTCLUSI's critical facilities vulnerable to damage or destruction from a mass earth movement.

#### 10.6.4 Environment

Specific environmental impact from mass earth movements within the Service Area is challenging to predict. In general, earth movements can alter the surface topography, smother vegetation underwater or ground materials, and carry new materials into an ecosystem. Mass earth movements that dump materials into rivers can block water flow, causing the flow to reroute or flood the area. Soil and exposed hazardous materials can accumulate downslope, potentially contaminating drinking water supplies (World Health Organization). CTCLUSI's entire Service Area is prone to the the environmental risks resulting from a mass earth movement, including flooding, altered waterways, and contaminated water.

### 10.7 Development Trends

The Tribal Code does not specify restricted areas for development due to hazards or establish formal reviews of planned development sites. Developing or updating codes is considered in the mitigation actions in Table 14-1 of the 2022 HMP update.

## 10.8 Issues

Mass earth movement considerations in the Service Area:

- Assess future development sites, especially near the coast, to reduce the likelihood of building in mass movement-prone areas.
- As new data, technology, and science become available, update maps and mass earth movement hazard assessments.
- Climate change could increase trigger events, escalating the likelihood and extent of mass earth movements.
- Plan for potential cascading impacts, such as ruptured gas lines, and potential for secondary hazards, such as fires.
- Exposure to landslide and mass earth movement hazards overlaps areas of exposure to other hazards, such as earthquakes, floods, and tsunamis. This overlap provides CTCLUSI with the opportunity to develop mitigation actions that reduce the risks of multiple hazards.

## 10.9 Hazard Maps

The mass earth movement hazard maps are in Figure 10-2 and 10-3, starting on the next page.

*Figure 10-2. Landslide Areas*

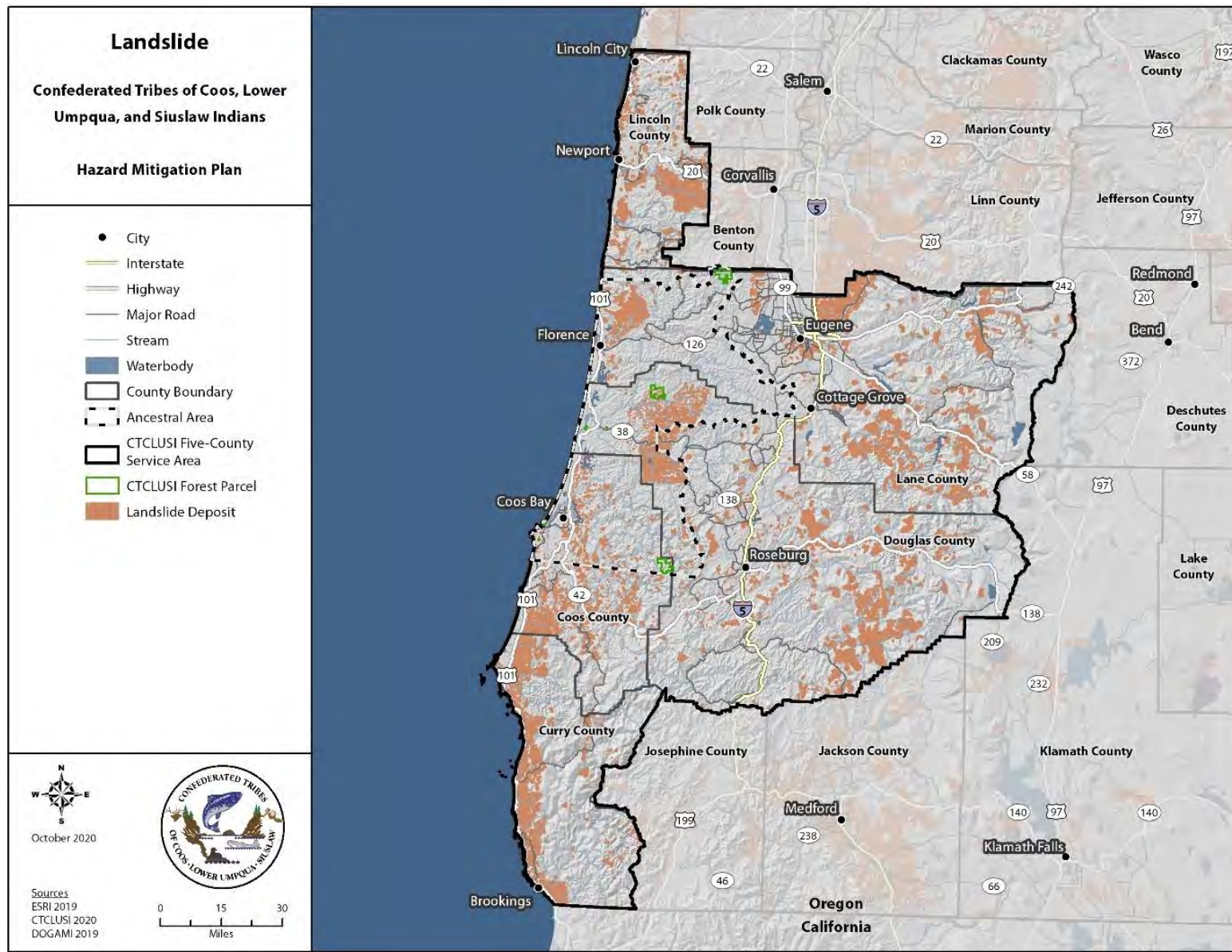
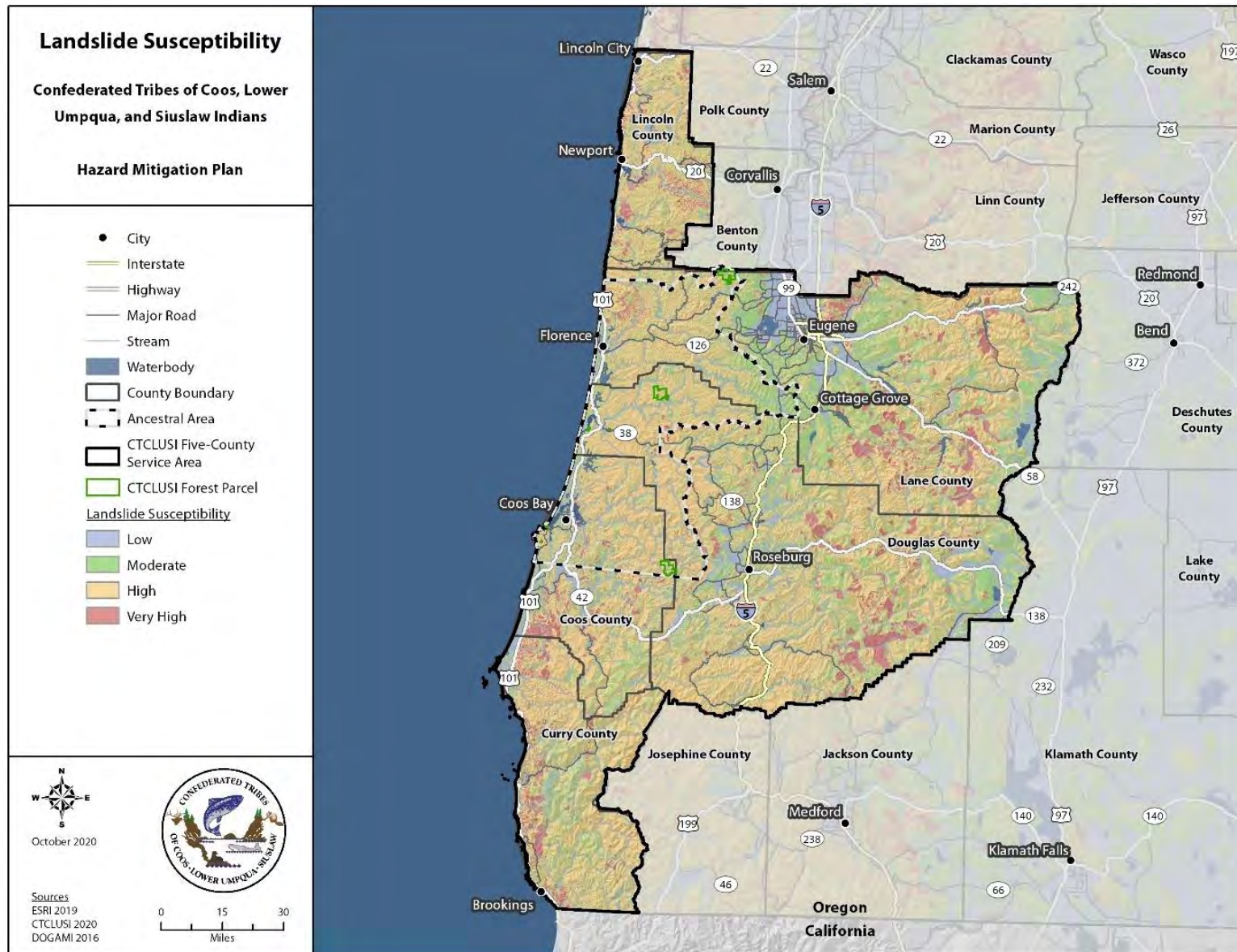




Figure 10-3. CTCLUSI Landslide Susceptibility Map



## 11 Severe Weather Events

### 11.1 General Background

Severe weather occurs all over the US and can take multiple forms, such as thunderstorms, drought, heatwaves, tornadoes, flash floods, and winter storms (Ready.gov, 2020). These varying types of storms can occur at any time of day or night and throughout the year. Severe weather events can damage or destroy structures, infrastructure, and the environment and result in injuries or loss of life. Severe weather events may be categorized into two groups (World Meteorological Organization, 2004):

- **General Severe Weather:** Systems that form over broad geographic areas that can cross regional and jurisdictional boundaries
- **Localized Severe Weather:** Storms in a limited geographic area

It is essential to note the distinction between extreme and severe weather. The most intense and rare weather events at a particular place and/or time are considered extreme weather; in contrast, common forms of storms that cause significantly more damage than usual are severe weather events (National Academy of Sciences, 2008). For example, in an area that experiences annual windstorms, when one storm is more violent than normal, it is severe weather.

Severe weather can trigger flooding, flash floods, storm surges, and erosion; these flood-related hazards are in Section 7 of this plan. Severe weather identified as a hazard in this plan (National Weather Service, 2009):

- **Thunderstorms:** A local storm with thunder and lightning can cause tornadoes, heavy rain, flash floods, hail, and high winds
- **Tornadoes:** A destructive rotating column of wind generated by a thunderstorm, shaped in a funnel that reaches the ground
- **Droughts:** Extended periods of deficient rainfall and snowpack leading to serious groundwater shortages impacting people, animals, and the environment
- **Excessive/Extreme Heat:** A combination of high temperatures and humidity, where the human body cannot maintain internal temperatures and can cause

### DEFINITIONS

**Drought:** Extended periods of extremely low rainfall and snowpack that lead to groundwater shortages impacting a large area of people, animals, and the environment.

**Excessive/Extreme Heat:** A combination of high temperatures and humidity, where the human body cannot maintain internal temperatures and can cause heat-stroke.

**General Severe Weather:** Systems that form over broad geographic areas that can cross regional and jurisdictional boundaries.

**Localized Severe Weather:** Damaging storms in a limited geographic area, can include all types of severe weather.

**Thunderstorm:** A local storm with thunder and lightning, can cause tornadoes, heavy rain, flash floods, hail, and high winds.

**Tornadoes:** A destructive rotating column of wind generated by a thunderstorm, shaped in a funnel that reaches the ground.

**Windstorm:** A storm featuring violent winds. Southwesterly winds are associated with intense storms moving onto the coast from the Pacific Ocean. Southern winds parallel to the coastal mountains are the strongest and most destructive winds.

**Winter Storm:** A cold event with significant precipitation in the form of snow, ice, freezing rain, sleet, etc. Higher elevations get more precipitation.



### 11.1.1 Potential Damage from Severe Weather Events

There are multiple forms of severe weather and a variety of potential damages. Thunderstorms can produce heavy rains, tornadoes, hail, lightning, and high winds. Heavy rains can lead to several secondary hazards, such as flooding, flash floods, mass earth movements, and coastal erosion; secondary hazards are in Section 9.3. Tornadoes are the most violent type of storm (National Weather Service), which can quickly destroy structures, infrastructure, the environment and result in injuries or the loss of life.

#### Hail Event

Hail are balls of ice that form inside thunderstorms (The National Severe Storms Laboratory). Hail size depends on how long the ice stays in the thundercloud and continues to add layers. Eventually, the weight is too much for the storm to hold, and the hail drops to the ground. The largest hail size recorded had a circumference of 18.62 inches, and it weighed one pound fifteen ounces (The National Severe Storms Laboratory). Hail can significantly damage vehicles, break windows, and cause human injury or death.

#### Lightning Event

If lightning hits a person, it can cause injury or loss of life. The high electrical current running through a body can damage the central nervous system, heart, lungs, and other vital organs (Krider). Lightning striking a building or power line can cause major electrical problems, including power outages, blown breaker boxes, blown transformers, and sometimes electrical fires (Krider). Under certain conditions, lightning-initiated fires can grow into wildfires.

#### Thunderstorm Event

Thunderstorms can bring high winds, sometimes called “straight-line” winds, to distinguish them from circular moving wind resulting in a tornado (The National Severe Storms Laboratory). High winds can reach up to 100 miles per hour and leave a destructive path that can extend hundreds of miles (The National Severe Storms Laboratory). These winds can directly damage structures and infrastructure and indirectly injure people struck by flying objects or cause loss of life.

#### Drought Event

Droughts are defined by their effects on people, animals, and the environment, which means the impacts determine when a weather event constitutes a drought (National Centers for Environmental Information). Droughts can have significant impacts on agricultural land and economies, animals, and human health. Droughts can also trigger several secondary hazards and cascading impacts; discussed in section 9.3

#### Excessive or Extreme Heat Event

Excessive or extreme heat can substantially affect every living thing, including humans, animals, and plants. Humans can experience heat-related illnesses such as heat stress, heat exhaustion, heatstroke, and in some cases, lead to loss of life (Centers for Disease Control, 2020). Extreme heat comes from a combination of temperatures above 90 degrees and high humidity over at least two days (Ready.gov, 2021). Warmer temperatures can reduce air quality and increase ozone levels (Centers for Disease Control, 2020). Excessive heat can lead to secondary hazards like wildfires and cascading impacts like rolling power blackouts, discussed in Section 11.4.

## 11.2 CTCLUSI Hazard Profile

CTCLUSI’s Service Area is located on Oregon’s Pacific coastline and extends inland. NOAA and FEMA have recorded major severe weather events, including flooding, severe weather, severe winter weather, and tornadoes (National Oceanic and Atmospheric Administration) (Federal Emergency Management Agency,

2020). High winds typically are associated with major storms, which form over the North Pacific between October and March and move along the coast and inland in a northeasterly direction (State Interagency Hazard Mitigation Team, 2020). Especially severe wind storms, such as the Columbus Day Storm in October 1962, are less common and can cause significant structural damage or loss of life (Western Regional Climate Center) (State Interagency Hazard Mitigation Team, 2020).

The climate along the coast is influenced by the ocean and characterized by mild temperatures, relatively dry summers, and cloudy and wet conditions the rest of the year. Storms coming off the Pacific Ocean are hazardous when combined with an El Niño wet season or a warm phase of the Pacific Decadal Oscillation (Woods Hole Oceanographic Institution). An El Niño occurs when the ocean and atmospheric system are disrupted, bringing heavy rains along the coast (Woods Hole Oceanographic Institution). These conditions often last one to two years.

#### December 14, 2006

The “Hannukah Eve” windstorm produced hurricane-force gusts and heavy rainfall. In Oregon, extensive tree damage was reported and caused damage to homes and power lines. More than 350,000 customers lost power at the peak of the storm. The governor requested a federal disaster declaration on January 31, 2007 (Douglas County Planning Department and Emergency Management, 2016)

The Willamette Valley is typically warmer in summer and cooler in winter; it also experiences less precipitation than CTCLUSI's coastal areas. Although, the mountains occasionally receive very heavy snowfall. In the Valley, extended dry periods can occur during the summer months. The risk of drought increases if winter precipitation is less than average or more precipitation falls as rain instead of snow, decreasing the amount of water from snowpack. Rising temperatures due to climate change could mean more extended droughts and more extreme heat events in the Service Area.

#### 11.2.1 Hazard Ranking

The Emergency Management Team completed a hazard ranking survey during the CTCLUSI 2022 HMP update process and assessed hazard-related factors based on worst case and most likely scenarios. Hazard definitions and ranking factors are in Table 5-1. Survey results were prioritized and ranked based on their averaged score. The severity, magnitude, frequency, onset, and duration variables are scored one to five, where one is the lowest and five is the highest. Compared to the other hazards in the survey, severe weather is the fifth worst-case scenario and the first most likely scenario.

Table 11-1. Severe Weather Hazard Ranking Output

Severity	Magnitude	Frequency	Onset	Duration	Average	Rank
<b>Worst-Case Scenario</b>						
3.25	4.75	4.5	4.5	3.75	4.15	5
<b>Most Likely Scenario</b>						
1.75	2.75	3.5	3	2.5	2.7	1

#### 11.3 Past Events

The National Oceanic and Atmospheric recorded 27 severe weather events that have resulted in injuries, deaths, or reported damages over \$25,000. Table 11-2 lists some of the most significant events in the Service Area; however, while these events occurred within the Five-County Service Area, CTCLUSI property was not damaged. The most damaging severe weather events were high wind storms, which

caused the only severe weather-related deaths recorded by NOAA in the Service Area. The most severe event was between September 7 and 8, 2020. The severity was due to wind-driven wildfires that overwhelmed many communities in the region. A complete list from CTCLUSI's 2006 HMP and surrounding county HMPs are in Appendix F.

*Table 11-2. Significant Severe Weather Events in the CTCLUSI's Five-County Service Area since 2006 (National Oceanic and Atmospheric Administration)*

Date	Type	Deaths or Injuries	Property Damage
<b>February 3, 2006</b>	High/strong wind	0	\$200,000
<b>March 7 2006</b>	High/strong wind	0	\$250,000
<b>December 14, 2006</b>	High wind	0	\$300,000
<b>December 2, 2007</b>	High wind	0	\$434,000
<b>February 11, 2010</b>	High wind	1 death	\$0
<b>November 18, 2012</b>	High wind	0	\$1 million
<b>September 5, 2013</b>	Lightning	1 injury	\$0
<b>October 25, 2014</b>	High wind	0	\$1.16 million
<b>December 10, 2015</b>	Thunderstorm wind	0	\$260,000
<b>February 23, 2018</b>	Heavy snow	0	\$349,000
<b>February 24, 2019</b>	Heavy snow	0	\$17.0 million
<b>September 7, 2020</b>	Strong wind	0	\$400.0 million
<b>September 8, 2020</b>	High wind	0	\$120.0 million

Past severe weather events have also resulted in federal disaster declarations for the Service Area. Some of the events in the last 15 years to note are in Table 11-3 below.

*Table 11-3. Service Area Severe Weather Disaster Declarations (Federal Emergency Management Agency, 2020)*

Year	Counties Affected	Event Type	Disaster Number
<b>2006</b>	Coos, Curry, Douglas, Lincoln	Severe storms, flooding, landslides, and mudslides	DR-1632-OR
<b>2006</b>	Lincoln	Severe storms, flooding, landslides, and mudslides	DR-1672-OR
<b>2006</b>	Lincoln	Severe winter storm and flooding	DR-1683-OR
<b>2007</b>	Coos, Curry, Lincoln, CTCLUSI	Severe storms, flooding, landslides, and mudslides	DR-1733-OR
<b>2011</b>	Douglas, Lincoln	Severe winter storm, flooding, mudslides, landslides, and debris flows	DR-1956-OR
<b>2014</b>	Lane, Lincoln	Severe winter storm	DR-4169-OR
<b>2015</b>	Coos, Curry, Douglas, Lane, Lincoln	Severe winter storms, straight-line winds, flooding, landslides, and mudslides	DR-4258-OR
<b>2016</b>	Lane	Severe winter storm and flooding	DR-4296-OR
<b>2019</b>	Coos, Curry, Douglas, Lane	Severe winter storms, flooding, landslides, and mudslides	DR-4432-OR

### 11.3.1 Location

Severe weather events can impact the entire CTCLUSI Service Area. Severe thunderstorms and hail, while rare, could affect any part of the Service Area and particularly Tribal properties at higher elevations. Tribal properties and Citizens along the coast and in exposed areas of the Willamette Valley or on ridges are more vulnerable to windstorm and flooding damage. The entire Service Area is vulnerable to severe snowstorms. Inland areas tend to have a higher frequency of occurrence; however, historically, there have been isolated snow events in the coastal region during winter storms. Drought and extreme heat may affect the entire Service Area, though extreme heat events are likely to occur more rarely at higher elevations.

The rainy season in the Valley extends from October through April, and the average annual precipitation ranges between 20 and 40 inches (McNamee, Highsmith, & Richard, 2021). The Willamette Valley receives an average of 10 to 15 inches of snowfall annually. Less commonly, heavy snowstorms can produce 20 to 25 inches of accumulation within 24 hours. Heavy snowstorms, while rare, typically affect parts of Oregon every few years (Western Regional Climate Center 2021).

Oregon's coast receives an annual average snowfall of only one to three inches, and in many years there is no measurable snow accumulation or significant ice or sleet. Winter storms primarily bring wind, rain, high tides, and strong waves. Due to its lower elevations, winter storms along the Coast Range produce more rain than snow. Average annual precipitation ranges between 60 and 120 inches along the coast, with higher elevations in the Coast Range receiving over 100 inches of precipitation (McNamee, Highsmith, & Richard, 2021).

#### December 1<sup>st</sup> to 4<sup>th</sup>, 2007

The "Great Coastal Gale" was a series of 3 powerful Pacific storms that affected the PNW. It produced hurricane-force winds and record flooding. The storms caused at least 18 deaths and direct financial losses of about \$300 million, and an estimated \$42 million in timber losses across the State (Lane County Hazard Mitigation & Emergency Management Steering Committee, 2018). Peak wind gusts in Lane County were measured at 87 miles per hour at the Sugarloaf Remote Automatic Weather Station (Lane County Hazard Mitigation & Emergency Management Steering Committee, 2018).

### 11.3.2 Frequency

The frequency of severe weather hazards varies. While hazards such as thunderstorms, hail, windstorms, and winter storms often occur multiple times each year, significantly damaging weather events are less frequent. In the past 50 years in CTCLUSI's Service Area, between 1970 and 2020, the frequency of occurrence for each type of severe weather hazard is summarized below (National Oceanic and Atmospheric Administration):

- **Thunderstorms/Tornadoes:** While thunderstorms are common in the warmer months, especially in higher elevations, approximately once every five years, severely damaging thunderstorms and potentially associated tornadoes occur less frequently.
- **Hail:** According to the NOAA National Centers for Environmental Information database, no damaging hail events have been reported in the Service Area since 1970. According to the data, hail events are likely to occur every one to two years.
- **Windstorms:** Windstorms are the most frequent damaging severe weather event in the Service Area and can occur annually.

- **Winter Storms:** While winter storms can occur annually, damaging snowstorms occur less frequently, approximately once every four years.
- **Drought:** These conditions are not typical for western Oregon. The State has only declared two droughts, one in 1992 and 2002. Based on the past events, droughts are likely to occur approximately once every 25 years.
- **Extreme Heat:** One instance of a death caused by extreme heat has been reported in the past 50 years in counties within the Service Area. Based on past events, extreme heat that causes injuries, deaths, or damage to property or crops rarely occurs in the CTCLUSI's Service Area

### 11.3.3 Severity

The Service Area can experience damage from all types of severe weather, including thunderstorms, snowstorms, and dangerous wind storms. Table 11-4 describes the severe thunderstorm categories. Tornado ratings are in Table 11-5. There are five drought levels in Table 11-6, and the Heat-Index risk levels are in Figure 11-1.

### Severe Storms and Thunderstorms

Thunderstorms occur more frequently in the mountainous parts of CTCLUSI's Service Area. Lightning associated with thunderstorms causes many forest fires each year (Western Regional Climate Center). High winds storms are more common and have resulted in loss of life and injuries in the Service Area. Wind direction and speed are influenced by the terrain along the coast and inland. For instance, in the Willamette Valley, prevailing wind directions are aligned north-south with the valley's orientation. On September 7, 2020, strong winds in the Service Area caused the highest cost of damage at \$400.0 million. The NWS provides five severity categories for severe storms and thunderstorms, shown in Table 11-4.

Table 11-4. NWS Severe Thunderstorm Risk Categories (National Weather Service)

Severity	Label	Impacts
None	Thunderstorms (no official label)	<ul style="list-style-type: none"> <li>▪ Severe thunderstorm not expected, winds up to 40 mph, and small hail</li> <li>▪ Lightning and floods can still occur</li> </ul>
1	Marginal (MRGL)	<ul style="list-style-type: none"> <li>▪ Limited duration and/or intensity isolated severe thunderstorms possible</li> <li>▪ Winds 40-60 mph</li> <li>▪ Low tornado risk</li> </ul>
2	Slight (SLGT)	<ul style="list-style-type: none"> <li>▪ Short term and/or not widespread, scattered severe thunderstorms and isolated intense storms are possible</li> <li>▪ Strong wind damage reports, maybe one or two tornadoes</li> <li>▪ Hail 1-inch diameter, and in isolated areas 2 inches</li> </ul>
3	Enhanced (ENH)	<ul style="list-style-type: none"> <li>▪ Persistent and/or widespread, numerous severe thunderstorms possible</li> <li>▪ Several strong wind damage reports with a few tornadoes</li> <li>▪ Damaging hail 1-2-inch diameter</li> </ul>
4	Moderate (MDT)	<ul style="list-style-type: none"> <li>▪ Longer widespread and intense thunderstorms likely</li> <li>▪ Widespread wind damage and strong tornadoes are possible</li> <li>▪ Destructive hail of 2-inch diameter or more</li> </ul>
5	High (HIGH)	<ul style="list-style-type: none"> <li>▪ Longer, very widespread, and especially intense thunderstorms expected</li> <li>▪ Tornado outbreak</li> <li>▪ Derecho</li> </ul>



Table 11-5. Enhanced Fujita Scale for Tornadoes (National Weather Service)

EF Rating	3 Second Gust (in mph)
0	65-85
1	86-110
2	111-135
3	136-165
4	166-200
5	Over 200

### Tornadoes

In the US, tornado intensity measurements are based on the Enhanced Fujita Scale (EF Scale). This scale defines a tornado's severity by the estimated wind speed and damages it causes, as shown in Table 9-5. Previous tornado events in the Service Area fell within an EF-0 to EF-3 range (National

Oceanic and Atmospheric Administration).

### Drought

Drought severity depends on several factors, including duration, intensity, geographic extent, and water supply needs in the Service Area. The measure of drought magnitude is in length of time and the water deficit severity. Prolonged droughts can have far-reaching consequences for agriculture and natural ecosystems, water quality, public health, infrastructure, and economies (National Integrated Drought Information System, 2021). Environmental factors can amplify droughts, such as prolonged high winds and wildfires. The effects of a drought, including limited food and water supplies, decreased water quality, and increased dust and wildfires, can result in long-term public health implications, particularly for vulnerable populations (Centers for Disease Control, 2020).

Table 11-6 – Drought Information System Measurements (National Integrated Drought Information System, 2021)

Drought Level	Drought Description
<b>D0: Abnormally Dry</b>	<ul style="list-style-type: none"> <li>- Dry soil, deliver irrigation early</li> <li>- Active fire season begins</li> </ul>
<b>D1: Moderate Drought</b>	<ul style="list-style-type: none"> <li>- Dryland pasture growth stunted, supplemental feed for cattle</li> <li>- Landscaping and gardens need irrigation earlier</li> <li>- Stock ponds and creeks are lower than normal</li> </ul>
<b>D2: Severe Drought</b>	<ul style="list-style-type: none"> <li>- Fire season is longer with high burn intensity, dry fuels, and a larger coverage area</li> <li>- More fire crews on staff</li> </ul>
<b>D3: Extreme Drought</b>	<ul style="list-style-type: none"> <li>- Federal water is not adequate for irrigation contracts, and extracting extra groundwater is expensive</li> </ul>
<b>D4: Exceptional Drought</b>	<ul style="list-style-type: none"> <li>- Many crop yields are low, affecting economies and households with possible food shortages</li> <li>- Fire season is costly and extensive, with numerous fires and large areas burned</li> <li>- Many recreational activities are affected</li> </ul>

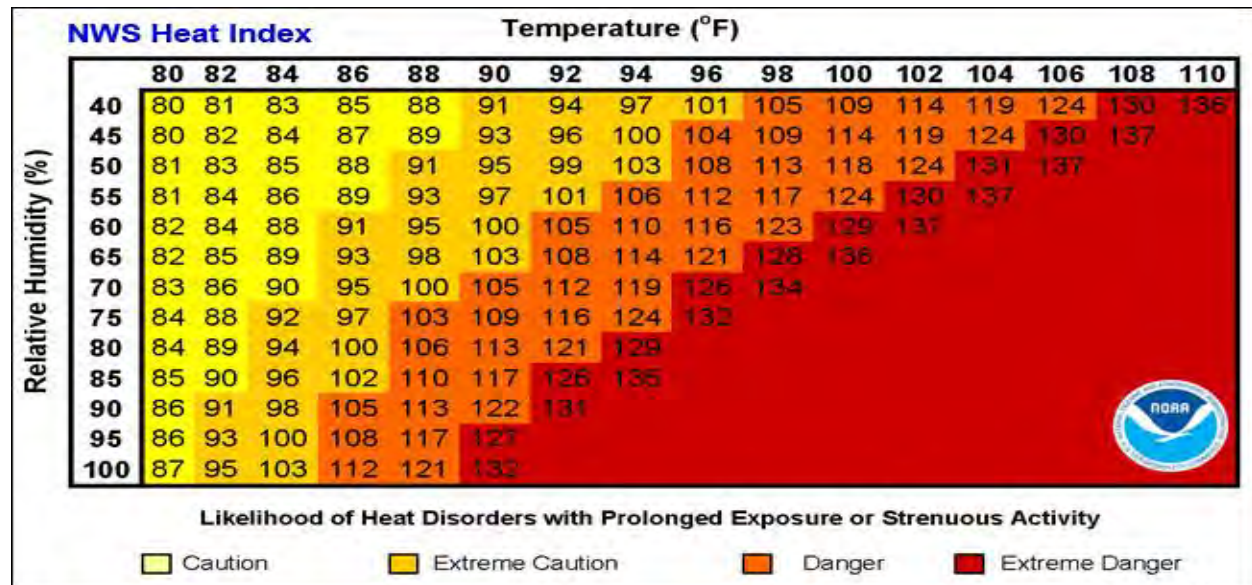
### Extreme Heat

Extreme heat events in the Service Area are already occurring more often and for longer lengths of time. The relationship between high temperatures and high humidity determines the extreme heat severity level. Increased humidity and higher than average nighttime temperatures contribute to the severity of an extreme heat event. Heatwaves increase demands on the electric system, increasing the risk of power outages, and can cause damage to roadways and other infrastructure. Although Tribal Citizens and local

communities may not experience extreme temperatures often, as climate change increases risks, citizens could use air conditioning and other cooling methods more often, adding new stresses to the power grid.

NOAA's table in Figure 11-1 illustrates the relationship between temperatures and relative humidity to provide the Heat-Index output level (National Oceanic and Atmospheric Administration). When the combined heat index reaches 90°F, citizens are at serious risk. Heat-related illnesses, like heat exhaustion or heat stroke, occur when the body cannot properly cool itself (Centers for Disease Control, 2020).

Figure 11-1. NOAA Heat Index (Leahy, 2019)



#### 11.3.4 Warning Time

##### Thunderstorm and Tornadoes

Meteorologists can often predict the likelihood of a severe storm, providing several days of advanced warning. For example, the NWS Climate Prediction Center issues long-range forecasts, with 8-14 day, monthly, and seasonal outlooks (National Weather Service) (National Oceanic and Atmospheric Administration and National Weather Service, 2021). However, specific aspects of a storm can be challenging to determine, such as where lightning strikes or how large hail will be (The National Severe Storms Laboratory). Numerous scientific factors inform predictions. However, with so many factors to account for, forecasts are not always correct or exact.

The NWS Portland office assesses potential weather and flood event factors to determine when to send emergency notifications and what warning level to set. The office also provides up-to-the-minute watches, warnings, and advisories for four categories of severe weather, listed in the table below.

Table 11-7. NWS Warnings and Advisories List (National Weather Service, 2021)

Convective/Tropical	Flooding	Winter Weather	Non-Precipitation
Tornado Watch	Flash Flood Watch	Winter Storm Watch	High Wind Warning
Tornado Warning	Flash Flood Warning	Winter Storm Warning	High Wind Advisory
Severe Thunderstorm Watch	Coastal/Flood Watch	Freezing Rain Advisory	

Convective/Tropical	Flooding	Winter Weather	Non-Precipitation
Severe Thunderstorm Warning	Coastal/Flood Warning	Ice Storm Warning	
Hurricane Watch	Small Stream Flood Advisory	Winter Weather Advisory	
Hurricane Warning			
Tropical Storm Watch			
Tropical Storm Warning			

## Drought

The NWS Climate Prediction Center provides a US Seasonal Drought Outlook that describes the changes that temperature and precipitation conditions will be below average, near-normal, or above normal in the future. The Climate Prediction Center uses data on patterns in oceanic and atmospheric currents together with climate and weather models and historical records to predict the likelihood that drought conditions will occur. Because the occurrence and severity of droughts depend on many variables, these outlooks are general and describe large-scale trends across country regions (National Integrated Drought Information System, 2021). Monthly and seasonal drought outlooks are available online at <https://www.cpc.ncep.noaa.gov/products/Drought/>.

Another tool for droughts is the Drought Early Warning System (DEWS). DEWS uses climate and drought science to predict future drought conditions, making the data accessible and valuable for decision-makers (National Integrated Drought Information System, 2020). The DEWS goal is to provide as much warning as possible to improve stakeholders' capacity to monitor, forecast, plan for, and cope with drought impacts (National Integrated Drought Information System, 2020).

## 11.4 Secondary Hazards and Cascading Impacts

### 11.4.1 Secondary Hazards

Severe weather can trigger several secondary hazards, such as accidental HAZMAT releases, mass earth movements, and flooding. They can also heighten the effects of storm surges, coastal erosion, and wildfires (Ready.gov, 2020). High winds in combination with SLR can drive higher than normal tides, contributing to coastal flooding. Intense thunderstorms can generate tornadoes, the most destructive weather type at a local scale (National Weather Service, 2009). Heavy rains can destabilize slopes, resulting in mass earth movements (United States Geological Survey).

Drier soil during a drought means less vegetation, increasing the risk of mass earth movements without the vegetation to stabilize slopes and surface erosion due to loose dry soil; mass earth movements are in Section 9. Lightning is the leading natural cause of wildfires and starts fires each year in mountainous and forested areas of the Service Area. Along with lightning strikes, droughts and extreme heat events substantially increase wildfire risks (National Centers for Environmental Information). Section 13 discusses wildfires further.

### 11.4.2 Cascading Impacts

The most common impacts caused by severe storms in the Service Area are disruption or loss of utilities and transportation infrastructure. Heavy snowfall, ice, rain, and wind associated with winter storms can disrupt transportation and emergency response services, damage utilities, cause power outages, and pose

health risks for people exposed to dangerously cold temperatures. Lightning, and tornadoes can knock out power, roads, communications and disrupt water management systems. Downed power and broken gas lines can start fires. High winds can topple trees, communication towers, and power lines. Damage to utilities and transportation infrastructure due to severe weather, drought, or extreme heat can increase public health risks for vulnerable populations due to power outages and disruptions to communications and emergency response services. This damage can also isolate Tribal Citizens, affect Tribal services, and cause economic loss for Tribal businesses.

During heatwaves, citizens may use more electricity at home, especially running air cooling units, which can overwhelm the electrical grid and cause rolling brown or blackouts. Brownouts are when power is still transmitted at a diminished capacity, while blackouts are a complete shutdown of affected power stations/substations (California Independent System Operator). Extreme heat can also disrupt transportation, limit construction activities, increase water demand, and increase wildfire risk (Centers for Disease Control, 2020). As storms escalate in frequency and severity all these cascading impacts could impact Tribal Citizens and CTCLUSI's properties.

### 11.5 Potential Impacts from Future Climate Conditions

Severe weather will occur more often and be more intense as climate change worsens (Environmental Protection Agency), resulting in more frequent and severe extreme heat days and heatwaves, droughts, and storms. As a result, the Service Area could see more extremely wet winters and springs at the current global carbon emissions rate. These extreme events could increase as much as 50 percent by the 2070s, compared to the increase between 1850 to the present (Constible, 2019). Additionally, higher temperatures for more extended periods in the Service Area mean more moisture evaporated into the atmosphere, amplifying rainfall and creating a cycle of extreme weather (Environmental Defense Fund).

If greenhouse gas emissions continue at current levels, average temperatures across Oregon are projected to increase by 5°F by around 2050 and 8.2°F by around 2080. The most significant seasonal temperature increases will occur in the summer. Additionally, increasing temperatures and changing precipitation and runoff conditions will affect severe weather hazards (State Interagency Hazard Mitigation Team, 2020) (Dalton & Fleishman, 2021):

- An increase in extreme precipitation events is projected for some areas along Oregon's coast, increasing the risk of secondary hazards such as landslides and flooding. However, there is little research regarding how climate change will influence winter storms and windstorms in the Pacific Northwest.
- As summers in Oregon continue to become warmer and drier and mountain snowpack decreases, the frequency of droughts is expected to increase.
- The frequency and severity of extreme heat days over 90°F are expected to continue to increase, with increases in nighttime lows expected to be greater than increases in daytime high temperatures.

Precipitation is projected to increase during winter and decrease during summer. Higher annual average temperatures contribute to drier conditions. The annual increase includes warmer weather in the winter with more precipitation in the mountains falling as rain instead of snow, resulting in less snowmelt in the summer to provide water in the drier summer months. Climate change factors have already increased temperatures and resulted in prolonged dry periods and severe drought conditions. These temperatures will continue to rise in the future, exacerbating already dry periods.

## 11.6 Exposure

### 11.6.1 Population

All CTCLUSI citizens are exposed to severe weather events to some extent. Certain areas are more exposed than others due to geographic location and localized weather patterns. Tribal Citizens living along the coast and Coastal Range are more susceptible to wind damage, utility loss, and flooding (URS, 2006).

### Vulnerability

CTCLUSI's vulnerable populations include those over 65 and children. These populations may suffer more secondary impacts from severe weather hazards or be isolated after weather events. Households and workplaces without indoor air conditioning expose more individuals to the health risks of extreme heat events. Households and Tribal Citizens that rely on private wells or small water supply systems are more vulnerable to water shortages during droughts. Power outages resulting from severe weather can be particularly harmful to those dependent on electricity for life support, heating, and air conditioning.

#### February 8, 2014

A major snow event with approximately 12 inches of snow to the southern Willamette Valley. It resulted in extended travel disruptions, power outages, and damage to infrastructure. Federal disaster number DR-4169 (Lane County Hazard Mitigation & Emergency Management Steering Committee, 2018)

### 11.6.2 Property

Tribal properties near the coast, including the Tribal administrative building and housing at Coos Bay and Florence, are exposed to coastal severe weather hazards, particularly winter storms and windstorms. All the facilities below are exposed to severe weather risks.

Table 11-8. CTCLUSI Facilities Exposed to Severe Weather

Facility Type	Total Facilities
Administration	4
Camp	11
Casino	3
Community	3
Housing	20
Lighthouse	1
Other	14
Ranch	3
<b>Total</b>	<b>59</b>

Table 11-9. Tribal Parcels at Risk from Severe Weather

Parcel Type	Total Parcels	Acres
Fee	51	430
Res	13	14,758
Trust	19	124
<b>Total</b>	<b>83</b>	<b>15,312</b>



Table 11-10. Forest Tracts at Risk from Severe Weather

Forest Tract	Total Stands	Sum of Acres
Coos Head	1	47.15
Macy	1	37.28
Talbot	1	36.61
Tioga	133	4565.54
Umpqua Eden	1	135.37
Upper Lake Cr.	118	646.96
Upper Smith	148	4934.78
<b>Total</b>	<b>403</b>	<b>10403.69</b>

### Vulnerability

All buildings owned by the CTCLUSI or Tribal Citizens are considered vulnerable to severe weather hazards; however, structures in poor condition are particularly vulnerable to damage. Buildings near the coast are more vulnerable to damage from high winds and storm surges, and buildings located under or near power lines or large trees may be damaged in the event these are felled by severe weather. Drought and extreme heat would not be expected to affect buildings.

#### 11.6.3 Critical Facilities

All critical facilities serving the Tribes and Tribal Citizens are potentially exposed to severe thunderstorms, winter storms, hail, and high winds. Facilities located on the coast or near wooded areas are particularly vulnerable to wind damage or damage from falling trees. Table 11-11 below shows all the Tribal critical facilities, all of them are at risk from severe weather.

Table 11-11. CTCLUSI Critical Facilities Exposed to Severe Weather

Critical Facility Type	Total Number	Sum of Acres
Communication	1	1
Maintenance	4	4
Power	1	1
Water/Wastewater	4	4
<b>Total</b>	<b>10</b>	<b>10</b>

### Vulnerability

All aboveground critical facilities are susceptible to wind and snow damage. Tribal facilities along the coast, including the Tribal administrative building, casino, lighthouse, maintenance facilities, and communications facilities, are more vulnerable to the effects of coastal winter storms and high winds.

#### 11.6.4 Environment

Severe weather events can radically affect the physical environment, altering surface geography and temporarily altering waterways. Some severe weather types can influence the environment significantly in a very short time, such as highly destructive tornadoes. Other severe weather forms can have slower harmful impacts, like prolonged heavy rain and more frequent and intense heatwaves. Higher temperatures and prolonged droughts reduce air quality and can be detrimental to vegetation. Secondary hazards such as flooding, coastal erosion, mass earth movements, and wildfires can change the ground's

surface, contaminate drinking water, change floodplains and waterways, and reduce vegetation. Cascading issues like downed powerlines can instigate wildfires, damaging the environment. These environmental impacts can impair or destroy CTCLUSI's buildings, infrastructure, cultural resources and alter their land.

### 11.7 Development Trends

Current and future development will be exposed to severe weather hazards. The vulnerability of future development to these hazards will be influenced by comprehensive land-use practices and building codes and regulations for new construction. The adoption of the CTCLUSI Building Code and the adoption of the Oregon Fire Code, Oregon Structural Specialty Code, and Oregon Residential Specialty Code, among others. These regulations can assist CTCLUSI and Tribal Citizens with developing mitigations to minimize the impacts of severe weather. The Tribal Planning Department can help guide land-use decisions and ensure compliance with all Tribal and building codes to help guide future growth and reduce severe weather impacts.

### 11.8 Issues

Issues associated with severe weather in the Service Area:

- CTCLUSI's access to backup power generation is limited.
- CTCLUSI's capacity to deal with snow and ice removal is limited and relies on outside service providers.
- Gregory Point is vulnerable to erosion and landslides during winter storms.
- Residential power outages can lead to health impacts due to improperly used generators (carbon monoxide poisoning), fires, and hypothermia.
- Heavy precipitation can erode drainage systems.

### 11.9 Hazard Maps

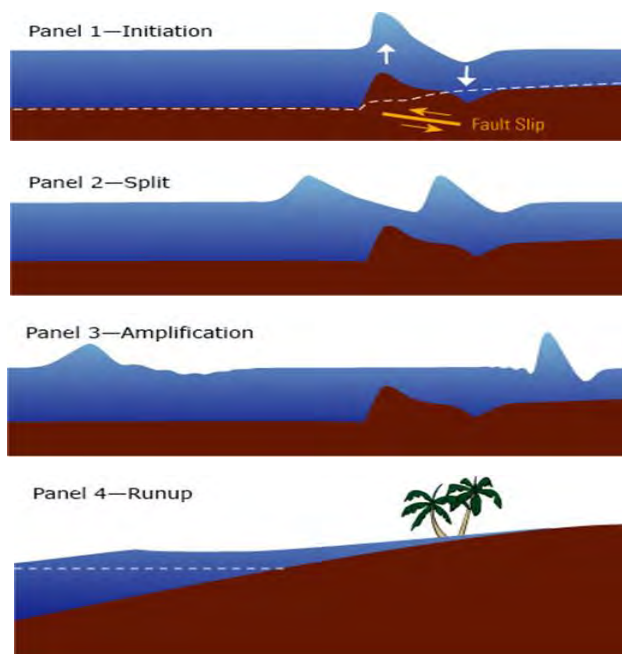
The entire Service Area is at risk from severe weather, so there are no specific maps for this hazard.

## 12 Tsunami/Seiches

### 12.1 General Background

Tsunamis are sizable waves caused by earthquakes, volcanic eruptions, landslides under the sea that impact coastlines, or major landslides from the shore that drop significant amounts of debris into water bodies (National Oceanic and Atmospheric Administration, 2019). As waves travel inland, they build to higher heights as the ocean's depth decreases (National Oceanic and Atmospheric Administration, 2019). Figure 12-1 shows how a water body is affected by an earthquake along a fault, generating a tsunami that inundates the coastline.

*Figure 12-1. Earthquake Triggered Tsunami Process (United States Geological Survey, 2006)*



Tsunami-generated waves can reach over 100 feet and travel at over 500 miles per hour, the same speed as a commercial jet (National Oceanic and Atmospheric Administration and National Weather Service, 2018). If a tsunami is close to the coastline, populations may only have minutes to prepare (United States Geological Survey). Major tsunamis occur globally about once per decade; 59 percent of the world's tsunamis occur in the Pacific Ocean, 25 percent in the Mediterranean Sea, 12 percent in the Atlantic Ocean, and 4 percent in the Indian Ocean (National Oceanic and Atmospheric Administration and National Weather Service, 2020).

### DEFINITIONS

**Arrival Time:** The time when the first wave of a tsunami hits the shore.

**Crest:** The highest point of the tsunami wave.

**Distant Source Tsunami:** A tsunami that begins a long distance from the coastline where it strikes.

**Evacuation Zone:** The area that needs to be evacuated when a tsunami is likely to reach the shore.

**Inundation Area:** Normally dry land that can or will be flooded by a tsunami. It is measured horizontally from the coastline moving inland.

**Runup:** A measurement of the height of the water onshore observed above a reference sea level.

**Tsunami:** Comes from the Japanese words for harbor ("tsu") and wave ("nami"); a long high sea wave caused by an earthquake, submarine landslide, or other disturbance.

**Tsunami from a large undersea earthquake:** The earthquake must cause significant vertical deformation on the seafloor for a tsunami to occur.

**Seiches:** A standing wave/oscillation in an enclosed or partially enclosed body of water that varies in a period from a few minutes to several hours.

### 12.1.1 Potential Damage from Tsunamis

Areas most at risk are near the coastline and waterways connected to the ocean, such as beaches, bays, lagoons, harbors, river mouths, and areas along rivers and streams. The coastline is where the water surges the highest and with the most force. Tsunamis also increase currents near the coastal waterline, damaging boats in the area and pulling people in the water farther out to sea. Destruction can occur inland as tsunamis carry large amounts of water and debris into coastal waterways and land. As the water surge recedes to the shore, it can also drag debris and people into the water body.

NOAA explains, even six inches of rapidly flowing water can push an adult over, while twelve inches of fast-moving water can carry larger objects like cars, trees, and small boats (National Oceanic and Atmospheric Administration, 2018). The influx of quickly flowing water and everything the water carries can impact anything in its path, including ships, harbors, buildings, infrastructure, natural and cultural resources, and people. Although tsunami waves cause damage, other hazards are associated with tsunamis, such as land erosion and flooding. Flooding, SLR, and Erosion are in Section 8.

## 12.2 CTCLUSI Hazard Profile

CTCLUSI's coastline is the most at risk of severe damage due to tsunamis. Although, tsunamis can also push large amounts of water up waterways and flood areas around ocean-connected channels. Figures 12-3 to 12-10 show zoomed map sections the Service Area exposed to a tsunami and associated flood zones. The maps are broken down into more accessible views of hazard areas, focusing in on Lincoln County, Newport, Lane County, Douglas County, Coos Bay, northern Coos County and southern Curry County, central Curry County, and southern Curry County. Tsunami waves are infrequent events but can be highly destructive. An earthquake in the CSZ, a 600-mile long fault zone that sits off the Pacific Northwest coast, can create a tsunami that will reach the Oregon coast within 15 to 20 minutes (Oregon Department of Geology and Minerals Industries).

After the 1964 magnitude 9.2 earthquake in Alaska, triggering a tsunami moving south along the entire west coast, from Washington to Southern California (United States Department of the Interior and United States Geological Survey, 2014). The incident caused extensive flooding along the coast and damaged harbors. There were sixteen deaths and millions of dollars in damage (United States Department of the Interior and United States Geological Survey, 2014). A distant tsunami produced by an earthquake or other disturbance far from Oregon may take four or more hours to travel across the Pacific Ocean, allowing time for warnings and evacuations, if necessary. A distant tsunami will be smaller and less destructive, but these tsunamis can still be very dangerous (Oregon Department of Geology and Minerals Industries).

Earthquakes are the primary cause of tsunamis, and there are hundreds of earthquake zones and active faults in and around the Service Area. These fault zones and seismic hazards, detailed in Section 6 of this plan. Past earthquakes that reached a “great” magnitude class ( $M > 8$ ) in other regions of the world resulted in tsunamis that struck CTCLUSI's coastline. Coastal communities in the Service Area, including the Tribal population centers of Florence, North Bend, and Coos Bay, are vulnerable to tsunami hazards. Local-generated tsunamis and earthquake-caused distant tsunamis can cause significant loss of life and injuries for people in low-elevation waterfront areas and result in costly damage to coastal communities and infrastructure.

### 12.2.1 Hazard Ranking

The Emergency Management Team completed a hazard ranking survey during the CTCLUSI 2022 HMP update process and assessed hazard-related factors based on worst case and most likely scenarios. Hazard

definitions and ranking factors are in Table 5-1. Survey results were prioritized and ranked based on their averaged score. The severity, magnitude, frequency, onset, and duration variables are scored one to five, where one is the lowest and five is the highest. Compared to the other hazards in the survey, tsunamis are the fourth worst-case and most likely scenario.

*Table 12-1. Tsunami Hazard Rating Output*

Severity	Magnitude	Frequency	Onset	Duration	Average	Rank
<b>Worst-case Scenario</b>						
5	4.5	2	5	4.75	4.25	4
<b>Most Likely Scenario</b>						
2.5	2.5	1.25	4	2.75	2.6	4

### 12.2.2 Past Events

CTCLUSI's Service Area has experienced the affects of tsunamis in the past. The geologic records indicate that over the last 10,200 years, approximately 45 tsunamis have been generated locally off the Oregon Coast along the CSZ. About 20 were from CSZ full-margin ruptures and struck the Oregon coast approximately 10 to 20 minutes after the earthquake (URS, 2006). The remaining 25 tsunami events primarily affected the southern Oregon coast, south of Cape Blanco (URS, 2006) (State Interagency Hazard Mitigation Team, 2020). Additionally, every coastal community in the Service Area has experienced tsunamis that have traveled from as far away as Japan, Chile, Alaska, Hawaii, and the Kamchatka Peninsula.

Since 1700, 10 reported tsunamis have affected coastal communities or caused observed effects within the Service Area (Federal Emergency Management Agency, 2021). The most recent damaging tsunamis were in 1964, resulting from the Great Alaska Earthquake, and in 2011 after the Great East Japan Earthquake. The March 11, 2011 tsunami reached the Oregon coast and caused approximately \$6.7 million in damage, including significant damage to the Port of Brookings (Federal Emergency Management Agency, 2011) (State Interagency Hazard Mitigation Team, 2020). There was one federal disaster declaration (FEMA-1964-DR) that resulted from a tsunami and impacted Coos, Curry, and Lincoln counties. Table 12-2 summarizes these tsunami events.

*Table 12-2. Reported Tsunamis within the CTCLUSI's Five-County Service Area Since 1700 (Federal Emergency Management Agency, 2020) (State Interagency Hazard Mitigation Team, 2020)*

Date	Origin	Communities	Details
<b>January 1700</b>	Cascadia Subduction Zone Offshore	Oregon Coast	An approximately 9.0 magnitude earthquake generated a tsunami that destroyed Native American villages along the coasts of Washington and Oregon and reached Japan.
<b>November 1873</b>	Northern California	Port Orford, Curry County	Debris observed at the high tide line of the tsunami
<b>April 1946</b>	Aleutian Islands	Bandon, Coos County, Depoe Bay, Lincoln County	Tsunami barely perceptible The bay was drained, and water returned as a wall.
<b>November 1952</b>	Kamchatka	Bandon, Coos County	Log decks broke loose from their supports



Date	Origin	Communities	Details
<b>May 1960</b>	South-Central Chile	Newport, Lincoln County	Tsunami crests were observed for about four hours
<b>March 1964</b>	Gulf of Alaska	Coos Bay, Coos County Depoe Bay, Lincoln County Florence, Lane County Gold Beach, Curry County	\$20,000 in damage \$5,000 in damage; four children drowned at Beverly Beach \$50,000 in damage \$30,000 in damage
<b>May 1968</b>	Japan	Newport, Lincoln County	Observed
<b>April 1992</b>	Northern California	Port Orford, Curry County	Observed
<b>March 2011</b>	Japan	Oregon Coast	Observed ocean waves. \$6.7 million in damage, including extensive damage to the Port of Brookings
<b>January 2018</b>	Kodiak Island, Alaska	Oregon Coast	Magnitude 7.9 earthquake caused minor tsunami impacts on the West Coast. The largest tsunami amplitude was measured at 25 centimeters in Crescent City, CA.

### 12.2.3 Location

CTCLUSI's Service Area along the coastline is susceptible to tsunami hazards. Citizens, properties, natural resources, and other Tribal assets located on the coast are at the greatest risk of damage from a tsunami. Figures 12-3 through 12-10 show the modeled tsunami inundation zones in the Service Area for the worst-case scenario tsunami event. As shown in these maps, tsunami inundation zones affect the immediate coastline the most; although, they can extend inland for up to several miles in low-lying areas and along waterways like the Siletz and Siuslaw rivers. Tribal properties and critical facilities within the tsunami inundation zone are discussed in Sections 12.5.2 and 12.5.3.

### 12.2.4 Frequency

As described in Section 12.1, tsunamis occur due to significant water displacement from events such as earthquakes, volcanic eruptions, and landslides. Therefore, the frequency of tsunamis is relative to the frequency of events that cause them. CTCLUSI's Service Area has experienced ten damaging tsunamis over the past 320 years and has been significantly impacted by three. Based on these historical events, the Tribes may encounter a damaging tsunami event on average, approximately once every 30 years.

### 12.2.5 Severity

Tsunami severity depends on three factors: the trigger site's location relative to the impact area, magnitude or size of the triggering event, and depth of the trigger event. Most earthquake-generated tsunamis come from magnitudes 7.0 and greater in shallower water, less than 62 miles below the surface (National Oceanic and Atmospheric Administration). The earthquake must be large enough and close enough to the water surface to generate a significant wave or series of waves classified as a tsunami.

A tsunami's height and impacts are influenced by local water depth, sea-floor or ground topography, and the direction of the tsunami (National Weather Service). The damage from a tsunami can range from

minimal to substantial, depending on the tsunami's severity. Even a six-foot tsunami can bring powerful currents that knock people over and carry them away (United States Geological Survey).

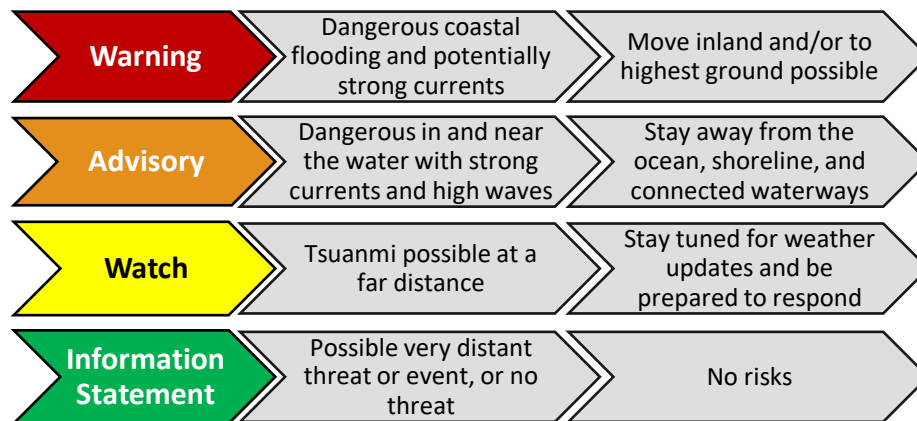
#### 12.2.6 Warning Time

The warning time before a tsunami hits can vary from minutes to hours. A local tsunami, especially one that follows a significant earthquake, will not allow much time for official warning and evacuation. To produce more accurate predictions, the NOAA tsunami warning centers use a vast network of sensors to determine which events will most likely result in a tsunami; when a tsunami is predicted, the centers then issue warnings to the appropriate locations (National Oceanic and Atmospheric Administration, 2018).

For CTCLUSI, the primary warning of a potential tsunami is a large earthquake. When the West Coast/Alaska Tsunami Warning Center (WCATWC) detects an earthquake with the potential to generate a tsunami in the Pacific Ocean, the Warning Center alerts communities at risk along the coasts of Oregon, Washington, California, British Columbia, and Alaska. There are four tsunami alert types defined by the NWS, listed in Figure 12-2. There are also natural signals before a tsunami arrives, such as (National Oceanic and Atmospheric Administration and National Weather Service, 2020):

- Severe ground shaking from local earthquakes
- Coastal water receding and exposing the ocean floor, reefs, and fish, and abnormal ocean activity
- A wall of water creating a loud roaring sound like a train or jet aircraft

Figure 12-2. Notifications (National Oceanic and Atmospheric Administration and National Weather Service, 2020)



### 12.3 Secondary Hazards and Cascading Impacts

#### 12.3.1 Secondary Hazards

Tsunamis can generate a couple of secondary hazards, such as flooding, mass earth movements, and accidental HAZMAT releases. The most common secondary hazard is flooding. High wave action and strong currents can significantly speed up natural erosion along the coast and connected waterways. The tsunami inundation can also generate secondary hazards, including landslides and other mass earth movements, significant coastal erosion, and hazardous materials releases. Flooding and SLR hazards to the Service Area are addressed in Section 8.

#### 12.3.2 Cascading Impacts

Tsunamis can carry tons of debris, endangering Tribal Citizens, CTCLUSI's property, environment, and cultural resources. Depending on the severity, the surging water and debris can shut down utilities, Tribal services, and roads immediately along the coast for weeks or even months until repairs are complete.

Coastal structures such as breakwaters, piers, port facilities, and public utilities may get swept away by the water or collapse from the foundation, eroding after the water recedes. Ships moored in marinas or harbors may be destroyed or washed up onto the shore. Impacted vessels and coastal facilities can release hazardous materials into the environment. Harmful materials can be structure debris itself or anything hazardous the facilities and vessels contained. These materials could contaminate the floodwater and potentially drinking water.

Tsunami waves move water across land near coasts and coastal waterways, inundating typically dry areas. Sedimentation traveling with the waves can resettle in rivers, streams, and coastal waters, reducing water quality for people and the environment.

## 12.4 Potential Impacts from Future Climate Conditions

Future climate conditions are not likely to affect the undersea earthquakes, volcanic eruptions, or landslides that may generate tsunamis. However, the projected increase in severe storms may make coastal areas more prone to landslides that a tsunami could trigger. Increased floodwaters and standing water left by a tsunami can oversaturate soils and erode underlying layers resulting in mass earth movements, see Section 10 for more details.

## 12.5 Exposure and Vulnerability

### 12.5.1 Population

The exposure and vulnerability assessment for the tsunami hazard is based on the worst-case scenario for tsunami inundation, using a scenario developed by DOGAMI. Based on this scenario, 38 Tribal Citizens out of a recorded total of 426 Citizens (8.9 percent of all Tribal Citizens) reside within the modeled tsunami inundation zone. The Service Area within the worst-case modeled inundation zone includes parts of Lincoln City, Newport, Florence, Coos Bay, North Bend, and Brookings. Table 12-3 shows Tribal Citizens in the tsunami inundation zone.

*Table 12-3. Tribal Citizens in the Tsunami Inundation Zone*

Row Labels	Sum of Population
<b>Tsunami Inundation Zone</b>	38
<b>Grand Total</b>	<b>38</b>

### Vulnerability

Population vulnerability to tsunamis depends on the number and location of citizens in the potential inundation zone and their ability to evacuate low-lying areas before the tsunami arrives. The most vulnerable to tsunami hazards are elders, people with limited mobility, children, pregnant women, and low-income populations that rely on public transportation. The CDC defines three types of human health risks from a tsunami: immediate secondary and long-lasting (Center for Disease Control, 2013). In the immediate aftermath of a tsunami, people can be trapped by debris or water. The secondary tsunami concern is food and potable water contamination and requires temporary shelter for displaced people.

Direct impacts to Tribal Citizens and the community can include disease and illness spread from contaminated food and drinking water and dead remains of animals or humans before removing inadequate sanitation in shelters and temporary living situations. Standing floodwater can also cause insect population growth, spreading disease, or consuming food supplies. Epidemic and pandemic hazards are detailed in Section 7.

### 12.5.2 Property

Property damage from a severe tsunami may be widespread and catastrophic along the coast and in low-lying inland areas along rivers and streams. Tables 12-4 to 12-6 show the exposure of CTCLUSI's facilities, forest stands, and parcels to inundation under the modeled worst-case scenario tsunami. Three Tribal facilities along the coast would be exposed to inundation under the worst-case scenario, along with forest stands at Coos Head and Umpqua Eden. Two of CTCLUSI's 403 forest stands (less than 0.5 percent) are within the modeled inundation area. There are 26 Tribal parcels (31.3 percent of all Tribal parcels) within the modeled inundation area. Most of these parcels (15 parcels) are fee simple parcels.

Table 12-4. Exposure of Tribal Facilities to Tsunami Hazards

Facility Type	Total Facilities	Inundation Worst-Case Scenario
Administration	4	0
Camp	11	1
Casino	3	0
Community	3	0
Housing	20	0
Lighthouse	1	1
Other	14	1
Ranch	3	0
<b>Total</b>	<b>59</b>	<b>3</b>

Table 12-5. Exposure of Forest Tracts to Tsunami Hazards

Forest Tract	Total Stands	Worst-Case Scenario Inundation
Coos Head	1	1
Macy	1	0
Talbot	1	0
Tioga	133	0
Umpqua Eden	1	1
Upper Lake Cr.	118	0
Upper Smith	148	0
<b>Total</b>	<b>403</b>	<b>2</b>

Table 12-6. Exposure of Tribal Parcels to Tsunami Hazards

Parcel Type	Total Parcels/Acreage	Worst-Case Scenario Inundation
Fee	51/430	15
Reservation	13/14,758	5
Trust	19/124	6
<b>Total</b>	<b>83/15,312</b>	<b>26</b>

### Vulnerability

Nearly all structures and property located within the tsunami inundation zone are vulnerable to damage or destruction by a major tsunami. Buildings and structures may be destroyed or damaged to the point

that they are structurally unsafe. Trees can be toppled and washed away. Reinforced concrete buildings may be less vulnerable but would likely still be damaged by wave action and debris.

### 12.5.3 Critical Facilities

Table 12-7 shows the exposure of the Tribes' critical facilities, including communication, maintenance, power, and water/wastewater facilities, to inundation under the worst-case tsunami scenario developed by DOGAMI.

*Table 12-7. Exposure of Tribal Critical Facilities to Inundation under Worst-Case Scenario Tsunami*

Critical Facility Type	Total Number	Worst-Case Scenario Tsunami
Communication	0	0
Maintenance	4	0
Power	1	0
Water/Wastewater	4	0
<b>Total</b>	<b>10</b>	<b>1</b>

### Vulnerability

All structures and property located along tsunami inundation areas would be vulnerable, especially during events with little to no warning time.

### 12.5.4 Environment

A tsunami could have a devastating impact on CTCLUSI's environment, wildlife, vegetation, and other natural resources. A severe tsunami can change the landscape by eroding beaches and coastal features, uprooting trees, and destroying animal habitats. Inundation with seawater for long periods can make the soil less fertile for vegetation and increase erosion rates. Tsunami events can also alter the availability of fresh water and make waterways unnavigable.

A tsunami can change the surface of the land above and below the water. In some areas, the tsunami can push the ground farther up, and in other areas, the water can erode the ground, lowering the surface. If the tsunami pushes water up waterways, it can expose new areas to flooding. Tsunami debris can clog waterways and leave a path of wreckage on the land when the water recedes.

## 12.6 Development Trends

Depending on the severity of the tsunami, environmental changes can include permanent modifications to beaches and coastal features, and freshwater sources can be contaminated by saltwater or hazardous materials released by the tsunami. These environmental impacts can affect CTCLUSI's services, businesses, and cultural and natural resources by changing land geography, topography, and environmental habitats.

Current and future development along the coast is exposed to tsunamis. The vulnerability of future development to these hazards will be influenced by comprehensive land-use practices and building codes and regulations for new construction, such as building back behind the worst-case scenario zones. The adoption of the CTCLUSI Building Code and the adoption of the Oregon Fire Code, Oregon Structural Specialty Code, and Oregon Residential Specialty Code, among others. These regulations can assist CTCLUSI in developing mitigations to minimize the impacts of tsunami inundation. The Tribal Planning



Department can help guide land-use decisions and ensure compliance with all Tribal and building codes to help guide future growth and reduce the risk from a tsunami.

### 12.7 Issues

Issues associated with tsunamis in the CTCLUSI's Service Area:

- Tsunami science and technology are continually evolving. Therefore, hazard maps should be regularly reviewed and updated.
- Monitor tsunami warning systems and update as new versions or technologies are released.
- Continue to assess SLR's potential impacts on tsunamis as new data and models update predictions
- CTCLUSI needs to address the specific needs of vulnerable citizens in the hazard zone through Tribal education on actions to take before, during, and after a tsunami and ways Tribal Citizens can request evacuation and recovery assistance.

### 12.8 Hazard Maps

The hazard maps for tsunami risks in the Service Area start on the next page.

Figure 12-3. CTCLUSI Tsunami Map for Lincoln County

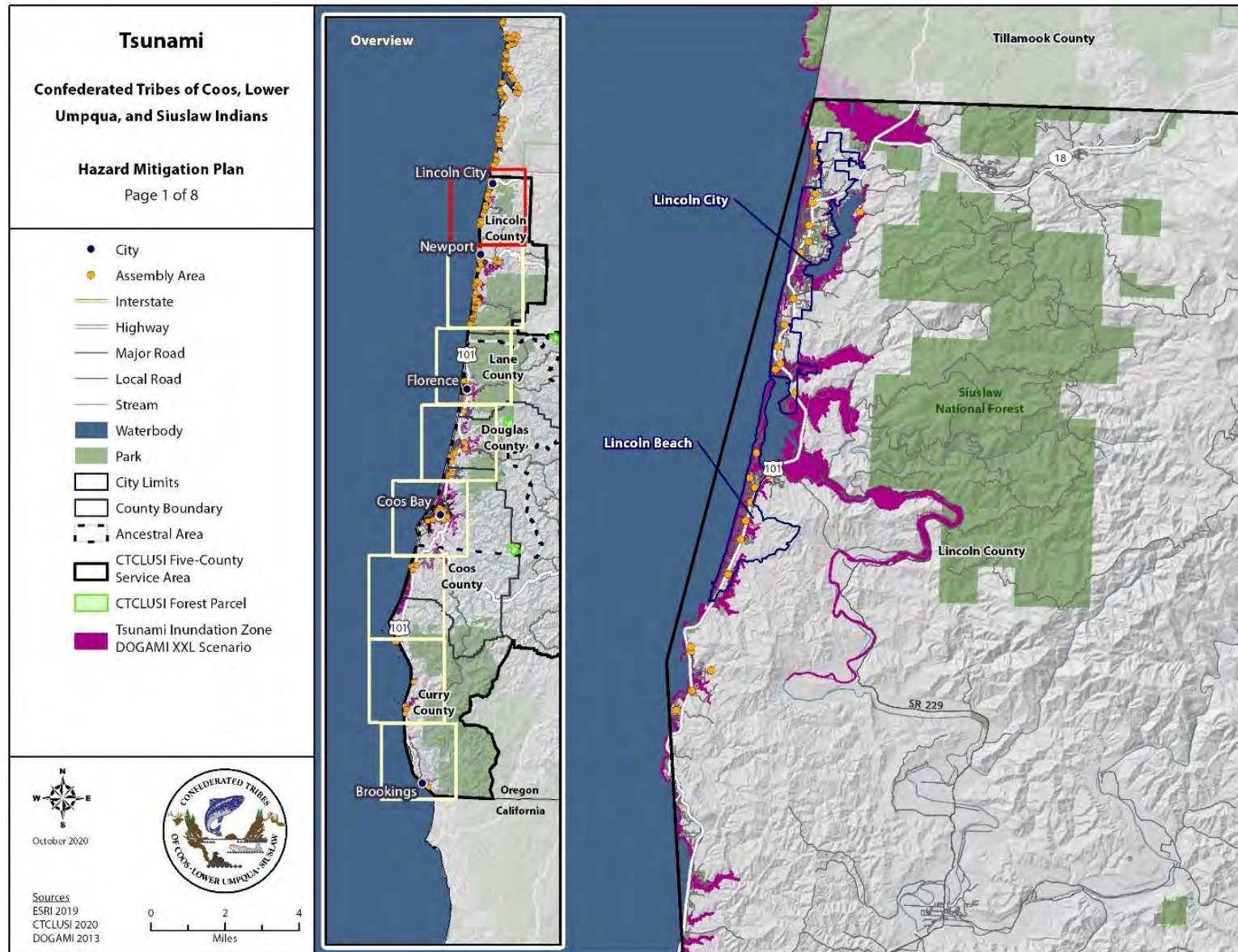




Figure 12-4. CTCLUSI Tsunami Map for Newport

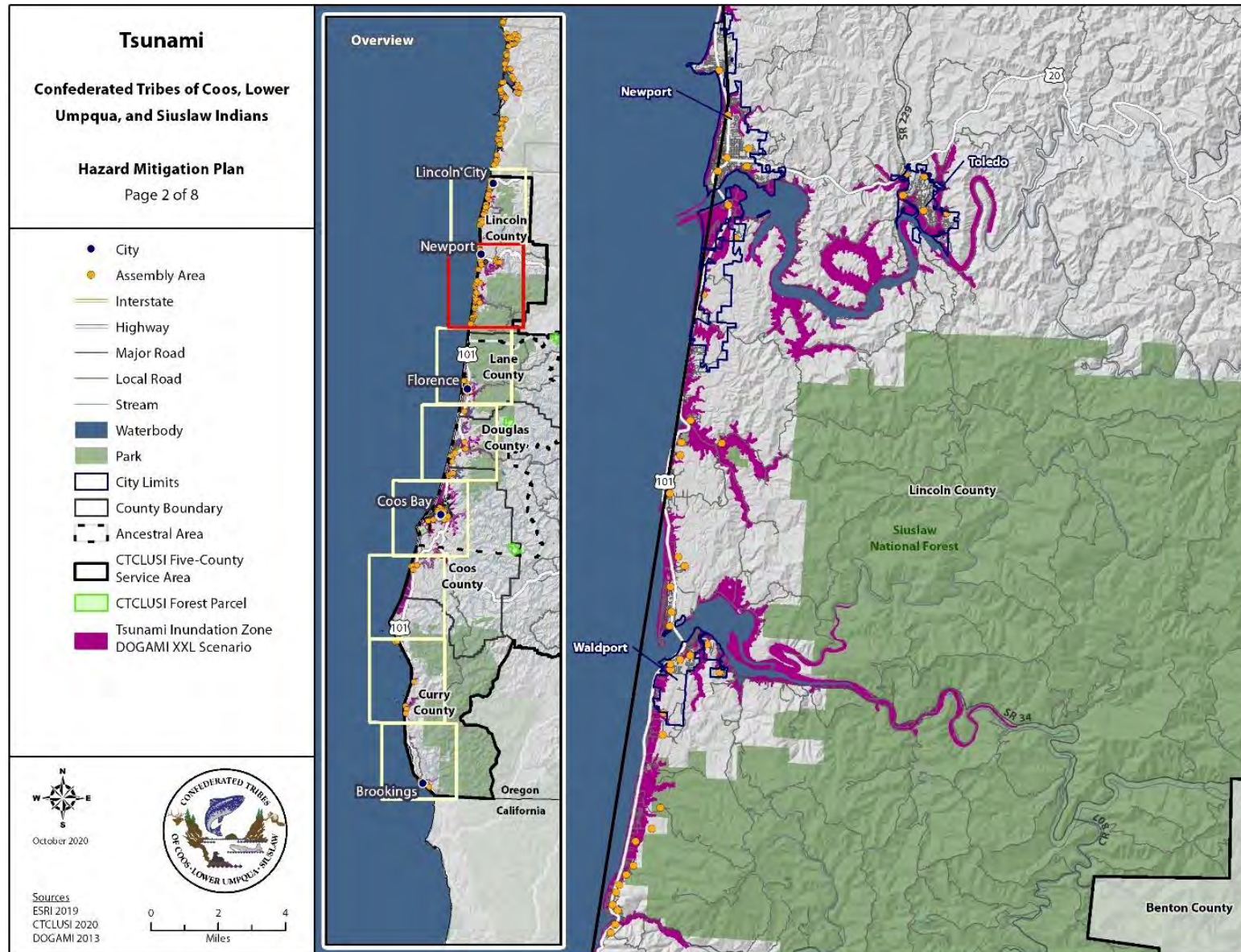




Figure 12-5. CTCLUSI Tsunami Map for Lane County

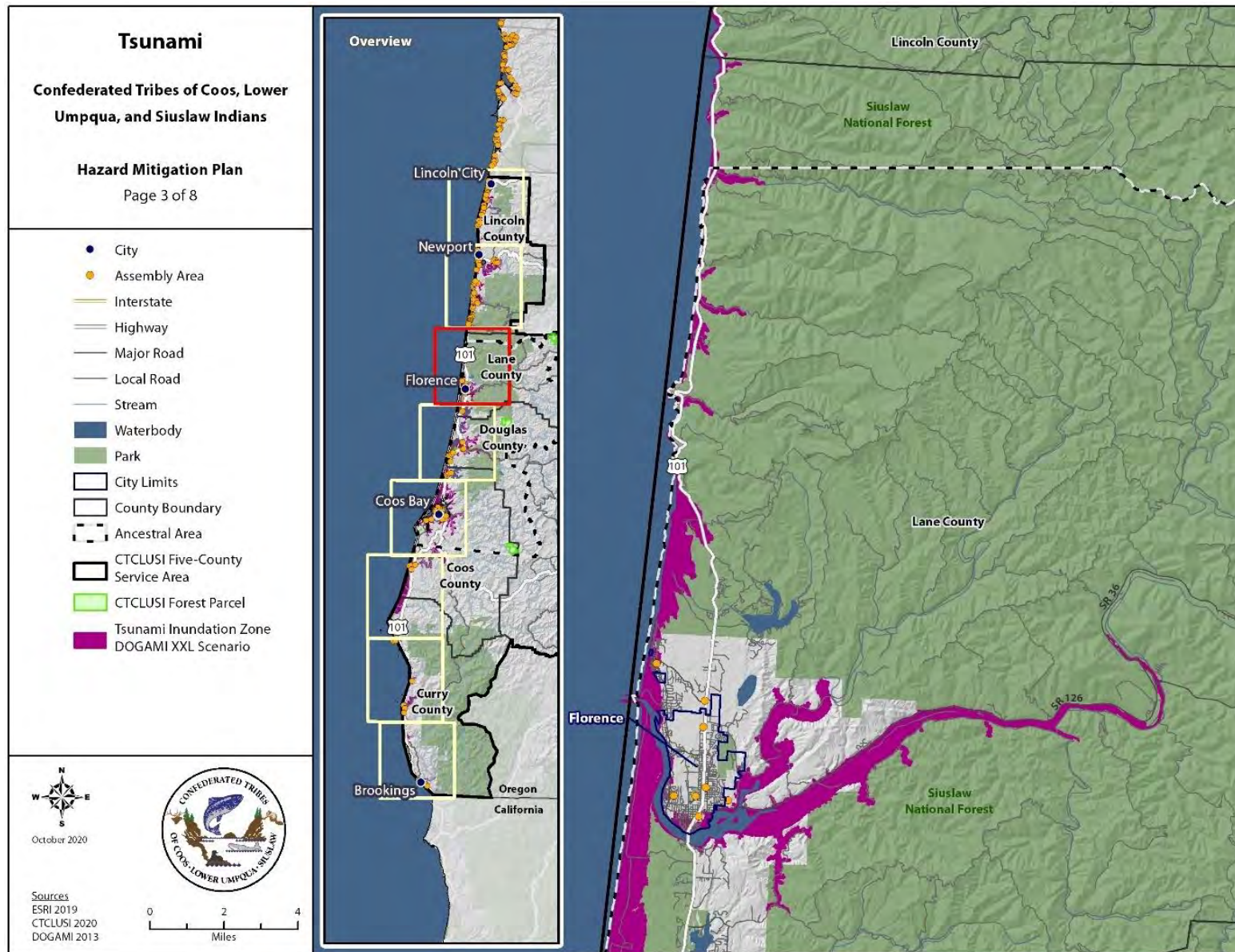




Figure 12-6. CTCLUSI Tsunami Map for Douglas County

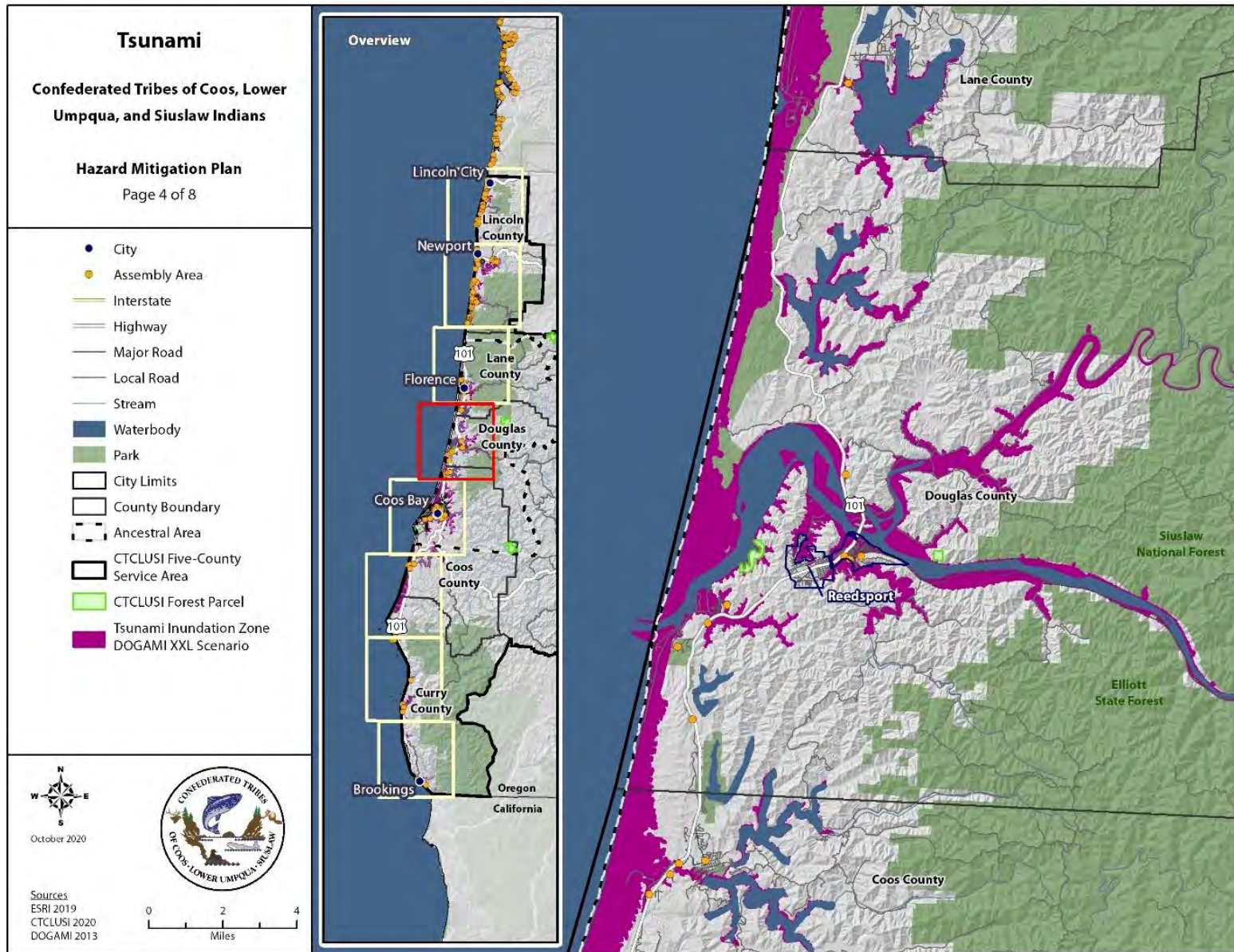




Figure 12-7. CTCLUSI Tsunami Map for Coos Bay

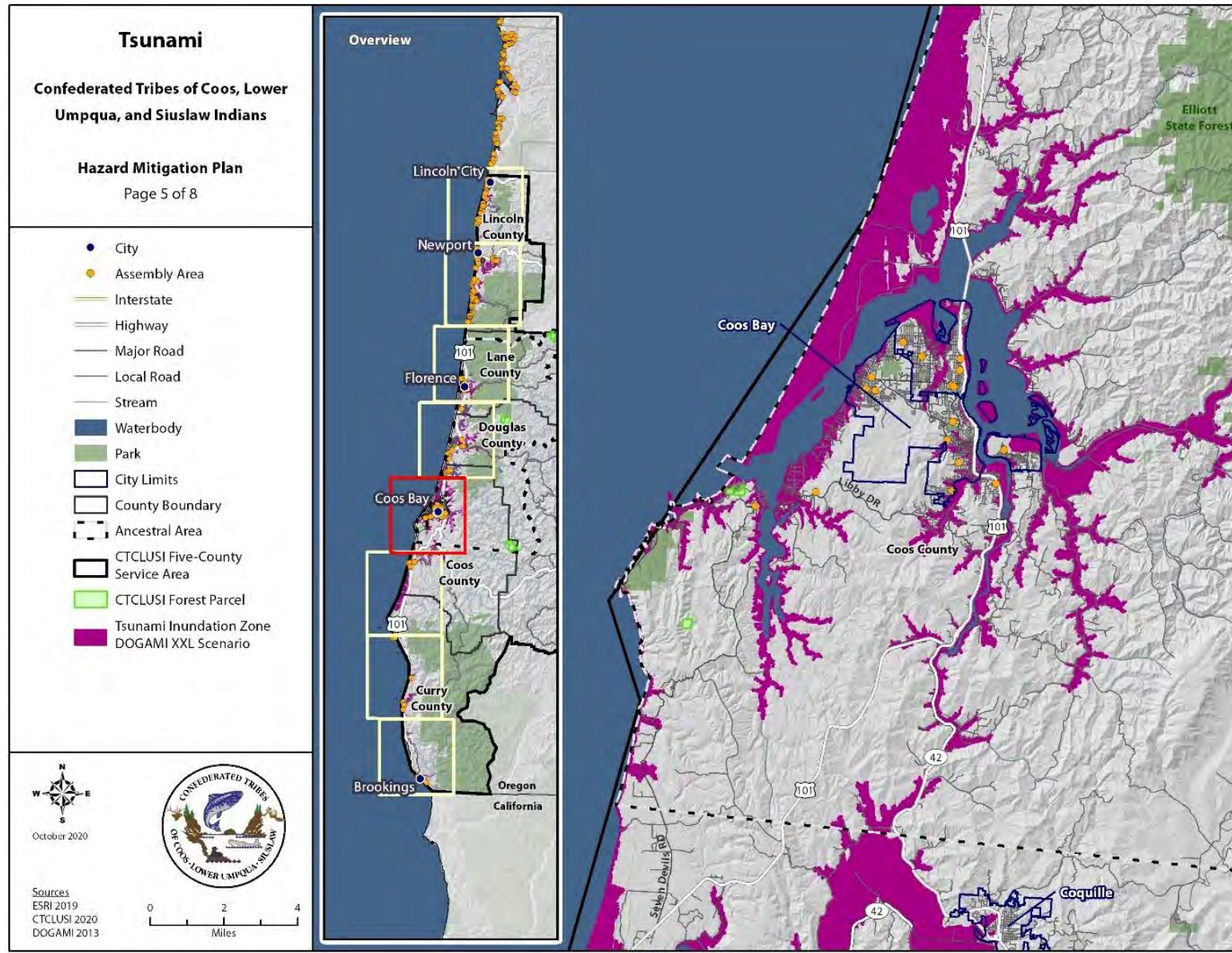




Figure 12-8. CTCLUSI Tsunami Map for Southern Coos County and Northern Curry County

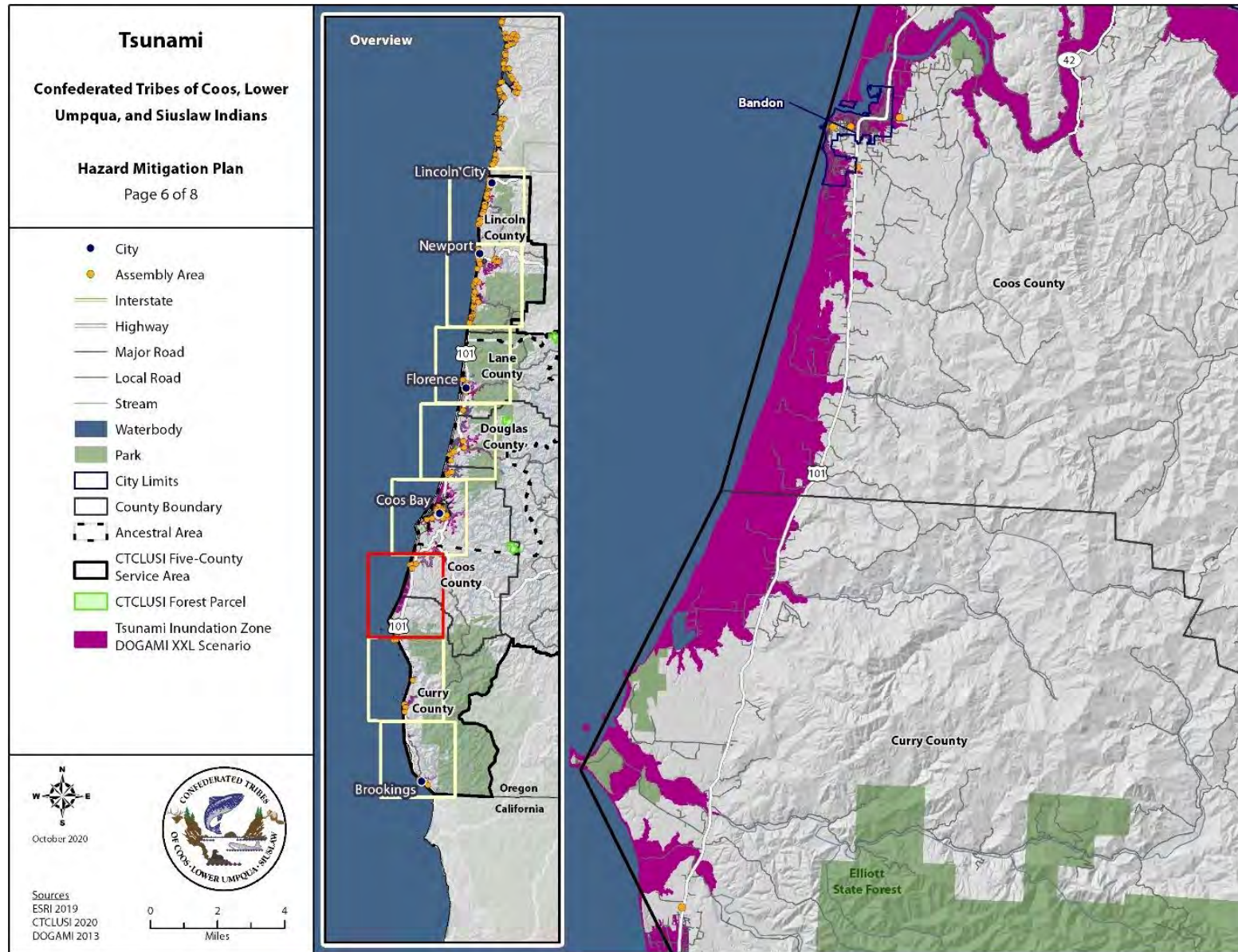


Figure 12-9. CTCLUSI Tsunami Map for Central Curry County

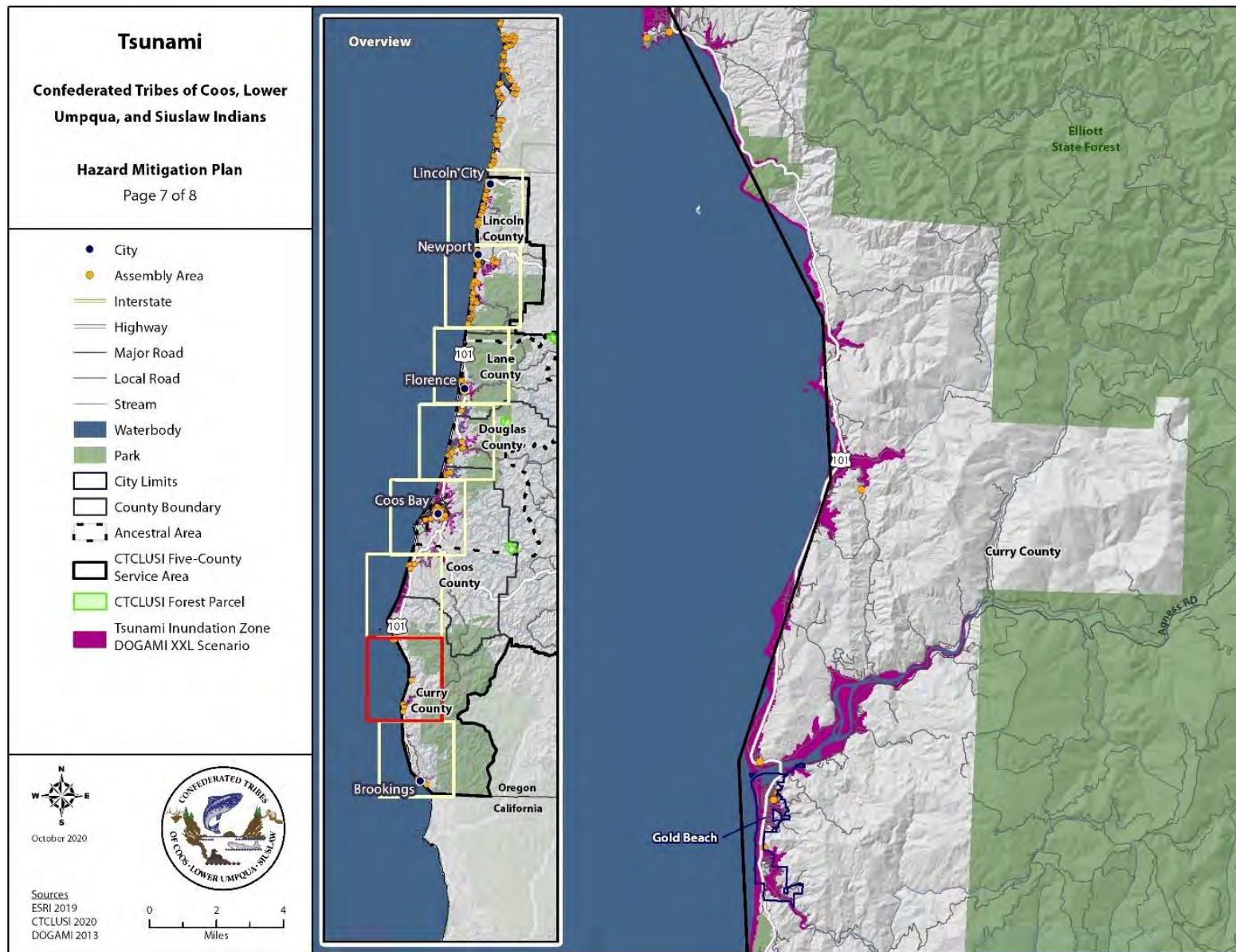
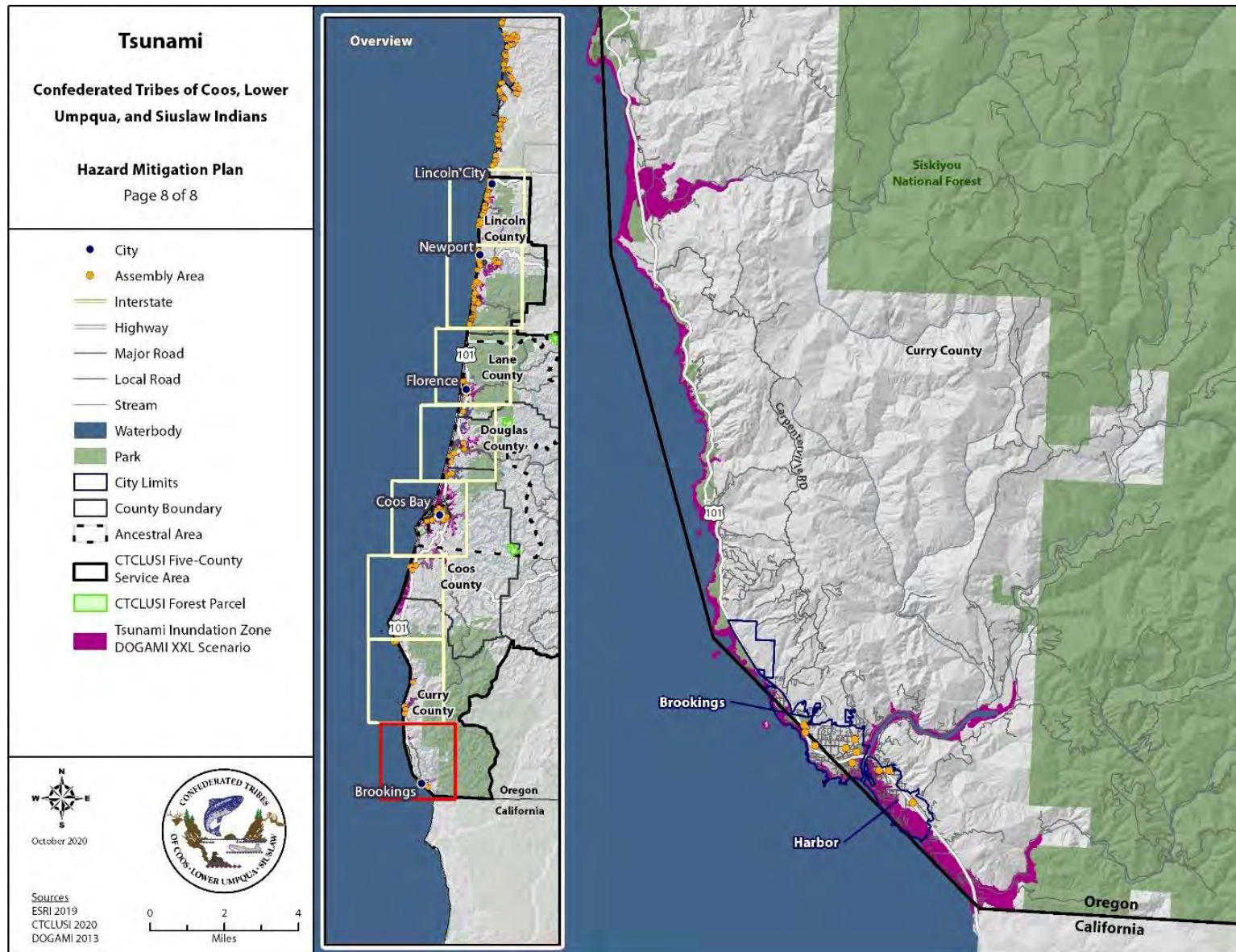




Figure 12-10. CTCLUSI Tsunami Map for Southern Curry County



## 13 Wildfires

### 13.1 General Background

A wildfire, or wildland fire, is an unplanned fire that burns uncontrolled in forests, grasslands, brushlands, or croplands (Editors of Encyclopedia Britannica, 2020). The name refers to the fire's characteristics and region (Editors of Encyclopedia Britannica, 2020). There are two types of wildfires: ground and surface. Ground fires burn underground into the vegetation's roots; this is most common when a thick layer of flammable organic matter is in the soil's top layer (National Geographic Society, 2019). Surface fires burn vegetation above the soil. A wildfire fire's behavior depends on three key factors, weather, topography, and fuel, in Figure 13-1.

*Figure 13-1. Wildfire Behavior Triangle (National Park Service, 2017)*



Wildfires can occur year-round due to natural and human-caused ignitions. The most common natural cause of wildfires is lightning, although volcanoes and meteors can also generate wildfires (United States Department of the Interior Indian Affairs). These natural hazards can ignite fires; however, nearly 85 percent of wildfires in the US are caused by human activity (e.g., campfires and arson) (National Park Service, 2018).

Massive wildfires are more common during droughts and warmer seasons due to drier vegetation and soil, lower groundwater levels, and less precipitation. High winds can exacerbate warm, dry conditions and spread wildfires considerably further. The US Forest Service Southern Research Station administered a report that studied the conceptual model that shows the relationship between ignition types, prevention methods, and extent factors in Figure 13-2 (Prestemon, et al., 2013). This model demonstrates the complicated nature of wildfire causes, severity, spread, and management. It can assist organizations in understanding all aspects of wildfire risks and develop effective mitigation actions.

### DEFINITIONS

**Fuels:** Materials that burn in a fire, such as paper products, flammable gases or chemicals, or wood products. The material composition determines how flammable it is, based on moisture level, chemical makeup, and material density. The less moisture and lower density, the faster and hotter it burns.

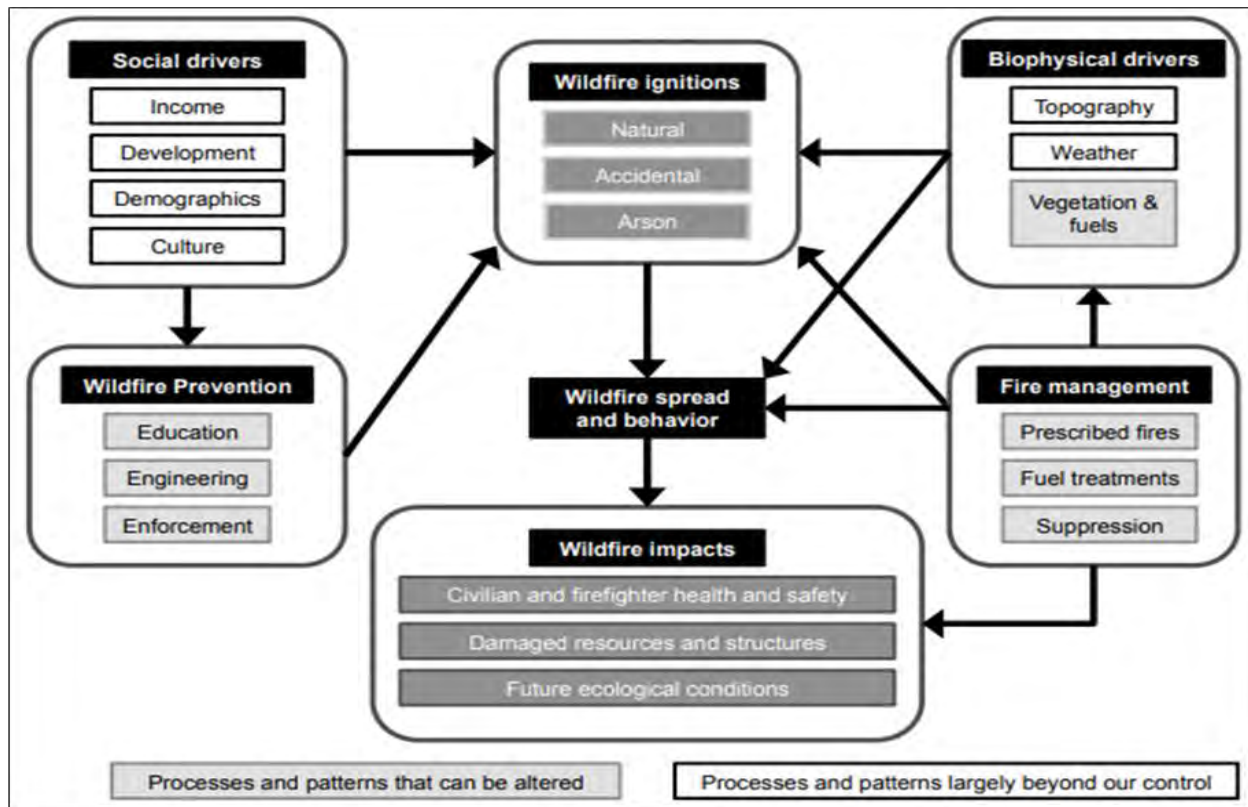
**Terrain/Topography:** The ground's slope can help or halt the spread of a wildfire. Large gaps in vegetation or waterways such as rivers and creeks can stop a wildfire from spreading. Fires also move faster upslope than down due to elevation changes and warm air rising.

**Wildland Urban Interface Area:** An area susceptible to wildfires 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.

**Wildfire:** 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 cause significant destruction.



Figure 13-2. Cohesive Strategy Wildfire Ignitions and Prevention Conceptual Model (Prestemon, et al., 2013)



### 13.1.1 Potential Damage from Wildfires

Wildfires pose a considerable risk to property, human life, and economies, as shown below (Western Forestry Leadership Coalition, 2010):

#### Buildings:

- Insured and uninsured property loss
- Secondary hazards

#### People:

- Loss of income
- Healthcare expenses
- Injuries or fatalities
- Evacuation displacement
- Reduced air and water quality

#### Economies:

- Lost revenues
- Infrastructure disruptions:
  - Communications
  - Transportation
  - Utilities

Wildfires can scorch vast areas of land, timber, and wildlife habitats (United States Forest Service). Fires can reduce the quality of drinking water and the air (World Health Organization). Additional health effects can be injuries, smoke irritation, and exacerbated medical conditions. They can also lead to cascading impacts, such as local businesses closing, hurting the area's economy. Wildfires can be extremely costly for tribes, government agencies, public and private businesses, and individuals. US wildfire loss costs from 2010-2019 ranged between a couple of million dollars to \$24,000,000,000, with the worst years in 2017 and 2018 by far (Insurance Information Institute, 2020). Hazardous materials can be released into the environment by damage to transportation and buildings that contain the materials. Secondary hazards and cascading impacts are in Section 13.3.

## 13.2 CTCLUSI Hazard Profile

Wildland fires regularly occur within CTCLUSI's Service Area. Table 13-2 lists some significant events that occurred in the past, and Table 13-3 includes average annual fires in the five counties. The Service Area contains approximately 8.9 million acres of land with varying risks and exposure to wildland fires (URS, 2006). Figure 13-4 displays those areas exposed to three different wildfire risk zones within the Service Area, while Figure 13-5 indicates the Wildland Urban Interface Zones exposed to wildfire risks.

There are three types of land in the Service Area where wildfires would significantly impact the Tribes' natural and cultural resources (URS, 2006):

- **Agricultural:** Dry Crops, like wheat, burn quickly but can be put out relatively easily. Communities with agricultural land are Siletz, Junction City, Elmira, Veneta, Fall Creek, Creswell, Drain, Sutherlin, Glide, Roseburg, Myrtle Creek, Riddle, Canyonville, Powers, Myrtle Point, Coquille, and Brandon.
- **Forest:** Wildfires can happen naturally or be human-caused; the size, intensity, and coverage depend on many factors such as fuel dryness, topography, and weather. CTCLUSI communities entirely in evergreen and mixed forest are Gleneden Beach, Blue River, Scottsburg, and Carpenterville.
- **Wildland-Urban Interface (WUI):** The area where population growth encroaches into wildland environments, increasing the wildland fire exposure of populations and structures in the area. These areas are mapped in Figure 13-5.

### 13.2.1 Hazard Ranking

The Emergency Management Team completed a hazard ranking survey during the CTCLUSI 2022 HMP update process and assessed hazard-related factors based on worst case and most likely scenarios. Hazard definitions and ranking factors are in Table 5-1. Survey results were prioritized and ranked based on their averaged score. The severity, magnitude, frequency, onset, and duration variables are scored one to five, where one is the lowest and five is the highest. Compared to the other hazards in the survey, wildfires are the sixth worst-case scenario and the seventh most likely scenario.

Table 13-1. Wildfire Hazard Ranking Output

Severity	Magnitude	Frequency	Onset	Duration	Average	Rank
<b>Worst-Case Scenario</b>						
3.75	4	4	5	4	4.15	6
<b>Most Likely Scenario</b>						
1.25	1.5	2.75	3.75	2.5	2.35	7

### 13.2.2 Past Events

Table 13-2 includes wildfires within the CTCLUSI's Service Area since 1953 that have resulted in federal disaster declarations.

Table 13-2. Federal Disaster Declarations for Wildfires within the CTCLUSI's Service Area (Federal Emergency Management Agency, 2020)

Year	Counties Affected	Event Type	Disaster Number
1973	Douglas	Doe Creek Fire	FSA-2013-OR
1987	Douglas	Bland Mountain Fire	FSA-2060-OR
1987	Lincoln	Shady Lane Fire	FSA-2066-OR

Year	Counties Affected	Event Type	Disaster Number
2002	Curry	Biscuit Fire	FSA-2453-OR
2004	Douglas	Or-Bland Mountain Wildfire	FM-2549-OR
2013	Douglas	Douglas Fire Complex	FM-5037-OR
2015	Douglas	Stouts Creek Fire	FM-5092-OR
2017	Curry	Chetco Bar Fire	FM-5198-OR
2019	Douglas	Mile Post 97 Fire	FM-5285-OR
2020	Douglas	Archie Creek Fire	FM-5365-OR
2020	Lincoln	Echo Mountain Fire	FM-5362-OR
2020	Lane	Holiday Farm Fire	FM-5357-OR
2020	Douglas, Lane, and Lincoln	Oregon Wildfires	EM-3542-OR

In 2020, historic wildfires directly affected nine counties in Oregon; this event resulted in a federal disaster declaration that included three counties in the service area: Douglas, Lane, and Lincoln. Over the fire season, 1.2 million acres burned statewide. A severe windstorm over Labor Day worsened the conditions and wildfire impact for Clackamas, Douglas, Jackson, Klamath, Lane, Lincoln, Linn, and Marion counties (Governor's Wildfire Economic Recovery Council, 2021). The windstorm brought hot and dry weather and sustained wind speeds of 20 to 30 miles per hour with gusts of 50 to 60 miles per hour (Nelsen, 2020). The Labor Day storm destroyed more than 5,000 structures and displaced thousands of residents.

The Archie Creek Fire started during the Labor Day storm and merged with the Star Mountain fire, and was not contained until November 16<sup>th</sup>, 2020 (Douglas County Oregon, 2021). Fire suppression for the massive fires cost approximately \$40 million (Federal Emergency Management Agency, 2020). The combined fires destroyed 109 homes, 143 outbuildings, and over 170 properties and buildings (Douglas County Oregon, 2021).

The Lane County Holiday Farm Fire also began during the 2020 Labor Day windstorm. It threatened Blue River, Vida, Nimrod, and Leaburg, displacing over 2,500 residents and destroying approximately 1,063 structures (Oregon Office of Emergency Management, 2020). Approximately 246,000 customers were without power for several days due to fire damage or mandated Public Safety Power Shutoffs. In Lincoln County, the Echo Mountain Complex fires destroyed 288 homes and placed 15,000 people, one-third of the County's population, under evacuation notice (Oregon Office of Emergency Management, 2020).

### 13.2.3 Location

As shown in Figure 13-5, Douglas County is all in the WUI. Most of the Service Area's coastal communities are also part of the WUI: Coos Bay, North Bend, Florence, Eugene outlying areas, and lower elevations in the Coast and Cascade mountain ranges. Figure 13-4 shows wildfire risk land area. Most of the Service Area falls in the wildfire high-risk zone, while parts of Douglas and Lane counties and higher elevations in the Cascades and Coast Ranges are moderate-risk zones. Table 13-3 explains the Wildfire Danger Ratings.

Table 13-3. Wildfire Danger Ratings (United States Forest Service)

Fire Danger Rating/Color Code	Description
<b>Low (L) – Dark Green</b>	Low danger fires ignite slowly from a small origin, unless the source is extremely hot (e.g., lightning, accelerators, etc.), or the fuel is highly flammable (extra dry ground cover, rotten dry wood, dead vegetation, etc.). Low fires have little danger of spotting.
<b>Moderate (M) – Light Green or Blue</b>	Moderate fires can start slow and with a few small fire spots. Fires in open grassland can spread faster on windy and dry days. Timber fires can spread slowly or moderately fast. Moderate-level fires can burn hot and have short-distance spotting, but they are not persistent fires. It is rare for them to become serious.
<b>High (H) – Yellow</b>	High-level fires ignite easily and quickly, often fueled by dead and fine vegetation. These fires can start in unattended brush and campfires. Danger from spot fires is constant, and the fire can spread rapidly with high intensity in slopes or with concentrated fuels. High-level fires can be challenging to control and become serious if they are not put out right away.
<b>Very High (VH) – Orange</b>	Very high-level fires start quickly and rapidly spread from any ignition type. In very high-risk areas, spot fires are a constant danger. Light fuels increase the fire's intensity faster, while heavier fuels cause long-distance spotting and fire whirlwinds.
<b>Extreme (E) – Red</b>	Extreme-level fires start, spread, and become more intense quickly. Firefighters cannot be approached extreme fires directly unless they can immediately suppress a small fire before it grows out of control.

#### 13.2.4 Frequency

Wildfires frequently occur in the wildland areas of Oregon. The Oregon Department of Forestry has recorded the average annual number of fires between 2011 and 2020. Table 13-4 shows the average annual number of fires from 2011 to 2020 for each county in the Service Area. As shown in the table, Douglas and Lane counties have experienced more fires on average than the other counties in the Service Area; this is a result of the larger size of these counties and the fact that they are in high-risk areas.

Table 13-4. Average Annual Number of Fires on Oregon Department of Forestry Land by County Between 2011 to 2020 (Oregon Department of Forestry, 2021)

County	Average Annual Number of Fires
Coos	39
Curry	16
Douglas	108
Lane	74
Lincoln	9

Current data shows wildfires can happen any time of year, especially in an unusually warm and dry winter. Based on current and future predicted risk exposure and past occurrences, it is likely that wildland fires will continue to affect the Service Area significantly. Dry conditions during the winter months, when combined with an abundance of dead or dry fuels and high winds, can fuel intense fires that spread quickly (URS, 2006). Wildfires in the area tend to be more severe because fuels are abundant in the Service Area's highly productive forests (State Interagency Hazard Mitigation Team, 2020).

### 13.2.5 Severity

Wildfires have caused injuries and death, destroyed, and damaged or destroyed structures and infrastructure in the Service Area. The events in Tables 13-2 and 13-3 detail some significant wildfire events in CTCLUSI's Service Area. However, the largest fires are not always the most destructive fires. There are no injuries or deaths in some events, but the value of property damage is in the millions of dollars; in other events, the cost is below the \$25,000 threshold, but the wildfire injured several people. The severity and extent of a wildfire are influenced by the following factors (National Park Service, 2017):

- **Fuel:** Materials that burn in a fire, such as paper products, flammable gases or chemicals, or wood products. The material composition determines how flammable it is, based on moisture level, chemical makeup, and material density. The less moisture and lower density, the faster and hotter it burns. Some plants have oils or resin that burn more easily, quickly, and/or intensely.
- **Weather:** Fires spread faster in hot, dry, windy weather. Less humidity and precipitation with warmer temperatures make fires easier to ignite. Strong wind adds lots of oxygen to the fire and carries embers, spreading the fires farther. Any combination of these factors makes wildfires more extensive and more severe.
- **Terrain/Topography:** The ground's slope can help or halt the spread of a wildfire. Significant gaps in vegetation or waterways such as rivers and creeks can stop a wildfire from spreading by removing the fuel to feed the fire or making the vegetation too wet to burn. Fires move faster upslope than down due to elevation changes and warm air rising.
- **Populated Areas:** In moderate and densely populated areas, the effects can be more severe for human injuries, loss of life, and/or property damage values.

The Oregon Wildfire Risk Explorer uses flame length to assess potential fire severity. Wildfires with flames exceeding 8 feet are considered severe and are very difficult to control. Severe fires are also more likely to spread to tree crowns and spread embers that start new spot fires (Oregon Wildfire Risk Explorer, 2019). At lower elevations along the coast and in Willamette Valley, the Service Area has a 0 to 50 percent probability of a fire producing flames exceeding 8 feet; higher elevations in the Coast and Cascades Ranges have a 75 to 100 percent probability (Oregon Department of Forestry and United States Forest Service).

### 13.2.6 Warning Time

Since humans cause most wildfires, there is no way to predict every ignition (National Park Service, 2018). However, weather factors that can lead to fire ignition or increase the spread and severity are more predictable, allowing for one to several days of warning time for current wildfire risks (United States Department of the Interior Indian Affairs).

Organizations such as NOAA and the NWS use climate models to predict the next year's wildfire risk level. Past wildfire and weather data are fed into the models along with current conditions, like droughts. Unfortunately, climate change factors alter these models in unpredictable ways, making the annual prediction results less accurate in recent years (Mulkern, 2020). Climate change effects on wildfires are covered in Section 13.4.

*Figure 13-3. NWS Wildfire Notification Levels (National Weather Service)*





The NWS monitors weather conditions and issues notifications from local NWS offices to estimate wildfire risks based on current weather conditions and smoke forecasts updated hourly (National Weather Service, 2021). The Service Area crosses multiple NWS local offices, such as the Medford and Portland Offices. When there are dangerous conditions, NWS will send out three wildfire notifications depending on the risk level; these levels are described in Figure 13-3. Extreme fire behavior is the most dangerous alert and only happens when one or more of the following conditions exist: spreading fast, significant crowning and/or spotting, there are fire whirls, or there is a strong convection column.

### 13.3 Secondary Hazards and Cascading Impacts

#### 13.3.1 Secondary Hazards

Wildland fires can contribute to several secondary hazards such as flooding, mass earth movements, and coastal erosion. Most wildland fires burn hot and long baking soils, especially in high clay concentrations, increasing the impervious ground area. Impenetrable ground means less water absorbed into the soil, increasing rain and stormwater runoff and rising flood risks (United States Geological Survey).

Vegetation removed by fires increases the risk of flooding frequency and severity. Flooding hazards in the Service Area are discussed in Section 8. Less vegetation along slopes also exposes the ground to more water runoff, which increases the potential for mass earth movements and coastal slope erosion. Erosion is also addressed in Section 8. Mass earth movements can even occur several years after a fire before the vegetation has had a chance to extend roots deep into the soil and stabilize the slope. Mass earth movements are covered in Section 10.

#### 13.3.2 Cascading Impacts

Wildland fires can cause cascading impacts for CTCLUSI and the Service Area, such as hazardous materials releases, utility disruptions, higher taxes and utility/infrastructure fees to recoup losses, loss of structures and infrastructure, and water contamination. Hazardous materials can be released when fires spread to buildings, storage areas, or vehicles containing these materials. Depending on the material's reaction to fire, they can be explosive, flammable, release toxic gas or fumes, or contaminate the environment and Tribal natural resources. Ravaged infrastructure can include road and rail transportation systems, internet and cellphone communications, earthen dams and levees, and water and wastewater systems (Department of Homeland Security, 2016).

Wildfires can also impair or demolish utilities resulting in cascading impacts such as power outages, broken water lines, natural gas line leaks, structure fires, or communication issues. Damage to public utilities, structures, and infrastructure can isolate CTCLUSI citizens and cause economic losses by affecting Tribal business operations. Following a fire, invasive species may spread in the burn scar and impede timber growth, affected Tribal cultural and natural resources, and increasing the risk of future fires in the Service Area (Lentile, et al., 2007).

Fires can cause health risks for Tribal Citizens by contaminating reservoirs and other water resources and releasing harmful particles and contaminants into the air through wildfire smoke. The Interagency Wildland Fire Air Quality Response Program, led by the US Forest Service (USFS), provides air quality information and maps (United States Forest Service). The program and its prediction models rely on subject matter experts (Air Resource Advisors), air quality monitoring equipment, smoke concentration and dispersion modeling, and coordination with agency partners (United States Forest Service). Predictions and warnings for air quality are provided to the public through the EPA's AirNow website. The

Oregon Health Authority provides water treatment best practices and drinking water quality standards related to wildfires (City of Salem, 2020).

### 13.4 Potential Impacts from Future Climate Conditions

CTCLUSI's Service Area is already experiencing the effects of climate change on wildfires. In 2020, Oregon experienced record land areas burned due to severe wildfires (Dalton & Fleishman, 2021). Climate change factors on wildfires (Dalton & Fleishman, 2021):

- **Temperature:** Since 1985, annual average temperatures have increased by about 2.2 F°.
- **Precipitation:** It is predicted that more precipitation will fall in the winter and less in the summer.
- **Snowpack and Runoff:** Precipitation is predicted to increase in the winter more as rain than snow.
- **Accurate Weather Data:** Global climate change models are constantly improving as more data is collected and new or advanced technology becomes available.

Historically the Service Area along the Coast and Cascade Ranges has been wet and cool with infrequent and less intense wildfires (Dalton & Fleishman, 2021). However, increased droughts, higher annual average temperatures, and more severe storms raise the probability of severe wildfires in the region.

### 13.5 Exposure and Vulnerability

#### 13.5.1 Population

Tribal Citizen data and GIS wildfire hazard zones were intersected to determine population exposure and social vulnerability. Populations exposed to wildfires are in Table 13-5 below. Table 13-6 shows that 80 percent of the Tribal Citizens live in the WUI, which have a higher risk of wildfires that can impact citizens' health and safety (Radeloff, et al., 2018). Specific sections of the Service Area will also have a higher risk of secondary hazards such as increased flooding or mass earth movements, shown in the maps in Section 8 for Floods and 10 for Mass Earth Movements. Additionally, the entire Service Area can be susceptible to cascading impacts of wildfires, such as poor air quality (World Health Organization).

Table 13-5. CTCLUSI Citizens Exposed to Wildfire Risk Zones

Wildfire Risk Zones	Sum of Population
None	305
Benefit	0
High	4
Low	86
Low Benefit	7
Moderate	22
Very High	1
<b>Grand Total</b>	<b>425</b>

Table 13-6. CTCLUSI Citizens in the Wildland Urban Interface

Citizens in the WUI	Sum of Population
Population	339
<b>Grand Total</b>	<b>339</b>

### Vulnerability

CTCLUSI and its Tribal Citizens in WUI are especially vulnerable to injury, loss of life, property damage or destruction, and potential displacement for months to years (Radeloff, et al., 2018). Citizens can become isolated from community centers if critical transportation routes are closed. Wildfire smoke can cause health concerns for all Tribal Citizens, especially for vulnerable populations such as children, those above 65 years old, and persons with respiratory or cardiovascular disease (World Health Organization).

#### 13.5.2 Property

Wildfire and the WUI hazard zones were intersected with geospatial hazard data to indicate the exposure to this hazard. Property damage from wildland fires can be severe and significantly alter CTCLUSI's services, community utilities, and infrastructure. Tables 13-7 to 13-9 show Tribal facilities, forest stands, and parcels exposed to wildfire hazard zones, their risk level, and those in the WUI zone.

Damage from wildfires can be severe and can significantly affect the character and economies of entire communities. As shown in Table 13-7, most Tribal facilities are located within WUI areas; however, no properties are exposed to wildfire risks that are moderate or greater. Of the Tribes' 403 forest stands, 275 stands (68 percent) are within WUI areas, and 395 stands (98 percent) are exposed to moderate or greater wildfire risk, even outside of mapped WUI areas, listed in Table 13-8. Table 13-9 shows that all 83 of the Tribes' fee-lands, Reservation, and trust parcels are located within WUI areas. Of these, only seven parcels (eight percent) are exposed to moderate or greater wildfire risks.

*Table 13-7. Exposure Tribal Facilities to Wildfire Hazards*

Facility Type	Total Facilities	Facilities in the WUI	Moderate or Greater Risk
Administration	4	4	0
Camp	11	11	0
Casino	3	3	0
Community	3	3	0
Housing	20	20	0
Lighthouse	1	0	0
Other	14	13	0
Ranch	3	3	0
<b>Total</b>	<b>59</b>	<b>57</b>	<b>0</b>

*Table 13-8. Exposure of Forest Tracts to Wildfire Hazards*

Forest Tract	Total Stands	Stands in the WUI	Moderate or Greater Risk
Coos Head	1	1	0
Macy	1	1	1
Talbot	1	1	0
Tioga	133	5	133
Umpqua Eden	1	1	0
Upper Lake Cr.	118	118	113
Upper Smith	148	148	148
<b>Total</b>	<b>403</b>	<b>275</b>	<b>395</b>

Table 13-9. Exposure of Tribal Parcels to Wildfire Hazards

Parcel Type	Parcel Count/Acreage	Parcels in UWI	Moderate or Greater Risk
Fee	51/430	51	2
Reservation	13/14,758	13	5
Trust	19/124	19	0
<b>Total</b>	<b>83/15,312</b>	<b>83</b>	<b>7</b>

### Vulnerability

Buildings, especially buildings constructed with wood shingle roofs and other combustible materials, are vulnerable to damage or destruction by wildfires. Timber stands may also be damaged or destroyed, and soils eroded or sterilized during severe wildfires, resulting in long-term economic and cultural impacts to CTCLUSI.

#### 13.5.3 Critical Facilities

Critical facilities and infrastructure for CTCLUSI include communication, maintenance, power, and water/wastewater facilities. Table 13-10 shows the exposure of these facilities to wildfire hazards. As shown in the table, all of the Tribes' critical facilities are located in WUI areas, but none are exposed to wildfire risks that are moderate or greater.

Table 13-10. Exposure of Tribal Critical Facilities to Wildfire Hazards

Critical Facility Type	Total Number	In the WUI	Moderate or Higher Risk
Communication	1	1	0
Maintenance	4	4	0
Power	1	1	0
Water/Wastewater	4	4	0
<b>Total</b>	<b>10</b>	<b>10</b>	<b>0</b>

### Vulnerability

Structures are vulnerable to damage or destruction during wildfires. Damage to critical facilities would have cascading effects on the Tribes and services CTCLUSI provides. Communication and utility disruptions can potentially affect emergency response operations and delaying disaster recovery.

#### 13.5.4 Environment

Wildfire events can adversely impact the Service Area. Ecosystems and habitats can be destroyed, and occasionally wild animals might migrate outside of their normal environment and into more urban areas (Kenney, 2019). When fires burn, they release carbon dioxide into the atmosphere, and this greenhouse gas is hazardous to humans and animals that inhale it (United States Forest Service). A massive wildfire release of carbon dioxide can affect the weather and climate (World Health Organization). Ways wildfires can severely impact the environment (Mendenhall, 2019):

- **Air Quality:** Wildfires can release large amounts of smoke into the atmosphere, and the smoke from large wildfires can travel long distances. The smoke and ash in the air will settle and cover ecosystems, severely affecting vegetation, wildlife, and CTCLUSI natural and cultural resources.
- **Reduced Water Quality:** Wildfires affect water quality in streams, rivers, lakes, and reservoirs due to increased sedimentation and elevated levels of nutrients like nitrogen and phosphorus from burned

vegetation that cause algae blooms and oxygen depletion. These changes in water quality can remain noticeable years and even decades after a fire.

- **Soil Erosion:** Wildfires can remove the protective covering and stability of dead organic matter and plant roots, exposing soils to erosion by wind and water. Accelerated soil erosion can cause landslides and debris flows and threaten streams and aquatic habitats.
- **Spread of Invasive Species:** Non-native invasive species can quickly establish themselves in burn scars, dominating the natural plant cover. Once established, they can be difficult and costly to remove.
- **Destroyed Endangered Species Habitat:** Wildfires can have devastating impacts on rare and endangered species, destroying critical habitats and potentially entire populations of the species.
- **Soil Sterilization:** Extreme heat can kill soil microorganisms and cause topsoil to become water repellent, affecting how quickly an ecosystem recovers and what types of vegetation can become established in a burn scar.

### 13.6 Development Trends

Most Tribal development is planned in the Tribes' population centers of Florence, Coos Bay, and North Bend (Confederated Tribes of Coos, Lower Umpqua, and Siuslaw, 2010). Future development in these communities is not expected to be at an elevated risk of wildfires compared to surrounding areas in the WUI. By 2024, CTCLUSI plans to construct a new access road to their Munsel Lake Property, located east of Florence, which is currently accessible only by boat (Confederated Tribes of Coos, Lower Umpqua, and Siuslaw, 2010). This forested property is undeveloped and located in an area at high risk for wildfire, as shown in Figure 13-4. Any future development or use of this property should be planned with consideration given to wildfire risks and mitigation measures.

### 13.7 Issues

Issues associated with wildfires in the Service Area:

- Timber resources on the Upper Lake, Smith, and Tioga tracts are vulnerable to wildfire. Loss of timber revenue could have potential economic impacts on the Tribes into the millions of dollars.
- Buildings in WUI areas constructed of wood framing or other combustible materials are more vulnerable to burning during a wildfire.

### 13.8 Hazard Maps

The hazard maps showing the wildfire risk areas are in Figures 13-4 and 13-5, starting on the next page.



Figure 13-4. CTCLUSI Wildfire Map

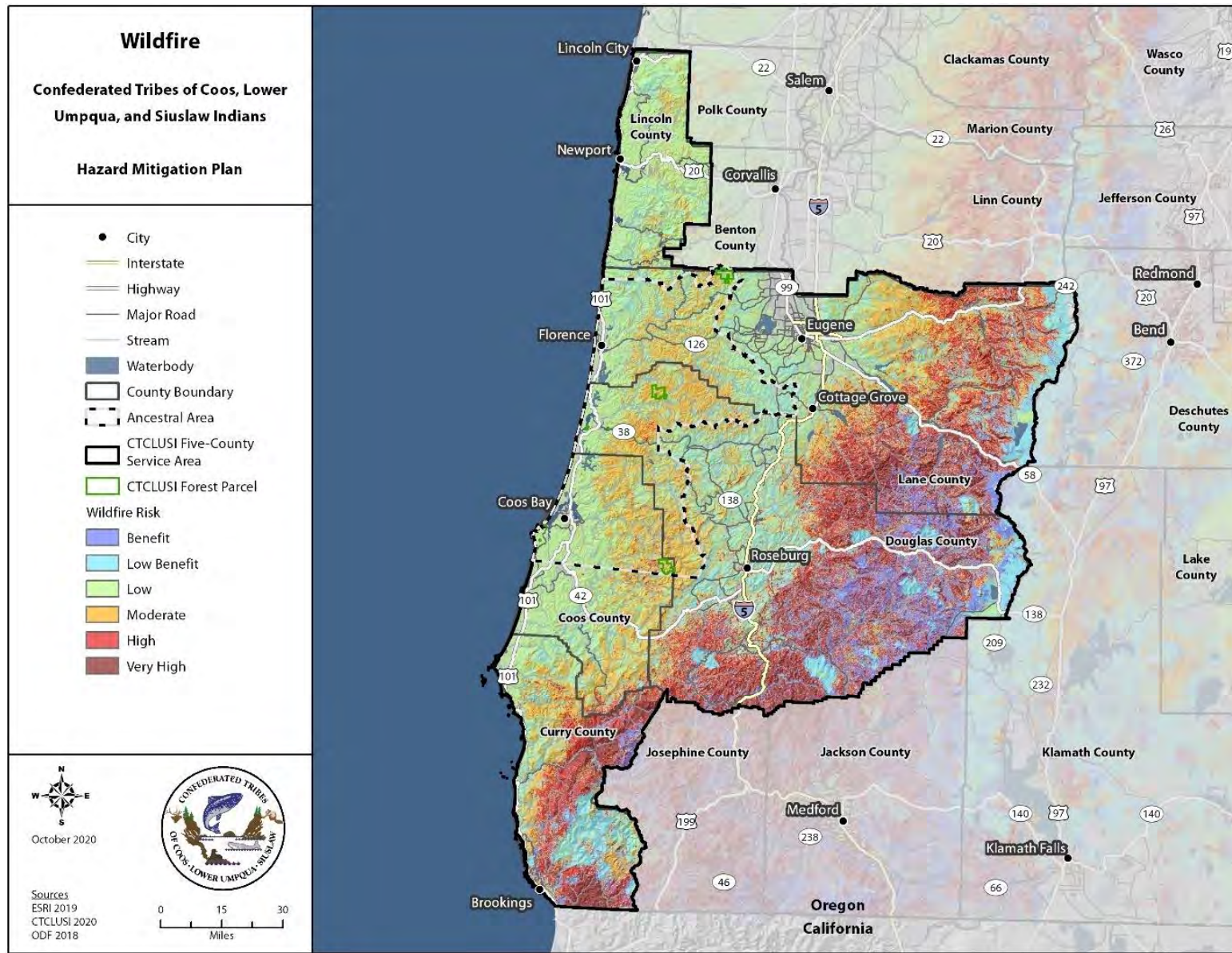
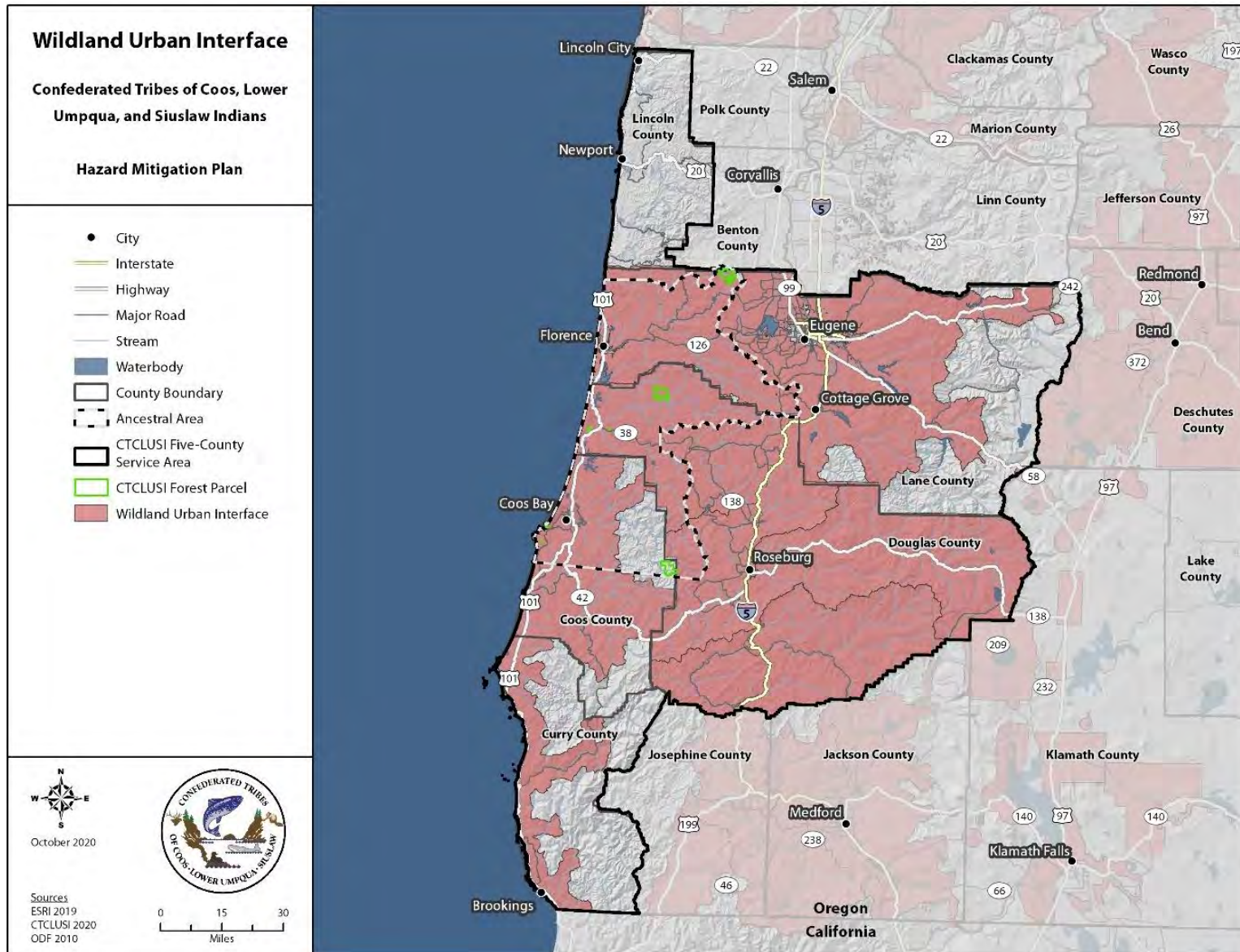


Figure 13-5. CTCLUSI Wildland Urban Interface Map



# CTCLUSI 2022 Hazard Mitigation Plan Part 3: Mitigation Strategy





## 14 Mitigation Strategy

Part 3 describes CTCLUSI's 2022 mitigation strategy, which is the primary focus of the Tribes' mitigation planning efforts. This strategy is the blueprint for the approaches chosen by the CTCLUSI 2022 Emergency Management Team to reduce or prevent losses caused by the hazards identified in the profiles in Part 2 of the HMP, Sections 6 through 13. The strategy has three required components: mitigation goals, mitigation actions, and an action plan implementation process, illustrated in Figure 14-1 below. These components provide the framework to identify, prioritize, and implement actions to reduce risk from hazards.

*Figure 14-1. Mitigation Strategy Process*



### 14.1 CTCLUSI's 2022 Hazard Mitigation Goals

Below are the ten goals that the CTCLUSI's 2022 Emergency Management Team has adopted. Achievement of these goals defines the effectiveness of a mitigation strategy. The goals establish mitigation strategy priorities.

1. Promote disaster-resistant development
2. Build and support local capacity to enable the public for, respond to, and recover from disasters
3. Reduce the possibility of damage and losses due to coastal erosion
4. Reduce the possibility of damage and losses due to earthquakes
5. Reduce the possibility of damage and losses due to tsunamis
6. Reduce the possibility of damage and losses due to wildland fire
7. Reduce the possibility of damage and losses due to winter storm: flood

8. Reduce the possibility of damage and losses due to winter storm: landslides
9. Reduce the possibility of damage and losses due to winter storm: snow
10. Reduce the possibility of damage and losses due to winter storm: wind

#### 14.1.1 Actions

The action plan in Table 14-1 identifies hazard mitigation actions for CTCLUSI as informed by the risk and capability assessments. The action plan lays the groundwork for how mitigation actions will be prioritized, implemented, and administered by the Tribes. The Tribes' mitigation actions include short-term actions that focus on planning, assessment, and capacity-building activities and long-term actions that will protect natural systems or structural projects that reduce vulnerability to hazards. Status updates for the mitigation actions included in the Tribes' 2006 HMP and worksheets for new 2022 mitigation actions are provided in Appendix B.

#### 44 CFR 201.6(c)(3)(i)

HMPs shall describe mitigation goals to reduce or avoid long-term vulnerabilities to identified hazards. The Steering Committee reviewed and established a set of three goals for this plan based on data from the preliminary risk assessment and the results of public outreach. The goals and objectives informed plan development, mitigation strategy identification, and prioritization, and are mutually reinforcing.



Table 14-1. CTCLUSI's Mitigation Actions

ID	Goal Name + Description	Lead Entity	Hazards Addressed	Action Status: New, Existing, + Complete	Support Entity	Estimated Time, Cost, + Funding to Implement	Priority	STAPLEE Score
<b>1</b>	<b>Goal: Promote Overall Disaster-Resistance Development</b>							
<b>1A</b>	Adopt the most recent International Building Code	Planning	All hazards	Complete	State	N/A	N/A	N/A
<b>1B</b>	Develop Tribal Comprehensive Plan, Multi-Hazard Plan to include human-caused hazards and a Natural Hazard Mitigation Plan	Emergency Management Team (EMT)	All hazards	Existing	Planning	- <b>Time:</b> < 1 year - <b>Cost:</b> < \$100,000 - <b>Funding:</b> HMGP + Tribal Funds	Low	15
<b>1C1</b>	Explore the need for hazard zoning and high-risk hazard land use ordinances, create as needed	Planning	All hazards	Existing		- <b>Time:</b> < 5 years - <b>Cost:</b> < \$100,000 - <b>Funding:</b> BIA-FHWA FAST Act	Medium	28
<b>1C2</b>	Improve geotechnical report standards for assessing the risk and mitigation measures for proposed developments in hazardous areas	Cultural and Nat. Resources	All hazards	Existing	Planning	- <b>Time:</b> < 5 years - <b>Cost:</b> < \$100,000 - <b>Funding:</b> BRIC	High	50
<b>1D</b>	An annual event for Tribal citizens: sell NOAA weather radios, hand out brochures on disasters, fire-resistant construction materials building retrofits, and demonstrate “defensible-space.”	Planning	Severe Weather, Tsunami, + Wildfire	Existing		- <b>Time:</b> < 1 year - <b>Cost:</b> < \$10,000 - <b>Funding:</b> NOAA Environmental Literacy Program	High	48
<b>1E</b>	Develop a stormwater management plan with run-off regulations for flood reduction and to minimize saturated soils on steep slopes	Department of Natural Resources & Culture	Flood/SLR + Mass Earth Movements	Existing		- <b>Time:</b> < 5 years - <b>Cost:</b> < \$100,000 - <b>Funding:</b> BIA-FHWA FAST Act	Medium	32
<b>1F</b>	Land acquisition criteria in Tribal laws and documents to include a hazard analysis component	Planning	All hazards	Existing		- <b>Time:</b> < 5 years - <b>Cost:</b> < \$50,000 - <b>Funding:</b> BIA Real Estate Services	Medium	24
<b>1G1</b>	Develop a coordinated and robust hazard/risk warning system.	Planning	All Hazards	Complete		N/A	N/A	N/A

ID	Goal Name + Description	Lead Entity	Hazards Addressed	Action Status: New, Existing, + Complete	Support Entity	Estimated Time, Cost, + Funding to Implement	Priority	STAPLEE Score
<b>1G2</b>	Develop a tsunami warning system for communities that could be affected by a tsunami.	Planning	Tsunamis	Complete		N/A	N/A	N/A
<b>1G3</b>	Install notification systems to warn Tribal members of imminent severe weather hazards so preventative and damage reducing actions can be taken	Planning	Flood/SLR + Severe Weather	Complete		N/A	N/A	N/A
<b>2</b>	<b>Build and support local capacity to enable Tribal members to prepare for, respond to and recover from disasters</b>							
<b>2A</b>	Collect and develop more sophisticated hazard mapping for GIS.	Planning	All hazards	Complete		N/A	N/A	N/A
<b>2A1</b>	Use updated GIS in plans. Make data available to Tribal Citizens and relevant stakeholders.	Planning	All hazards	Complete		N/A	N/A	N/A
<b>2B</b>	Create a mitigation outreach program that helps Tribal members prepare for disasters	Emergency Management Team	All hazards	Existing		- Time: < 1 year - Cost: < \$20,000 - Funding: ODE-SB13	High	52
<b>2B1</b>	Prepare and distribute educational coastal hazards videos and outreach material to support Tribal Citizen preparedness.	Planning	Flood/SLR, Mass Earth Movements, + Tsunami	Existing		- Time: < 5 years - Cost: < \$20,000 - Funding: ODE-SB13	Low	16
<b>2B2</b>	Create a virtual and physical library that contains all technical studies, particularly about natural resources. See co-benefits opportunities. Define Relevance as a Hazard Mitigation Tool.	CNR	All hazards	Existing		- Time: < 5 years - Cost: < \$100,000 - Funding: BIA Forest Management/ Inventory Planning	Low	10
<b>2B3</b>	Earthquake education: what to do in an earthquake, and ways to mitigate damages, including structural seismic retrofits and non-structural mitigation actions.	Planning	Earthquakes	Existing		- Time: < 1 years - Cost: < \$100,000 - Funding: BRIC, Tribal Funds	High	47

ID	Goal Name + Description	Lead Entity	Hazards Addressed	Action Status: New, Existing, + Complete	Support Entity	Estimated Time, Cost, + Funding to Implement	Priority	STAPLEE Score
2B4	Increase public awareness educational programs to reduce wildfires losses and to mitigate the wildfire hazard	Planning	Wildfires	Existing		- <b>Time:</b> < 1 years - <b>Cost:</b> < \$20,000 - <b>Funding:</b> BIA Forest Management/ Inventory Planning; Fire Mitigation Assistance Grants	Low	15
2B5	Increase public understanding of flood hazards, encourage homeowners to take the necessary steps to flood-proof their property	EMT	Flood/SLR	Existing		- <b>Time:</b> < 1 years - <b>Cost:</b> < \$20,000 - <b>Funding:</b> Flood Mitigation Assistance, Tribal Funds	Low	12
2B6	Increase public awareness for snowstorms and how to mitigate them (e.g., safe winter driving practices, prepare and maintain hazards kits to be able to survive on their own for 72 hours)	EMT	Severe Weather	Existing		- <b>Time:</b> < 1 years - <b>Cost:</b> < \$20,000 - <b>Funding:</b> BIA-FHWA FAST Act	Low	14
2B7	Increase public education about hazards through prevention and caring for them	EMT	All Hazards	Existing		- <b>Time:</b> < 1 years - <b>Cost:</b> < \$20,000 - <b>Funding:</b> BRIC, Tribal Funds	Medium	16
2C1	Develop or update existing plans for backup electric systems in Tribal owned critical facilities	EMT	All hazards	Existing		- <b>Time:</b> < 5 years - <b>Cost:</b> < \$100,000 - <b>Funding:</b> BRIC, Tribal Funds	High	51
2C2	Develop or update existing backup communication systems. [ <i>Satellite phones and Armature Radios have been established.</i> ]	EMT	All hazards	Complete		N/A	N/A	N/A
2D	Develop tsunami, wildfire, and flood-prone areas emergency evacuation programs, especially in hazard zones and high-risk areas	State + Counties	Flood/SLR, Tsunami, + Wildfires	Complete	CTLCUSI	N/A	N/A	N/A
2E	Develop a Community Emergency Response Team (CERT) program with a mitigation component.	Counties	All Hazards	Complete	CTLCUSI	N/A	N/A	N/A

ID	Goal Name + Description	Lead Entity	Hazards Addressed	Action Status: New, Existing, + Complete	Support Entity	Estimated Time, Cost, + Funding to Implement	Priority	STAPLEE Score
<b>3</b>	<b>Reduce the possibility of damage and losses due to coastal erosion</b>							
<b>3B</b>	Work with neighboring communities, state agencies, and universities to update current beach erosion research.	CNR	Flood/SLR, Mass Earth Movements, Severe Weather, + Tsunami	Complete	State + Counties	N/A	N/A	N/A
<b>3C</b>	Examine alternative shore protection methods and the effects of hard shore protection structures (e.g., near-shore circulation processes, sediment budes, etc.) Undertaken in coordination with the US Coast Guard.	CNR	Flood/SLR, Mass Earth Movements, Severe Weather, + Tsunami	Existing	US Coast Guard	- <b>Time:</b> < 5 years - <b>Cost:</b> < \$80,000 - <b>Funding:</b> BRIC	Low	17
<b>3D</b>	Update hazard maps and inventories in the estuary response plan, including existing studies, maps, GIS, etc., from city, county, state, federal, university, private, and other resources.	CNR	Flood/SLR, Mass Earth Movements, Severe Weather, + Tsunami	Complete		N/A	N/A	N/A
<b>3F</b>	Incorporate coastal erosion into land-use planning documents.	Planning	Flood/SLR, Mass Earth Movements, Severe Weather, + Tsunami	Existing		- <b>Time:</b> < 5 years - <b>Cost:</b> < \$10,000 - <b>Funding:</b> Tribal Funds	Medium	29
<b>4</b>	<b>Reduce the possibility of damage and losses due to earthquakes</b>							
<b>4A</b>	Reduce the vulnerability of structures to earthquake damage. Ensure all future Tribal development meets seismic protection requirements.	Planning	Earthquakes	Existing		- <b>Time:</b> < 10 years - <b>Cost:</b> < \$50,000, 000 - <b>Funding:</b> BRIC	High	52
<b>5</b>	<b>Reduce the possibility of damage and losses due to tsunamis</b>							
<b>5A1</b>	Continuously educate the public on tsunamis hazards associated, such as what to do for tsunami and how to mitigate tsunami hazards.	EMT	Tsunamis	Existing		- <b>Time:</b> < 1 year - <b>Cost:</b> < \$100,000 - <b>Funding:</b> BRIC	High	

ID	Goal Name + Description	Lead Entity	Hazards Addressed	Action Status: New, Existing, + Complete	Support Entity	Estimated Time, Cost, + Funding to Implement	Priority	STAPLEE Score
5A2	Display standardized and accessible signs to alert Tribal members of tsunami hazard zones, evacuation routes, and evacuation sites.	State + Counties	Tsunamis	Existing	CTCLUSI	- <b>Time:</b> < 1 years - <b>Cost:</b> < \$10,000 - <b>Funding:</b> Tribal Funds	Low	17
5D	Enroll in the tsunami-ready program.	EMT	Tsunamis	Existing		- <b>Time:</b> < 1 year - <b>Cost:</b> < \$10,000 - <b>Funding:</b> Tribal Funds	Low	16
6	<b>Reduce the possibility of damage due to wildland fire</b>							
6A	Update and improve UWI maps, identify specific wildfire risk areas within Coos Bay and Florence	Forestry	Wildfires	Complete	State + Counties	N/A	N/A	
6B1	Develop or update the Fuel/Forestry Management Plan	Forestry	Wildfires	Existing	State + Counties	- <b>Time:</b> < 10 years - <b>Cost:</b> < \$100,000 - <b>Funding:</b> BIA Forest Management/ Inventory Planning; Fire Mitigation Assistance Grants	Medium	35
6B2	Include a Wildfire Management Plan in the Fuel/Forestry Management Plan. Investigate and apply new and safer emerging fuel management techniques.	Forestry	Wildfires	Existing	State + Counties	- <b>Time:</b> < 10 years - <b>Cost:</b> < \$100,000 - <b>Funding:</b> BIA Forest Management/ Inventory Planning; Fire Mitigation Assistance Grants; Tribal Funds	Medium	35
6C	Develop community fuel breaks in high risk and high priority wildland interface areas	Forestry	Wildfires	Existing	Counties	- <b>Time:</b> < 5 years - <b>Cost:</b> < \$10,000 - <b>Funding:</b> Tribal Funds	Medium	32
6D	Create a community fire plan	Forestry	Wildfires	Existing	Counties	- <b>Time:</b> < 5 years - <b>Cost:</b> < \$10,000 - <b>Funding:</b> Fire Mitigation Assistance Grants; Tribal Funds	High	38



ID	Goal Name + Description	Lead Entity	Hazards Addressed	Action Status: New, Existing, + Complete	Support Entity	Estimated Time, Cost, + Funding to Implement	Priority	STAPLEE Score
6E	Review the Oregon Forestland-Urban Interface Fire Protection Act of 1997 and other state and federal regulations to develop additional CTCLUSI actions.	Forestry	Wildfires	Existing		- <b>Time:</b> < 1 year - <b>Cost:</b> < \$10,000 - <b>Funding:</b> Tribal Funds	Medium	18
7	<b>Reduce the possibility of damage and losses due to winter storm: Flood</b>							
7A	Support the improvement and updating of floodplain maps to identify and document repetitively flooded properties	Planning	Flood/SLR	Complete	State + Counties	N/A	N/A	N/A
7B	Explore mitigation opportunities for repetitively flooded properties and, if necessary, carry out acquisition, relocation, elevation, and floodproofing measures to protect these properties	Planning	Flood/SLR	Complete		N/A	N/A	N/A
7C	Look into the NFIP: Hollering Place development	Planning	Flood/SLR	Canceled		N/A	N/A	N/A
7E	Develop flood action plans for each community where Tribal members and critical facilities are located	EMT	Flood/SLR	Complete	State + Counties	N/A	N/A	N/A
8	<b>Reduce the possibility of damage due to winter storm: Landslides</b>							
8A	Create or obtain comprehensive geological maps in areas considered for development on land prone to Mass Earth Movements to understand the hazard and magnitude of the risk in these areas	EMT	Mass Earth Movements	Complete	State + Counties	N/A	N/A	N/A

ID	Goal Name + Description	Lead Entity	Hazards Addressed	Action Status: New, Existing, + Complete	Support Entity	Estimated Time, Cost, + Funding to Implement	Priority	STAPLEE Score
8B	In areas with Tribal structures where repetitive and ongoing landslide hazards cannot be mitigated and when opportunities and funding become available, explore options for the acquisition of the developed areas or relocation of facilities	Planning	Mass Earth Movements	Complete	State + Counties	N/A	N/A	N/A
8C	Develop a vegetation management plan	Forestry	Mass Earth Movements	Existing		- <b>Time:</b> < 5 years - <b>Cost:</b> < \$100,000 - <b>Funding:</b> Fire Mitigation Assistance Grants, Tribal Funds	Medium	24
9	<b>Reduce the possibility of damage and losses due to winter storms: Snow</b>							
9A	Retrofit critical facilities for maximum load-bearing capacity with minimum weight.	Planning	Severe Weather	Complete		N/A	N/A	N/A
10	<b>Reduce the possibility of damage and losses due to winter storm: Wind</b>							
10A	Develop or update the Vegetation Management Plan to provide for areas adjacent to rights of way, to reduce the risk of tree failure and property damage	Planning	Mass Earth Movements	Existing		- <b>Time:</b> < 5 years - <b>Cost:</b> < \$100,000 - <b>Funding:</b> Fire Mitigation Assistance Grants, Tribal Funds	Low	17

## 14.2 Action Plan

The action plan above includes prioritized initiatives to mitigate natural hazards. Members of the Emergency Management Team were asked to weigh the estimated benefits of an action against the estimated costs to establish a parameter to be used in prioritization. This benefit-cost review was qualitative and did not include the level of detail required under specific FEMA grant programs. A qualitative approach was used because projects may not be implemented for up to 10 years, and the associated costs and benefits could change dramatically in that time. Each mitigation action was assessed by estimating the total cost of the initiative and assigning subjective ratings (high, medium, and low) to benefits, as described below.

### 44 CFR 201.7(c)(3)(iii)

Requires a description of how the actions will be prioritized, implemented, and administered by the Tribal Government.

### 14.2.1 Cost

Participants were given a dollar range to choose from to estimate the cost of the proposed initiative:

- < \$50,000
- < \$100,000
- < \$500,000
- < \$1,000,000
- > \$1,000,000

For many of the initiatives identified, CTCLUSI may seek financial assistance under FEMA's hazard mitigation grant programs and other federal grant programs, including:

Building Resilient Infrastructure and Communities (BRIC) Program	Emergency Management Performance Grant Program	Indian Community Development Block Grant Program	Assistance to Firefighters Grant Program's Fire Prevention and Safety Grant	Imminent Threat, Indian Community Development Block Grant Program
Hazard Mitigation Grant Program	Severe Repetitive Loss Grant Program	Flood Mitigation Assistance Program	Administration for Native Americans Grant Programs	Repetitive Flood Claims Grant Program

### 14.2.2 Benefit

The Emergency Management Team evaluated each action using the STAPLEE and Mitigation Effectiveness criteria, shown in Tables 14-2 and 14-3. Evaluators were asked to rate each STAPLEE and Mitigation Effectiveness criteria to develop a total score for each action's relative suitability and potential effectiveness.

Table 14-2. STAPLEE Criteria

STAPLEE Criteria	Evaluation Rating
<b>S:</b> Is it Socially acceptable?	Strongly Agree = 5 Agree = 4 Neutral = 3 Disagree = 2 Strongly Disagree = 1
<b>T:</b> Is it Technically feasible and potentially successful?	
<b>A:</b> Does the responsible city agency/department have the Administrative capacity to execute this action?	
<b>P:</b> Is it Politically acceptable?	
<b>L:</b> Is there Legal authority to implement?	
<b>E:</b> Is it Economically beneficial?	
<b>E:</b> Will the project have a positive impact on the natural environment?	
Will historic structures or key cultural resources be saved or protected?	

STAPLEE Criteria	Evaluation Rating
Could it be implemented quickly?	

Table 14-3. Mitigation Effectiveness Criteria

Mitigation Effectiveness Criteria	Evaluation Rating
Will the implemented action result in lives saved?	Strongly Agree = 5 Agree = 4 Neutral = 3
Could it be implemented quickly?	Disagree = 2 Strongly Disagree = 1

STAPLEE scores can range from a low of 9 to a high of 45. Mitigation effectiveness scores can run from a low of 2 to a high of 10. When these scores are combined, mitigation actions can score within a range of 11 to 55 points. Actions were ranked as "low benefit" if the total score was between 0 and 17, "medium benefit" if the score was between 18 and 35, and "high benefit" if the score was 36 to 55.

Many initiatives will require detailed benefit-cost analysis as part of the grant application process. These analyses will be performed when funding applications are prepared, using the FEMA or other applicable model processes. CTCLUSI is committed to implementing mitigation actions with benefits that exceed costs. For projects not seeking financial assistance from grant programs, the Tribes reserve the right to define benefits according to parameters that meet the plan's needs and the goals and objectives.

### 14.3 Plan Adoption

This plan will be submitted to FEMA Region X for review after formal adoption by the Tribes. Suppose the Tribal government would like the option of being a subgrantee under Oregon State. In that case, they must also submit the plan to the Oregon Emergency Management Division for review and comment. A copy of the adoption resolution is provided in Appendix E.

#### 44 CFR 201.7(c)(5)

Requires documentation that the hazard mitigation plan has been formally adopted by the governing body of the Tribal government.

CTCLUSI's Tribal Government will comply with all applicable federal statutes and regulations in effect with respect to the periods for which it receives grant funding, including 2 CFR Parts 200 and 3002, and will amend its plan whenever necessary to reflect changes in Tribal or federal laws and statutes.

### 14.4 Plan Implementation and Maintenance Strategy

This section details the formal process to ensure that the CTCLUSI's HMP remains an active and relevant document, ensuring eligibility for relevant funding sources. The plan maintenance process annually monitors and evaluates the plan and produces an updated plan every five years. This section also describes how participation from CTCLUSI Citizens will continue to be a part of the plan during the maintenance and implementation process. The plan's format allows sections to be reviewed and updated when new data becomes available, ensuring the plan stays current and relevant.

#### 14.4.1 Plan Implementation

The effectiveness of the HMP depends on the implementation of the plan through the initiatives identified in the action plan; additionally, incorporating mitigation principles and actions into other CTCLUSI plans, policies, and programs. The updated plan includes a range of actions that, if implemented, would reduce losses from hazard events in the Service Area. The Emergency Management Team has established plan

goals that will be implemented through new plans and incorporation into existing plans, policies, and programs.

CTCLUSI's Emergency Preparedness Program under the Planning Department will assume lead responsibility for planning and facilitating implementation and maintenance meetings. The Planning Director will act as the Tribes' point-of-contact for this plan. Although the Emergency Preparedness Program will have primary responsibility for convening these meetings, plan implementation and evaluation will be shared among all Tribal departments identified as leads in the mitigation action plan.

#### 14.4.2 Emergency Management Team

The Emergency Management Team is comprised of members from across CTCLUSI Tribal Government, each of whom contributed significantly to the plan 2022 update. The purpose of this committee was to oversee the development of the plan update and make recommendations on key elements, including the maintenance strategy. The Emergency Management Team's position is that an oversight committee with representation similar to that of the Emergency Management Team should have an active role in the maintenance strategy for this plan. Therefore, it is recommended that the Emergency Management Team remains a viable body involved in the plan maintenance strategy.

The Emergency Management Team should continue to include CTCLUSI Citizens and other pre-identified key planning partners. The Emergency Management Team will convene to perform annual reviews at a place and time to be determined. The make-up of this committee can be dynamic, which will allow differing views and for different participants to have a say in the implementation of the plan. The Emergency Preparedness Program will strive to represent all Tribal Citizens on this committee. Individuals involved in this plan update process will be contacted and given the option to remain involved in the process.

Each year, Tribal Government will appoint a Emergency Management Team Chair to lead annual progress reporting. The Chair will verify that the plan is reviewed and evaluated annually and updated as needed (at least every five years). The Emergency Preparedness Program will be responsible for facilitating annual progress review workshops.

#### 14.4.3 Annual Progress Report

The minimum task of the Emergency Management Team will be the evaluation of the progress of the plan during annual reviews. This evaluation will include the following:

- Summary of hazard events that occurred during the prior year and their impact on the Service Area
- A review of successful mitigation actions identified in the plan
- A brief discussion about why targeted mitigation actions were not completed
- Re-evaluation of the action plan to determine if the timelines for identified actions need to be amended (e.g., changing a long-term project to a short-term project because of funding availability)
- Recommendations for new projects
- Changes in or potential for new funding options (grant opportunities)
- Impact of any other Tribal or planning partner programs or initiatives that involve hazard mitigation

CTCLUSI department leads will complete an annual progress report using the Mitigation Strategy Evaluation and Mitigation Action Evaluation forms in Appendix B and submit their progress reports to the Emergency Management Team. Then the Emergency Management Team will develop a formal annual report on the progress of the plan. This report will be used as follows:



- Posted on the website page dedicated to the 2022 HMP update
- Provided to the local media through a press release
- Presented to the Tribal Council

#### 14.4.4 Plan Updates

CTCLUSI will update the plan on a five-year cycle from the date of formal adoption of this plan update. This cycle may be accelerated to less than five years based on the following triggers:

- A Presidential Disaster Declaration that impacts CTCLUSI
- A hazard event that causes loss of life

It will not be the intent of this update process to start from scratch and develop a new HMP for CTCLUSI's Service Area. Based on needs identified by the Emergency Management Team, plan updates will, at a minimum, include the elements below:

- The update process will be convened through the Emergency Management Team
- The hazard risk assessment will be reviewed and, if necessary, updated using the best available information and technologies
- The action plan will be reviewed and revised to account for any initiatives completed, dropped, or changed and to account for changes in the risk assessment or changes in planning goals or priorities identified by the Emergency Management Team or under other planning mechanisms, as appropriate (such as Tribal strategic plans)
- The draft HMP update will be sent to appropriate agencies and organizations for comment
- CTCLUSI citizens will be given the opportunity to comment on the update before adoption
- A new resolution will be adopted following the update

#### 44 CFR 201.7(d)(3)

Requires that local HMPs be reviewed, revised if appropriate, and resubmitted for approval to remain eligible for benefits under the Disaster Mitigation Act of 2000.

#### 14.4.5 Continuing CTCLUSI Citizens Involvement

CTCLUSI Citizens will be regularly updated on the status of hazard mitigation actions through annual reports and the Tribes' community-wide hazard mitigation education program. Copies of the HMP annual progress reports will be distributed to stakeholders and the media, where appropriate, and hard copies of the 2022 HMP update will be available to Tribal Citizens.

Additionally, a new Tribal Citizens involvement strategy will be initiated based on guidance from the Emergency Management Team each time the plan is updated. This strategy will be based on the needs and capabilities of the Tribe at the time of the update. At a minimum, this strategy will include the use of local media outlets and social media.

#### 14.4.6 Integration with Other Planning Mechanisms

The information on hazards, risks, vulnerability, and mitigation in this plan update is based on the best science and technology currently available. This information can be invaluable in informing decisions made under other planning efforts, such as strategic planning, growth management planning, and capital facilities planning. The Tribes will use information from this updated plan as the best available science and data on natural hazards impacting the CTCLUSI's Service Area. Information in the updated plan can be used as a tool in other programs, such as the following:

- Land use planning
- Critical areas regulation
- Water Resource Inventory Area planning
- Growth management
- Capital improvements
- Basin planning

As information becomes available from other planning mechanisms that can enhance this plan, it will be incorporated into the HMP via the update process.

# CTCLUSI 2022 Hazard Mitigation Plan Appendices



## Appendix A. Acronyms and Definitions

### Acronyms

Acronym	Definition	Acronym	Definition
<b>APA</b>	Approval Pending Adoption	<b>BCA</b>	Benefit-Cost Analysis
<b>BCAR</b>	FEMA's Benefit-Cost Analysis Tool	<b>BCE</b>	Before the Common/Current Era
<b>BIA</b>	Bureau of Indian Affairs	<b>BRIC</b>	Building Resilient Infrastructure and Communities
<b>CAA</b>	Clean Air Act	<b>CERT</b>	Community Emergency Response Team
<b>CDC</b>	US Centers for Disease Control	<b>CFR</b>	Code of Federal Regulations
<b>cfs</b>	Cubic feet per second	<b>COOP</b>	Continuity of Operations Plan
<b>COVID-19</b>	Novel coronavirus 2019 (COVID-19)	<b>CSZ</b>	Cascadia Subduction Zone
<b>DEWS</b>	Drought Early Warning System	<b>DOGAMI</b>	Oregon Department of Geology and Mineral Industries
<b>DOL</b>	US Department of Labor	<b>DOT</b>	US Department of Transportation
<b>DMA</b>	Disaster Mitigation Act	<b>DNR</b>	Department of Natural Resource
<b>EF</b>	Enhanced Fujita Scale	<b>EOP</b>	Emergency Operations Plan
<b>EPA</b>	US Environmental Protection Agency	<b>EPCRA</b>	Emergency Planning and Community Right-to-Know Act
<b>FEMA</b>	Federal Emergency Management Agency	<b>FIRM</b>	Flood Insurance Rate Map
<b>GIS</b>	Geographic Information System	<b>HAN</b>	Health Alert Network
<b>HAZMAT</b>	Hazardous Materials	<b>HHS</b>	US Department of Health and Human Services
<b>HMGP</b>	Hazard Mitigation Grant Program	<b>HMP</b>	Hazard Mitigation Plan
<b>HVAC</b>	Heating Ventilation and Air Conditioning	<b>I-5</b>	Interstate 5
<b>ISO</b>	Insurance Services Office	<b>IMDG</b>	International Maritime Dangerous Goods
<b>MMI</b>	Modified Mercalli Scale	<b>MOA</b>	Memorandum of Agreement
<b>NEHRP</b>	National Earthquake Hazards Reduction Program	<b>NCDC</b>	National Climatic Data Center
<b>NFIP</b>	National Flood Insurance Program	<b>NME</b>	Non-Medical Exemption
<b>NOAA</b>	National Oceanic and Atmospheric Administration	<b>NRCS</b>	Natural Resources Conservation Service

Acronym	Definition	Acronym	Definition
<b>NWS</b>	National Weather Service	<b>OSHA</b>	Occupational Safety and Health Administration
<b>PPE</b>	Personal Protective Equipment	<b>PHMSA</b>	Pipeline and Hazardous Materials Safety Administration
<b>PGA</b>	Peak Ground Acceleration	<b>PSAF</b>	Pandemic Severity Assessment Framework
<b>SLR</b>	Sea-Level Rise	<b>SLIDO</b>	Statewide Landslide Information Database for Oregon
<b>STAPLEE</b>	Social, Technical, Administrative, Political, legal Economic, and Environmental	<b>US</b>	United States
<b>USFS</b>	US Forest Service	<b>USGS</b>	US Geological Survey
<b>WCATWC</b>	West Coast/Alaska Tsunami Warning Center	<b>WHO</b>	World Health Organization
<b>WUI</b>	Wildland-Urban Interface		

## Definitions

**100-Year Floodplain:** An area inundated by a flood with a 1 percent chance of being equal or greater each year.

**500-year Floodplain:** An area inundated by floodwaters with a 0.2 percent chance of being equal or greater each year.

**Aftershock:** Lower-magnitude earthquakes that follow an initial primary earthquake.

**Arrival Time:** The time when the first wave of a tsunami hits the shore.

**Asset:** Any human-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.

**Benefit/Cost Analysis:** 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.

**Benefit:** A benefit is a net project outcome and is usually defined in monetary terms. Benefits may include direct and indirect effects. For benefit-cost analysis mitigation measures, benefits are limited to specific, measurable, risk reduction factors, including reducing expected property losses (buildings, contents, and functions) and protecting human life.

**Building:** A building is defined as a walled and roofed structure, principally above-ground 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 entity's mission, programs, policies and an analysis of its capacity to carry them out. A capability assessment is an integral part of the planning process. 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, and fiscal capability.

**Coastal Flood:** Occur by seawater and coastlines, often due to severe weather events and cause coastline erosion.

**Communicable Disease:** An illness transmitted from an infected agent to an animal or individual through direct or indirect contact.

**Corrosive Material:** A liquid or solid that causes irreversible damage to skin on contact over a certain amount of time.

**Crest:** The highest point of the tsunami wave.

**Critical Facility:** Those facilities and infrastructure that are critical to the health and welfare of the population. These become especially important after any hazard event occurs. Critical facilities can include the following:

- Structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic, and/or water-reactive materials
- Public and private utilities, facilities, and infrastructure are vital to maintaining or restoring standard services to areas damaged by hazard events
- Government facilities

**Dam:** Any artificial barrier and/or any controlling works, together with appurtenant works, can impound or divert water.

**Debris Flow:** A form of a rapid mass movement in which loose soil, rock, and sometimes organic matter combines with water to form a slurry that flows downslope.

**Distant Source Tsunami:** A tsunami that begins a long distance from the coastline where it strikes.

**Disaster Mitigation Act of 2000 (DMA):** A Public Law 106-390 that 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. The DMA established a pre-disaster hazard mitigation program and new requirements for the national post-disaster Hazard Mitigation Grant Program (HMGP).

**Disease Vector:** An agent that carries and transmits infectious diseases, such as an insect, fungus, or animal.

**Drainage Basin:** 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:** Extended periods of extremely low rainfall and snowpack lead to groundwater shortages impacting a large area of people, animals, and the environment.

**Earthquake:** A sudden shaking of the ground caused by seismic waves traveling through the earth.

**Earthquake Magnitude:** The seismic wave/amplitude measured and recorded by seismographs from an earthquake's epicenter. Magnitude is represented by a class name and numerical value from 3 to 8.

**Emergency Operations Plan (EOP):** A formal document that provides an entity's emergency response procedures, structure, and authorities.

**Epicenter (seismology):** The ground surface directly above the focal point where the fault ruptures.

**Epidemic:** Happens when there is a significant and unexpected increase in disease cases.

**Essential Workers:** Individuals that work in roles that are critical to infrastructure operations.

**Evacuation Zone:** The area that needs to be evacuated when a tsunami is likely to reach the shore.

**Excessive/Extreme Heat:** A combination of high temperatures and humidity, where the human body cannot maintain internal temperatures and cause heat-stroke.

**Explosive:** A substance, article, or device that functions by exploding, or chemical reaction that causes an explosion, including pyrotechnic substances.

**Fault:** A fracture in the Earth's crust where compression or tension pressure causes displacement of soil and rock on the opposite side of the fracture.

**Flammable Liquid:** A liquid with a flashpoint at or above 100°F that is heated and transported at or above its flashpoint in bulk packaging.

**Flammable Gas:** A substance that has a boiling point and is a gas at 68°F or less.

**Flammable Solid:** Any substance that is flammable in a solid form.

**Flash Flood:** A rapid rise in water with a high flow velocity that carries debris. Flash floods have enough force to pull up and carry significant amounts of large debris (e.g., cars and trees).

**Flood:** Inundation of ordinarily dry land resulting from rising and overflowing of a body of water.

**Floodplain:** An area of land neighboring a waterway or water body that is known to be flood-prone.

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

**Fuels:** Materials that burn in a fire, such as paper products, flammable gases or chemicals, or wood products. The material composition determines how flammable it is, based on moisture level, chemical makeup, and material density. The less moisture and lower density, the faster and hotter it burns.

**General Severe Weather:** Systems that form over broad geographic areas that can cross regional and jurisdictional boundaries.

**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. The Act provides grant information to states, tribes, and local governments.

**Hazardous Materials (HAZMAT):** Any substance or chemical that is a health or physical hazard to humans or the environment.

**Hazardous Waste:** A dangerous waste product of a hazardous material.

**Hazards US Multi-Hazard (HAZUS-MH) Loss Estimation Program:** A GIS-based program to support the development of risk assessments required under the DMA. The HAZUS-MH software program quantitatively estimates damages and losses associated with natural hazards. HAZUS-MH is FEMA's nationally applicable, standardized methodology and software program. It contains modules for estimating potential losses from hazards.

**Herd Immunity:** when enough of the population becomes resistant to a disease by recovering from the illness or vaccination.

**Hypocenter:** The region underground where an earthquake's energy originates.

**Infectious Diseases:** Medical conditions/illnesses caused by organisms like bacteria, viruses, fungi, or parasites.

**Inundation Area (dams):** The area of land that would be flooded following a dam failure.

**Inundation Area (tsunamis):** Normally dry land that can or will be flooded by a tsunami. It is measured horizontally from the coastline moving inland.

**Landslide:** A large amount of rock, debris, or earth that travels down a slope.

**Liquefaction:** A loss of soil strength or cohesion results in the soil behaving like a thick liquid (e.g., quicksand).

**Local Government:** Any county, municipality, city, town, township, public authority, school district, special district, intrastate district, a 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. Any rural community, unincorporated town or village, or other public entity.

**Localized Severe Weather:** Damaging storms and severe weather in a limited geographic area, can include all types of severe weather.

**Mass Earth Movement:** A collective term for landslides, debris flows, falls, and sinkholes.

**Miscellaneous Hazardous Material:** A material that only poses a risk when transported.

**Mitigation:** A preventive action that can be taken to reduce or eliminate the risk to life or property in advance of an event.

**Mitigation Actions:** Specific actions to achieve goals and objectives that minimize the effects of a disaster and reduce life and property loss.

**Modified Mercalli Scale:** A measurement of the level of intensity felt on the ground's surface in populated areas, represented by a Roman numeral from I to X.

**Mortality Rate:** A mathematical measure of the frequency that individuals die in a defined population during a specific period.

**Mudslide, Mudflow, or Debris Flow:** A river of rock, earth, organic matter, and other water-saturated materials.

**Objective:** For this plan's purposes, an objective is defined as a short-term aim that forms a strategy or course of action to meet a goal when combined with other objectives. Unlike goals, objectives are specific and measurable.

**Outbreak:** Similar to an epidemic but limited to a specific geographic area or group of people.

**Oxidizer or Organic Peroxide:** A substance that, by yielding oxygen, can enhance or cause the compustion of other materials.

**Pandemic:** Occur when a disease crosses multiple countries and infects a large number of people.

**Preparedness:** Actions that strengthen an entity's capability to respond to disasters and support their community.

**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.

**Radioactive Material:** Any material containing radionuclides when the activity concentration and total activity exceeds specified values.

**Risk:** The estimated impact of a hazard 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 determined threshold due to the occurrence of a specific type of hazard. Risk also can be expressed in terms of potential monetary losses from the hazard.

**Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act):** Public Law 100-107 signed 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 for FEMA and its programs.

**Runup:** A measurement of the height of the water onshore observed above a reference sea level.

**Seiches:** A standing wave/oscillation in an enclosed or partially enclosed body of water varies in a period from a few minutes to several hours.

**Sinkhole:** A collapse depression in the ground with no visible outlet. Its drainage is subterranean. It is commonly vertical-sided or funnel-shaped.

**Slope Failure:** Occur when the soils' strength forming the slope is exceeded by the pressure, such as weight or saturation, acting upon them.

**Stakeholder:** Individuals and organizations with a vested interest in a project and/or plan, such as business leaders, civic groups, academia, non-profit organizations, major employers, critical facilities managers, farmers, developers, special purpose districts, etc.

**Emergency Managment Team:** The group that oversaw all phases of the HMP's development. Committee members included key stakeholders and community members in the Service Area.

**Stormwater Management:** Physical and natural systems used by people to control and regulate the flow of surface and stormwater runoff.

**Storm Surge:** When a coastal flood happens at the same time as a high-tide, causing the coastal flood to reach farther and bring more water than it would during a lower tide.

**Surface Rupture:** An area of the ground that is offset (raised, lowered, tilted) when a fault rupture reaches the surface of the ground.

**Terrain/Topography:** The ground's slope can help or halt the spread of a wildfire. For example, significant gaps in vegetation or waterways such as rivers and creeks can stop a wildfire from spreading. Fires also move faster upslope than down due to elevation changes and warm air rising.

**Thunderstorm:** A local storm with thunder and lightning can cause tornadoes, heavy rain, flash floods, hail, and high winds.

**Tornadoes:** A destructive rotating column of wind generated by a thunderstorm, shaped in a funnel that reaches the ground.

**Tsunami:** Comes from the Japanese words for *harbor* ("tsu") and *wave* ("nami"); a long high sea wave caused by an earthquake, submarine landslide, or other disturbance.

**Tsunami from a large undersea earthquake:** The earthquake must cause significant vertical deformation on the seafloor for a tsunami to occur.

**Vulnerability:** A description of how exposed or susceptible an asset is to damage. Vulnerability depends on an asset's construction, contents, and the economic value of its functions. The vulnerability of a community is often related to another's nearby community's vulnerability. Also, indirect effects can be much more widespread and damaging than direct effects.

**Watershed:** An area that drains downgradient from areas of higher land to lower land areas to the lowest point, a common drainage basin.

**Wildland Urban Interface Area (WUI):** An area susceptible to wildfires and wildland vegetation and urban or suburban development occur together. An example would be smaller urban areas and dispersed rural housing in forested areas.

**Wildfire:** Fires result in uncontrolled destruction of forests, brush, field crops, grasslands, and personal property in non-urban areas. Because of their distance from firefighting resources, they can be difficult to contain and cause a great deal of destruction.

**Windstorm:** A storm featuring violent winds. Southwesterly winds are associated with intense storms moving onto the coast from the Pacific Ocean. Southern winds parallel to the coastal mountains are the strongest and most destructive winds. In addition, windstorms tend to damage ridgelines facing the wind.

**Winter Storm:** A cold event with significant precipitation in snow, ice, freezing rain, sleet, etc. Higher elevations get more precipitation.



## Appendix B. Annual Hazard Mitigation Progress Reporting and Mitigation Action Evaluation Forms

Every year lead entities identified in the action plan will submit a Hazard Mitigation Strategy Evaluation Form. This provides the Emergency Management Team with all the information needed to compile a formal annual report on the progress of the plan. If any additional mitigation initiatives have been identified that were not previously addressed in CTCLUSI's 2022 HMP update, the identified lead entity will also complete a Mitigation Action Evaluation Form to attach to the Strategy Evaluation Form.

## Annual Hazard Mitigation Progress Reporting Form



CTCLUSI Department: \_\_\_\_\_

Prepared By: \_\_\_\_\_ Title: \_\_\_\_\_

For the 12-month period ending: \_\_\_\_\_ Date: \_\_\_\_\_

Instructions: Complete this form for each entity. Check the box beside the Yes or No options. Complete descriptions for each question to which a Yes response applies, inserting additional lines as needed. *Please answer the following questions to the best of your knowledge for the preceding 12 months:*

1. Did CTCLUSI experience any hazard events resulting in losses?

☐ No ☐ Yes – Describe (e.g., deaths, injuries, property damage, and indirect impacts such as loss of use, economic or environmental impacts, if a damage assessment was conducted, emergency or disaster declaration):


2. Have there been any observed impacts, physical changes, or new studies that affect the hazard analysis?

☐ No ☐ Yes – Describe:


3. Have any additional mitigation initiatives been identified that were not in the previous HMP?

☐ No ☐ Yes – For each new initiative, complete a Mitigation Action Evaluation Form.

4. Have any identified mitigation initiatives been completed and successful?

☐ No ☐ Yes – Review:


5. Were there targeted strategies in the past year that did not get completed?

☐ No ☐ Yes – Discuss:


6. Do any mitigation strategies in the current plan need timeline amendments (such as changing a long-term project to a short-term project due to funding)?

☐ No ☐ Yes – Describe:


7. Have there been any changes in potential or new funding options, including grant opportunities?

☐ No ☐ Yes – Describe:


8. Were there any other planning programs or initiatives that involved hazard mitigation? If so, what was their impact?

☐ No ☐ Yes – Describe:


9. Has public awareness of hazards improved?

☐ No ☐ Yes – Describe:


## Mitigation Action Evaluation Form

The CTCLUSI HMP Emergency Management Team will review the status of hazard mitigation actions using this form, informing the Annual Progress Report.



Project ID: \_\_\_\_\_ Project Name: \_\_\_\_\_

1. Project Description:


2. Affected Entity: \_\_\_\_\_

3. Lead Entity: \_\_\_\_\_

4. Status and Priority Level: \_\_\_\_\_

5. Anticipated Completion Timeframe: \_\_\_\_\_

6. Actual Timeframe Completed: \_\_\_\_\_

7. Anticipated Cost: \_\_\_\_\_

8. Actual Cost to Complete: \_\_\_\_\_

9. Funding Source(s):


10. Anticipated Benefit vs. Cost – (For those projects with a measurable benefit in terms of future loss reduction, please quantify. For projects less easily quantified, please provide a qualitative assessment of the benefit to the cost):


9. Other Comments:


Prepared By: \_\_\_\_\_

Date: \_\_\_\_\_

## Appendix C. Planning Process with CTCLUSI Citizens

[Add info here]



## Appendix D. FEMA Tribal Review Tool

The *Tribal Mitigation Plan Review Tool* records how the tribal mitigation plan meets the regulations in 44 CFR §§ 201.7 and 201.5 (if applicable) and offers FEMA plan reviewers an opportunity to provide feedback to the tribal government.

1. **Section 1:** The Regulation Checklist documents FEMA's evaluation of whether the plan has addressed all requirements. If plan requirements are not met, FEMA uses each Required Revisions section to indicate necessary changes.
2. **Section 2:** The Strengths and Opportunities for Improvement summary identifies plan's strengths as well as areas for improvement as part of the next plan update.

The FEMA mitigation planner must reference the *Tribal Mitigation Plan Review Guide* when completing the Tribal Mitigation Plan Review Tool.

<b>Tribal Jurisdiction:</b> CTCLUSI	<b>Title of Plan:</b> CTCLUSI 2022 Hazard Mitigation Plan	<b>Date of Plan:</b>
<b>Tribal Point of Contact:</b>		<b>Address:</b>
<b>Title:</b>		
<b>Agency:</b>		
<b>Phone Number:</b>		<b>E-Mail:</b>

<b>State Reviewer (if applicable):</b>	<b>Title:</b>	<b>Date:</b>
----------------------------------------	---------------	--------------

<b>FEMA Reviewer:</b>	<b>Title:</b>	<b>Date:</b>
<b>Date Received in FEMA Region 10</b>		
<b>Plan Not Approved</b>		
<b>Plan Approvable Pending Adoption</b>		
<b>Plan Approved</b>		

## Section 1: Regulation Checklist

**INSTRUCTIONS:** The Regulation Checklist is completed by FEMA. The purpose of the Checklist is to identify the location of relevant or applicable content in the Plan by Element/sub-element and to determine if each requirement has been ‘Met’ or ‘Not Met.’ The ‘Required Revisions’ summary at the bottom of each Element is completed by FEMA to provide a clear explanation of the revisions that are required for plan approval. Required revisions are explained for each plan sub-element that is ‘Not Met.’ Sub-elements are referenced in each summary by using the appropriate numbers (A1, B3, etc.), where applicable.

1. REGULATION CHECKLIST	Location in Plan (section and/or page number)	Met	Not Met
<b>Regulation (44 CFR 201.7 Tribal Mitigation Plans)</b>			
<b>ELEMENT A. PLANNING PROCESS</b>			
A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process? (Requirement 44 CFR §201.7(c)(1))			
A2. Does the plan document an opportunity for public comment during the drafting stage and prior to plan approval, including a description of how the tribal government defined “public”? (Requirement 44 CFR § 201.7(c)(1)(i))			
A3. Does the plan document, as appropriate, an opportunity for neighboring communities, tribal and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? (Requirement 44 CFR §201.7(c)(1)(ii))			
A4. Does the plan describe the review and incorporation of existing plans, studies, and reports? (Requirement 44 CFR §201.7(c)(1)(iii))			
A5. Does the plan include a discussion on how the planning process was integrated to the extent possible with other ongoing tribal planning efforts as well as other FEMA programs and initiatives? (Requirement 44 CFR §201.7(c)(1)(iv))			
A6. Does the plan include a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within the plan update cycle)? (Requirement §201.7(c)(4)(i))			
A7. Does the plan include a discussion of how the tribal government will continue public participation in the plan maintenance process? (Requirement 44 CFR § 201.7(c)(4)(iv))			
<b>ELEMENT A: REQUIRED REVISIONS</b>			
<b>ELEMENT B. HAZARD IDENTIFICATION AND RISK ASSESSMENT</b>			
B1. Does the plan include a description of the type, location, and extent of all natural hazards that can affect the tribal planning area? (Requirement 44 CFR §201.7(c)(2)(i))			

1. REGULATION CHECKLIST Regulation (44 CFR 201.7 Tribal Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
B2. Does the plan include information on previous occurrences of hazard events and on the probability of future hazard events for the tribal planning area? (Requirement 44 CFR §201.7(c)(2)(i))			
B3. Does the plan include a description of each identified hazard's impact as well as an overall summary of the vulnerability of the tribal planning area? (Requirement 44 CFR §201.7(c)(2)(ii))			
<b><u>ELEMENT B: REQUIRED REVISIONS:</u></b>			
<b>ELEMENT C. MITIGATION STRATEGY</b>			
C1. Does the plan include a discussion of the tribal government's pre-and post-disaster hazard management policies, programs, and capabilities to mitigate the hazards in the area, including an evaluation of tribal laws and regulations related to hazard mitigation as well as to development in hazard-prone areas? (Requirement 44 CFR §§ 201.7(c)(3) and 201.7(c)(3)(iv))			
C2. Does the plan include a discussion of tribal funding sources for hazard mitigation projects and identify current and potential sources of Federal, tribal, or private funding to implement mitigation activities? (Requirement 44 CFR §§ 201.7(c)(3)(iv) and 201.7(c)(3)(v))			
C3. Does the Mitigation Strategy include goals to reduce or avoid long-term vulnerabilities to the identified hazards? (Requirement 44 CFR § 201.7(c)(3)(i))			
C4. Does the plan identify and analyze a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with emphasis on new and existing buildings and infrastructure? (Requirement 44 CFR § 201.7(c)(3)(ii))			
C5. Does the plan contain an action plan that describes how the actions identified will be prioritized, implemented, and administered by the tribal government? (Requirement 44 CFR § 201.7(c)(3)(iii))			
C6. Does the plan describe a process by which the tribal government will incorporate the requirements of the mitigation plan into other planning mechanisms, when appropriate? (Requirement 44 CFR § 201.7(c)(4)(iii))			
C7. Does the plan describe a system for reviewing progress on achieving goals as well as activities and projects identified in the mitigation strategy, including monitoring implementation of mitigation measures and project closeouts? (Requirement 44 CFR §§ 201.7(c)(4)(ii) and 201.7(c)(4)(v))			
<b><u>ELEMENT C: REQUIRED REVISIONS:</u></b>			

1. REGULATION CHECKLIST		Location in Plan	Met	Not Met
Regulation (44 CFR 201.7 Tribal Mitigation Plans)		(section and/or page number)		
<b>ELEMENT D. PLAN REVIEW, EVALUATION, AND IMPLEMENTATION</b> (applicable to plan updates only)				
D1. Was the plan revised to reflect changes in development? (Requirement 44 CFR § 201.7(d)(3))				
D2. Was the plan revised to reflect progress in tribal mitigation efforts? (Requirement 44 CFR §§ 201.7(d)(3) and 201.7(c)(4)(iii))				
D3. Was the plan revised to reflect changes in priorities? (Requirement 44 CFR §201.7(d)(3))				
<b><u>ELEMENT D: REQUIRED REVISIONS:</u></b>				
<b>ELEMENT E. PLAN ADOPTION</b>				
E1. Does the plan include assurances that the tribal government will comply with all applicable Federal statutes and regulations in effect with respect to the periods for which it receives grant funding, including 2 CFR Parts 200 and 3002, and will amend its plan whenever necessary to reflect changes in tribal or Federal laws and statutes? (Requirement 44 CFR § 201.7(c)(6))				
E2. Does the plan include documentation that it has been formally adopted by the governing body of the tribal government requesting approval? (Requirement 44 CFR § 201.7(c)(5))				
<b><u>ELEMENT E: REQUIRED REVISIONS</u></b>				

## Section 2: Plan Strengths and Opportunities for Improvement

**INSTRUCTIONS:** The purpose of the ***Strengths and Opportunities for Improvement*** section is for FEMA to provide more comprehensive feedback on the tribal mitigation plan to help the tribal government advance mitigation planning. The intended audience is the tribal staff responsible for the mitigation plan update. FEMA will address the following topics:

1. Plan strengths, including specific sections in the plan that are above and beyond the minimum requirements
2. Suggestions for future improvements

FEMA will provide feedback and include examples of best practices, when possible, as part of the *Tribal Mitigation Plan Review Tool*, or, if necessary, as a separate document. The tribal mitigation plan elements are included below in italics for reference. FEMA is not required to provide feedback for each element.

Required revisions from the **Regulation Checklist** are not documented in the **Strengths and Opportunities for Improvement** section. Results from the **Strengths and Opportunities for Improvement** section are not required for Plan Approval.

**Describe the mitigation plan strengths areas for future improvements, including areas that may exceed minimum requirements.**

- Planning process
- Hazard identification and risk assessment
- Mitigation strategy (including Mitigation Capabilities)
- Plan updates
- Adoption and assurances



## Appendix E. Plan Adoption Resolution

[Placeholder for CTCLUSI Plan Adoption Document]

CTCLUSI Tribal Government

Resolution # \_\_\_\_\_

CTCLUSI 2022 Hazard Mitigation Plan [Insert Date of Mitigation Plan]

WHEREAS the [insert Tribal governing body name] recognizes the threat that natural hazards pose to people and property within the CTCLUSI;

WHEREAS CTCLUSI has prepared a multi-hazard mitigation plan in accordance with the Disaster Mitigation Act of 2000 and the requirements in Title 44 Code of Federal Regulations Section 201.7;

WHEREAS the Plan specifically addresses hazard mitigation strategies and plan maintenance procedures for CTCLUSI;

WHEREAS the Plan recommends several hazard mitigation actions and projects that will provide mitigation for specific natural hazards that impact CTCLUSI, with the effect of protecting people and property from loss associated with those hazards;

WHEREAS, adoption of this plan will make CTCLUSI eligible for funding to alleviate the impacts of future hazards on the Reservation,

NOW THEREFORE BE IT RESOLVED by the [insert appropriate official titles] of the [insert Tribe name] that:

1. The Plan is hereby adopted as an official plan of CTCLUSI.
2. The respective officials identified in the mitigation strategy of the Plan are hereby directed to pursue implementation of the recommended actions assigned to them.
3. Future revisions and plan maintenance required by 44 CFR 201.7 and FEMA are hereby adopted as a part of this resolution for a period of five (5) years from the date of this resolution.
4. An annual report on the progress of the implementation elements of the Plan shall be presented to the Tribal Council by [insert date] of each calendar year.
5. CTCLUSI will comply with all applicable Federal statutes and regulations in effect with respect to the periods for which it receives grant funding, including 2 CFR Parts 200 and 3002; and will amend our plan whenever necessary to reflect applicable changes in Tribal or federal laws and statutes.

PASSED by the [insert appropriate title], this \_\_\_\_ day of \_\_\_\_ (month), \_\_\_\_ (year).

[Provide various signature blocks as required]

## Appendix F. Hazard Descriptions and Event Tables

### CTCLUSI's Disaster Declarations

Figure F-1. CTCLUSI's Disaster Declarations (Federal Emergency Management Agency, 2021)

Type of Incident	Date of Declaration	Event Effects	FEMA Disaster Number
Severe Weather, Flooding, Mass Earth Movement	2007	Severe Storms, Flooding, Landslides, and Mudslides	DR-1733-OR

The CTCLUSI 2006 HMP and HMPs from counties in the Service Area recorded significant past snow and wind events (Douglas County Planning Department and Emergency Management, 2016) (Lane County Hazard Mitigation & Emergency Management Steering Committee, 2018) (University of Oregon, Community Service Center, & Oregon Partnership for Disaster Resilience, 2016):

Table F-2. Significant Snow and Wind Events that Affected the Service Area

Date	Event Description
January 11 to 15, 1916	A winter storm affected the entire state, with every weather station except southwestern coastal and interior areas reporting snow accumulation of at least 5 inches.
December 9 to 11, 1919	One of the three heaviest snow-producing storms on record affected almost the entire state.
January 1921	Hurricane force winds occurred along the entire Oregon coast.
January 1950	Three severe storms occurred one after the other in January. The storms had severe effects on infrastructure, residents, and businesses across the state. Deep snowdrifts closed highways west of the Cascades, and sleet that turned to freezing rain caused unsafe conditions on roadways and damaged trees and power lines.
December 9 to 18, 1950	A series of three nearly continuous storms produced heavy snowfall and high winds, causing considerable damage to property. Blowing snow created massive snowdrifts, requiring closure of highways west of the Cascades.
November 10 and 11, 1951	High winds caused extensive damage across the entire state, especially to transmission and utility lines, buildings, and timber. Sustained southerly to southwesterly winds of 40 to 60 miles per hour were recorded across the state, with gusts of 75 to 80 miles per hour recorded at many stations.
December 4, 1951	Sustained winds reached speeds between 60 and 100 miles per hour along the coast, while inland valleys reported sustained wind speeds up to 75 miles per hour. This windstorm damaged buildings and caused widespread power losses throughout the State.
December 21 to 23, 1955	Sustained wind speeds were measured at 55 to 65 miles per hour with gusts reaching 69 miles per hour. Wind gusts measured at North Bend reached 90 miles per hour. High winds caused extensive damage to buildings, power, and telephone lines, and orchards in the Willamette Valley and timber across the state were heavily damaged.
November 1958	A windstorm with gusts between 80 and 100 miles per hour struck Curry and Coos counties, blocking roads and toppling over a billion board feet of timber.
February 1961	Heavy wind gusts and rain caused widespread damage in Curry and Coos counties.

Date	Event Description
<b>October 12, 1962</b>	“The Columbus Day Storm” developed off the coast of California and came into Oregon directly from the south. The storm was the equivalent of a Category IV hurricane in terms of central pressure and wind speeds and measured 1,000 miles long and 125 miles wide. Communities in the northern coastal portion of the CTCLUSI Service Area, including Lincoln City, Gleneden Beach, Newport, South Beach, and Waldport, experienced the strongest wind readings of at least 131 miles per hour.
<b>March 1963</b>	Winds recorded at between 100 and 115 miles per hour resulted in widespread damage along the coast and in northwest Oregon.
<b>October 2 to 3, 1967</b>	High winds along the coast measuring 100 to 115 miles per hour damaged buildings, utilities, agriculture, and timber. One person died and 15 were seriously injured.
<b>January 25 to 31, 1969</b>	An extreme winter storm produced dangerous snowfall in many areas of the state. Lane, Douglas, and Coos counties set new snowfall records. The city of Eugene recorded a total January snowfall of 47 inches, and coastal weather stations recorded total snowfall accumulations for the month of 2 to 3 feet, greatly exceeding the normal average snowfall of less than 2 inches. Damage costs were estimated between \$3 and \$4 million as structures collapsed, livestock was lost, and communities were isolated.
<b>March 1971</b>	High winds affected nearly the entire state and resulted in notable damage to power lines and buildings in Newport.
<b>April 5, 1972</b>	A windstorm produced the most damaging tornado in the state’s recorded history. Fifty cabin cruisers, several boathouses and dry docks, homes, and utilities were damaged.
<b>January 1980</b>	A series of storms brought snow, ice, wind, and freezing rain to the entire state, causing six fatalities.
<b>November 13-14, 1981</b>	Two successive storms produced the strongest windstorm since the Columbus Day storm. Damage was widespread, including toppled trees, damaged roofs, and damage to marinas, airports, and bridges. Approximately 500,000 homes were without power for several days.
<b>February 1985</b>	The western valleys received 2 to 4 inches of snow, which caused widespread power outages as a result of falling tree limbs that damaged power lines.
<b>January 1986</b>	Winds of approximately 75 miles per hour along the north and central coast left about 5,000 residents without power (United States Geological Survey, 2017).
<b>January 1987</b>	Wind gusts up to 96 miles per hour at Cape Blanco caused significant erosion along highways and beaches and resulted in several injuries (University of Oregon, Community Service Center, & Oregon Partnership for Disaster Resilience, 2016).
<b>December 1987</b>	Wind speeds reached up to 60 miles per hour along the coast and in northwest Oregon. Trees were uprooted in areas where the ground was saturated.
<b>March 1988</b>	A winter storm brought heavy snowfall and strong winds that affected the entire state. Winds along the coast reached 55 to 75 miles per hour, uprooting trees. One fatality occurred near Ecola State Park.
<b>January 1990</b>	A winter storm brought high winds and heavy snow to Lincoln County. Most damage resulting from this storm occurred in Lincoln City.
<b>February 1990</b>	Wind gusts of 53 miles per hour at Netarts damaged docks, piers, and boats.
<b>November 1991</b>	A slow-moving storm brought 25-foot waves offshore. The storm damaged buildings and boats and downed power lines.
<b>December 1992</b>	Western Oregon received heavy snowfall that resulted in closure of interstates.

Date	Event Description
<b>December 11, 1995</b>	This storm followed the path of the Columbus Day storm of 1962 and produced sustained winds of 62 miles per hour in the Willamette Valley. Sea Lion Caves recorded gusts of 119 miles per hour. The windstorm caused widespread damage to homes and trees, especially in areas where the soils were already saturated. The storm also damaged power and telephone lines and caused four fatalities and many additional injuries. Douglas County received a presidential disaster declaration following this storm.
<b>December 1997</b>	Approximately 80 mile per hour winds caused severe beach erosion in Newport and toppled trees.
<b>Winter 1998-1999</b>	This winter was one of the snowiest recorded in state history.
<b>February 7, 2002</b>	A State of Emergency was declared for Coos, Curry, Douglas, Lane, and Linn counties following the “South Valley Surprise” windstorm that lasted less than an hour but caused widespread damage to buildings, downed trees, power outages and subsequent water supply problems. The total estimated damage was approximately \$6.14 million. Douglas, Coos, and Curry counties recorded wind speeds ranging from 75 to 100 miles per hour.
<b>December 26, 2003</b>	January 14, 2004: Douglas, Lane, and Lincoln counties received FEMA disaster declarations because of severe winter storms.
<b>February 3, 2006</b>	A strong winter storm brought high winds to portions of western Oregon. Downed trees caused widespread power outages in Lane County, and an estimated \$300,000 in damage was reported.
<b>March 7, 2006</b>	A strong Pacific storm system caused a reported \$375,000 in damage. Winds were recorded at 43 miles per hour at Florence.
<b>November 2006</b>	Storms with winds measured at 70 miles per hour caused a total of \$10,000 in damage in Curry County.
<b>December 14, 2006</b>	The “Hannukah Eve” windstorm produced hurricane-force gusts and heavy rainfall. In Oregon, extensive tree damage was reported and caused damage to homes and power lines. More than 350,000 customers lost power at the peak of the storm. The governor requested a federal disaster declaration on January 31, 2007.
<b>February 2007</b>	A federal disaster (DR-1683) was declared following a severe winter storm.
<b>December 1 to December 4, 2007</b>	The “Great Coastal Gale” was a series of three powerful Pacific storms that affected much of the Northwest, producing hurricane-force wind gusts and record flooding. The storms caused at least 18 deaths and total direct losses of about \$300 million, including a total estimated \$42 million in timber losses across the state, including significant areas of timber along the coast in Douglas County. Peak wind gusts in Lane County were measured at 87 miles per hour at the Sugarloaf Remote Automatic Weather Station, about 8 miles west-southwest of Oakridge.
<b>December 19, 2007</b>	A strong Pacific storm and associated cold front brought 59 mile per hour winds to the coast and heavy snow to the Cascades.
<b>December 2008</b>	Intense rain and wind resulted in nearly \$8 million in estimated property and crop damage in the affected counties, including Lane and Lincoln counties.
<b>February 2011</b>	A severe winter storm brought high winds, flooding, and landslides. A federal disaster (DR-1956) was declared in the affected counties, including Lincoln and Douglas counties.
<b>January 17-21, 2012</b>	A winter storm and mudslides blocked or damaged numerous roads in Lane County. Total damages in the county were over \$1.4 million. A federal disaster was declared for this storm (DR-4055).

Date	Event Description
<b>March 2012</b>	Damaging winds, heavy rain, flooding, and mudslides, landslides, and erosion caused nearly \$6 million in damage in Coos, Curry, and 10 other affected counties.
<b>December 6-8, 2013</b>	Approximately 12 inches of snow fell across the southern Willamette Valley, resulting in major travel disruptions, power outages, and significant infrastructure damage. The storm was followed by near record cold temperatures. The National Weather Service station in Eugene recorded a low of -10° Fahrenheit, the second coldest temperature ever recorded at the station.
<b>February 8, 2014</b>	A major snow event brought approximately 12 inches of snow to the southern Willamette Valley, resulting in extended travel disruptions, power outages, and infrastructure damage. A federal disaster was declared for this storm (DR-4169).
<b>November 22, 2014</b>	Downburst winds of 60 miles per hour downed approximately 50 large trees and resulted in \$45,000 in damage in Coburg.
<b>April 14, 2015</b>	A Lane Community College official witnessed a tornado that damaged three vehicles. Wind speeds were estimated at 65 to 85 miles per hour, and the tornado resulted in approximately \$25,000 in damage. No injuries were reported.
<b>December 10, 2015</b>	Thunderstorm winds of 47 miles per hour were reported in Eugene and Creswell. Numerous trees were downed on vehicles and buildings, and damaged power lines resulted in widespread power outages. Approximately \$260,000 in damage was reported.
<b>December 11-24, 2015</b>	A strong winter storm brought wind, rain, and landslides. Hundreds of downed trees closed roadways and damaged vehicles, power lines, and structures. Landslides and erosion were widespread in coastal areas. A federal disaster was declared for this storm (DR-4258).
<b>January 16, 2016</b>	High winds associated with a band of thunderstorms downed trees and damaged power lines, structures, and buildings, including one home in Eugene. Winds were recorded at 63 miles per hour. The storms caused an estimated \$15,000 in damage.

### Comprehensive List of FEMA Disaster Declarations for Coos, Curry, Lincoln, Douglas, and Lane Counties

Table F-3. Disaster Declarations for Coos, Curry, Lincoln, Douglas, and Lane Counties (Federal Emergency Management Agency, 2020)

Incident	Year	Event Effects	County(ies) Impacted	Disaster Number
<b>Flooding</b>	1964	Heavy Rains and Flooding	Coos County, Curry County, Lincoln County, Douglas County, Lane County	DR-184-OR
<b>Severe Weather and Flooding</b>	1972	Severe Storms and Flooding	Coos County, Lincoln County, Douglas County, Lane County	DR-319-OR
<b>Severe Weather and Flooding</b>	1974	Severe Storms, Snowmelt, and Flooding	Coos County, Curry County, Lincoln County, Douglas County, Lane County	DR-413-OR
<b>Flooding</b>	1994	The El Nino (The Salmon Industry)	Coos County, Curry County, Lincoln County, Douglas County, Lane County	DR-1036-OR



Incident	Year	Event Effects	County(ies) Impacted	Disaster Number
<b>Severe Weather, Flooding, Mass Earth Movement</b>	1996	Flooding, Land, Mud Slides, High Winds, Severe Storms	Coos County, Douglas County, Lane County	DR-1149-OR
<b>Severe Weather and Flooding</b>	1996	High Winds, Severe Storms and Flooding	Coos County, Lincoln County, Douglas County, Lane County	DR-1099-OR
<b>Severe Weather</b>	1996	Severe Storms and High Winds	Lincoln County, Douglas County, Lane County	DR-1107-OR
<b>Severe Winter Weather, Mass Earth Movement, Flooding</b>	1997	Severe Winter Storms, Land and Mudslides, Flooding	Coos County, Douglas County, Lane County	DR-1160-OR
<b>Severe Winter Weather</b>	2002	Severe Winter Storm with High Winds	Coos County, Curry County, Douglas County, Lane County	DR-1405-OR
<b>Wildfire</b>	2002	Biscuit Fire	Curry County	DR-2453-OR
<b>Wildfire</b>	2004	OR-Bland Mountain Wildfire	Douglas County	DR-2549-OR
<b>Severe Winter Weather</b>	2004	Severe Winter Storms	Lincoln County, Douglas County, Lane County	DR-1510-OR
<b>Severe Weather, Flooding, Mass Earth Movement</b>	2006	Severe Storms, Flooding, Landslides, and Mudslides	Coos County, Curry County, Lincoln County, Douglas County	DR-1632-OR
<b>Severe Weather, Flooding, Mass Earth Movement</b>	2006	Severe Storms, Flooding, Landslides, and Mudslides	Lincoln County	DR-1672-OR
<b>Severe Storm, Flooding, Mass Earth Movement</b>	2007	Severe Storms, Flooding, Landslides, and Mudslides	Coos County, Curry County, Lincoln County	DR-1733-OR
<b>Severe Winter Weather and Flooding</b>	2007	Severe Winter Storm and Flooding	Lincoln County	DR-1683-OR
<b>Severe Winter Weather, Flooding, Mass Earth Movement</b>	2011	Severe Winter Storm, Flooding, Mudslides, Landslides, and Debris Flows	Lincoln County, Douglas County	DR-1956-OR
<b>Tsunami</b>	2011	Tsunami Wave Surge	Coos County, Curry County, Lincoln County	DR-1964-OR
<b>Severe Winter Weather</b>	2012	Severe Winter Storm, Flooding, Landslides, and Mudslides	Coos County, Curry County, Lincoln County, Douglas County, Lane County	DR-4055-OR
<b>Wildfire</b>	2013	Douglas Fire Complex	Douglas County	DR-5037-OR
<b>Severe Winter Weather</b>	2014	Severe Winter Storm	Lincoln County, Lane County	DR-4169-OR

Incident	Year	Event Effects	County(ies) Impacted	Disaster Number
Wildfire	2015	Stouts Creek Fire	Douglas County	DR-5092-OR
Severe Winter Weather, Flooding, Mass Earth Movement	2016	Severe Winter Storms, Straight-Line Winds, Flooding, Landslides, and Mudslides	Coos County, Curry County, Lincoln County, Douglas County, Lane County	DR-4258-OR
Wildfire	2017	Chetco Bar Fire	Curry County	DR-5198-OR
Severe Winter Weather and Flooding	2017	Severe Winter Storm and Flooding	Lane County	DR-4296-OR
Severe Weather, Flooding, Mass Earth Movement	2019	Severe Storms, Flooding, Landslides, and Mudslides	Curry County, Douglas County	DR-4452-OR
Severe Winter Weather, Flooding, Mass Earth Movement	2019	Severe Winter Storms, Flooding, Landslides, and Mudslides	Coos County, Curry County, Douglas County, Lane County	DR-4432-OR
Wildfire	2019	Mile Post 97 Fire	Douglas County	DR-5285-OR
Wildfire	2020	Archie Creek Fire	Douglas County	DR-5365-OR
Pandemic	2020	COVID-19	Coos County, Curry County, Lincoln County, Douglas County, Lane County	DR-3429-OR
Pandemic	2020	COVID-19 Pandemic	Coos County, Curry County, Lincoln County, Douglas County, Lane County	DR-4499-OR
Wildfire	2020	Echo Mountain Fire Complex	Lincoln County	DR-5362-OR
Wildfire	2020	Holiday Farm Fire	Lane County	DR-5357-OR
Wildfire	2020	Wildfires	Lincoln County, Douglas County, Lane County	DR-3542-OR

### Severe Weather Events in Coos, Curry, Lincoln, Douglas, and Lane Counties Resulting in Deaths/Injuries or \$25,000 or More in Damages

Table F-4. Severe Weather Events in Coos, Curry, Lincoln, Douglas, and Lane Counties (National Oceanic and Atmospheric Administration)

Date	Weather	County(ies) Impacted	Death/Injury	Damage Value
3/23/1983	Tornado	Curry County	0	\$25,000
5/14/1984	Tornado	Lane County	0	\$25,000
11/2/1984	Tornado	Lincoln County	0	\$250,000
11/24/1989	Tornado	Lane County	0	\$25,000

Date	Weather	County(ies) Impacted	Death/ Injury	Damage Value
1/15/1996	Thunderstorm Wind	Lincoln County	0	\$1,500,000
2/5/1996	Debris Flow	Central Coast Range of Western Oregon	1	0
2/6/1996	Flood	Central Coast Range of Western Oregon	7	\$400,000,000
8/24/1996	Wildfire	Lane County	0	\$1,700,000
9/01/1996	Wildfire	Lane County	0	\$1,700,000
11/18/1996	Debris Flow	Central Oregon Coast	2	0
12/5/1996	Tornado	Lane County	0	\$50,000
1/1/1997	Flood	Rogue Basin	0	\$60,400,000
1/10/1998	Winter Storm	Columbia Central/Western Multnomah	0	\$100,000
1/12/1998	Ice Storm	Columbia Central/Western Multnomah	1	\$1,000,000
1/28/1998	High Wind	JOSEPHINE T X SE/JACKSON T X S.	0	\$30,000
2/07/1998	Storm Surge/Tide	Curry County	0	\$300,000
3/21/1998	Flood	JOSEPHINE T X SE/JACKSON T X S	3	0
7/26/1998	Heat	Columbia Central/Western Multnomah	1	0
12/27/1998	Flood	Lincoln/ W X Lane	0	\$500,000
12/27/1998	Flood	Columbia Central/Western Multnomah	0	\$500,000
2/20/1999	High Wind	Columbia Central/Western Multnomah	0	\$100,000
3/2/1999	High Wind	JOSEPHINE T X SE/JACKSON T X S	1	0
3/2/1999	High Wind	JOSEPHINE T X SE/JACKSON T X S	1	0
11/25/1999	Flood	Central Coast	0	\$2,300,000
12/2/1999	Tornado	Lane County	1	\$10,500
2/7/2002	High Wind	Southern Willamette Valley	4	\$6,000,000
8/17/2002	Wildfire	Lane County	4	0
11/9/2002	Tornado	Curry County	0	\$500,000
12/08/2004	Debris Flow	Central Coast Range of Western Oregon	0	\$50,000
9/19/2005	High Surf	South Central Oregon Coast	0	\$1,000,000
9/19/2005	High Surf	South Central Oregon Coast	0	\$1,000,000
9/19/2005	High Wind	South Central Oregon Coast	0	\$1,000,000
12/26/2005	Flood	Central Douglas County, South Central Oregon Coast	0	\$1,580,000, \$4,600,000
12/26/2005	Flood	South Central Oregon Coast	0	\$4,600,000
12/26/2005	Flood	Central Douglas County	0	\$1,580,000
1/27/2006	Strong Wind	Central Coast Range of Western Oregon	0	\$50,000
1/27/2006	High Wind	Central Oregon Coast	0	\$100,000
1/29/2006	High Wind	Central Oregon Coast	0	\$50,000
1/29/2006	Strong Wind	Central Coast Range of Western Oregon	0	\$50,000
2/3/2006	Storm Surge/Tide	Central Oregon Coast	0	\$100,000
2/3/2006	High Wind	Central Oregon Coast	0	\$100,0000

Date	Weather	County(ies) Impacted	Death/ Injury	Damage Value
2/3/2006	Strong Wind	Central Coast Range of Western Oregon	0	\$50,000
2/3/2006	High Wind	Cascade Foothills in Lane County	0	\$50,000
3/1/2006	Strong Wind	Central Oregon Coast	0	\$25,000
3/7/2006	High Wind	Cascades in Lane County	0	\$100,000
3/7/2006	Strong Wind	Central Coast Range of Western Oregon	0	\$50,000
3/7/2006	High Wind	Central Oregon Coast	0	\$100,000
5/09/2006	High Surf	South Central Oregon Coast	3	0
3/27/2007	Rip Current	Central Oregon Coast	1	0
12/2/2007	High Wind	Central Oregon Coast	0	\$434,000
12/3/2007	Flood	Lincoln County	0	\$124,000
12/3/2007	Coastal Flood	Central Oregon Coast	0	\$62,000
3/8/2008	Rip Current	Central Oregon Coast	1	0
1/2/2009	Landslide	Central Oregon Coast	0	\$150,000
11/6/2009	Tornado	Lincoln County	0	\$35,000
11/18/2009	High Surf	Central Oregon Coast	2	0
1/18/2012	Flood	Lincoln County	0	\$3,000,000
1/18/2012	Flood	Lincoln County	0	\$2,000,000
11/18/2012	High Wind	Central Oregon Coast	0	\$1,000,000
12/4/2012	High Wind	Central Oregon Coast	0	\$100,000
6/28/2013	Rip Current	Central Oregon Coast	1	0
6/30/2013	Rip Current	Central Oregon Coast	4	0
4/20/2014	High Surf	Central Oregon Coast	2	0

## Original CTCLUSI Hazard Identification and Ranking Results

Below are the original ten hazards and output tables, later condensed into the eight hazard profiles in this HMP update. The scores were measured with one as the lowest and five as the highest.

*Table F-5. Most likely Hazard Scenario*

Hazard	Severity	Magnitude	Frequency	Onset	Duration	Average	Rank
Hazardous Materials	1.75	2.75	3.5	3	2.5	2.7	1
Pandemic	2.5	2.25	2	3.75	2.75	2.65	2
Earthquake	1.5	2.25	3	2.75	3.75	2.65	3
Tsunamis & Seiches	2.5	2.5	1.25	4	2.75	2.6	4
Severe Weather	1.5	2	2.75	3.75	2	2.4	5
Wildfires	2	3.25	1.75	1.75	3.25	2.4	6
Flood & SLR	1.25	1.5	2.75	3.75	2.5	2.35	7
Drought	1.5	1.75	2.25	3	3.25	2.35	8
Extreme Heat	1	2.25	2.5	2.25	2.75	2.15	9
Mass Movements (landslides)	1.25	2	2.25	1.25	3.25	2	10

*Table F-6. Worst-Case Hazard Scenario*

Hazard	Severity	Magnitude	Frequency	Onset	Duration	Average	Rank
Hazardous Materials	4	4.25	4.25	5	5	4.5	1
Pandemic	4.75	5	3.75	4	4.75	4.45	2
Earthquake	4.5	5	2.75	4.75	4.5	4.3	3
Tsunamis & Seiches	5	4.5	2	5	4.75	4.25	4
Severe Weather	3.25	4.75	4.5	4.5	3.75	4.15	5
Wildfires	3.75	4	4	5	4	4.15	6
Flood & SLR	2.5	4.25	4	3.5	4.5	3.75	7
Drought	3	4	4.25	2	5	3.65	8
Extreme Heat	2.5	4	3.75	3.5	4	3.55	9
Mass Movements (landslides)	2.5	3.25	3.5	5	3.25	3.5	10



## 1 Appendix G. FEMA Code of Federal Regulations Crosswalk

2 The Table below indicates the major changes between the two plans as they relate to 44 CFR planning requirements:

3 *Table G-1. CFR Requirements*

44 CFR Requirement	2006 Hazard Mitigation Plan	2022 Hazard Mitigation Plan
<b>44CFR 201.7(b): An effective planning process is essential in developing and maintaining a good plan. The mitigation planning process should include coordination with other tribal agencies, appropriate Federal agencies, adjacent jurisdictions, interested groups, and be integrated to the extent possible with other ongoing tribal planning efforts as well as other FEMA mitigation programs and initiatives.</b>	The Planning Process is addressed briefly in Section I: Introduction. The introduction discusses involvement with the public and FEMA approval. It does not go into detail about involving other agencies, jurisdictions, or any other stakeholders in the planning process.	Sections 3.2 through 3.4 describe the public involvement process and the opportunities presented for comments on the plan during drafting stages and prior to plan approval. Section 3.3 describes the opportunity for other communities and agencies to be involved in the plan update process. Section 3.3 also provides an overview of the review and incorporation of plans, studies, reports, and technical information. 3.4 outlines Tribal member involvement in the assessment and planning processes.
<b>44CFR 201.7(c)(2): A risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Tribal risk assessments must provide sufficient information to enable the Indian tribal government to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.</b>	The first part of Section III: Risk Analysis – Risk Assessment outlines the assessment and prioritization method.	Section 5.2 to 5.4 detail the methodology and tools utilized in the comprehensive risk assessment. The 9 hazards of concern looked at in the risk assessment were (1) active assailant, (2) earthquake, (3) epidemic/pandemic, (4) flooding and sea level rise, (5) hazardous materials, (6) mass earth movement, (7) tsunami, (8) severe weather events, and (9) wildfire
<b>44CFR 201.7(c)(2)(i): The risk assessment shall include a description of the type, location, and extent of all natural hazards that can affect the tribal planning area. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.</b>	Section III: Risk Analysis – Hazards Profiled provides an overview of the hazards identified and assessed. The following part Presidential Declared Disasters includes a table of previous large-scale disasters that impacted the Tribal area.	Sections 6-13 go through the comprehensive risk assessment for each hazard the Tribe identified as a risk, not just natural hazards. The updated hazard profiles include a general overview of the hazard and updated historical occurrences. Future probability was updated based on the latest data and studies. Scenarios were removed. Hazard maps were updated with the latest data and added to the end of the profiles.

44 CFR Requirement	2006 Hazard Mitigation Plan	2022 Hazard Mitigation Plan
<b>44CFR 201.7(c)(2)(ii):</b> The risk assessment shall include a description of the Indian tribal government's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the tribe.	Section III: Risk Analysis contains a hazard list that describes each hazard, vulnerability, and level of risk in detail.	Sections 6-13 of the plan addresses each hazard in detail and the Tribe's specific vulnerabilities and potential impacts to those hazards.
<b>44CFR 201.7(c)(2)(ii)(A):</b> The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas.	Each hazard profile discusses vulnerability to buildings, infrastructure, and critical facilities potentially at risk from that hazard.	Sections 6-13 each hazard profile discusses vulnerability to buildings, infrastructure, and critical facilities potentially at risk from that hazard.
<b>44CFR 201.7(c)(2)(ii)(B):</b> The plan should describe an estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate.	Details of potential impacts from each hazard are included in the hazard profiles, including an estimate of potential dollar losses to vulnerable structures and the method to estimate the loss.	Sections 6-13 detail the potential impacts from each hazard are included in the hazard profiles, including an estimate of potential dollar losses to vulnerable structures and the method to estimate the loss.
<b>44CFR 201.7(c)(2)(ii)(C):</b> The plan should provide a general description of land uses and development trends within the tribal planning area so that mitigation options can be considered in future land use decisions.	In Section V: Implementation and Maintenance – Tribal Capabilities: Planning and Regulations, the plan briefly describes incorporation of other plans and regulations that impact future land use and how those can align with mitigation measures.	Individual hazard profiles in Sections 6-13 include a part that assesses Tribal land use plans and codes and their ability to mitigate each hazard in future developments.
<b>44CFR 201.7(c)(2)(ii)(D):</b> The plan should provide a general description of cultural and sacred sites that are significant, even if they cannot be valued in monetary terms.	Mitigation Action 15 identifies a gap in mapping and assessment of critical facilities, including those with cultural and economic value.	Section 4.6 of the plan lists the Tribes' significant natural and cultural resources.

44 CFR Requirement	2006 Hazard Mitigation Plan	2022 Hazard Mitigation Plan
<b>44CFR 201.7(c)(3): The plan should include a mitigation strategy that provides the Indian tribal government's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.</b>	Section IV: Mitigation Actions provides the goals and mitigation actions that are the strategy for reducing potential losses from the hazards listed. The detailed actions identify existing authorities, policies, programs and resources to assist the Tribe with the actions.	Section 15 defines the entire mitigation strategy, including goals, actions, an action plan, plan adoption, and plan implementation and maintenance strategy. These pieces work together to support the Tribe with applying their mitigation actions, as well as ensuring the actions are regularly reviewed and updated.
<b>44CFR 201.7(c)(3)(i): The mitigation strategy shall include a description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.</b>	Section IV: Mitigation Actions – Goals and Objectives defines the Tribes' mitigation goals.	Section 15.1 describes the Tribes' mitigation goals.
<b>44CFR 201.7(c)(3)(ii): The mitigation strategy shall include a section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.</b>	Section IV: Mitigation Actions – Mitigation Actions and Activities outlines all the actions included in the 2006 update. Each action includes an analysis and implementation guidance. There is no particular emphasis on new and existing buildings and infrastructure in the actions.	Section 15.1.1 sets forth specific mitigation actions and projects for the Tribes to take to reduce risks from each hazard. Actions include considerations for new and existing buildings and infrastructure.
<b>44CFR 201.7(c)(3)(iii): The mitigation strategy shall include an action plan describing how the actions identified in paragraph (c)(3)(ii) of this section will be prioritized, implemented, and administered by the Indian Tribal government.</b>	Section V: Implementation and Maintenance includes a current capabilities assessment with current and potential sources of funding for the mitigation actions. Section V also outlines the process for local plan integration and the plan monitoring process. These steps combined make up the mitigation prioritization and implementation strategy.	The Action Plan in Section 15.2 includes the costs, benefits, and a cost-benefit comparison. The Plan Adoption process is in Section 15.3. Section 15.4 describes the Plan Implementation and Maintenance Strategy, including the plan implementation process, the Emergency Management Team involvement, Annual Progress Reports, Plan Update procedures, Continuing Tribal Member Involvement, and Integration with Other Planning Mechanisms.

44 CFR Requirement	2006 Hazard Mitigation Plan	2022 Hazard Mitigation Plan
<b>44CFR 201.7(c)(3)(iv):</b> The mitigation strategy shall include a discussion of the Indian tribal government's pre- and post-disaster hazard management policies, programs, and capabilities to mitigate the hazards in the area, including: An evaluation of tribal laws, regulations, policies, and programs related to hazard mitigation as well as to development in hazard-prone areas; and a discussion of tribal funding capabilities for hazard mitigation projects.	Section V: Implementation and Maintenance – Local Plan Integration Process includes	Integration with Other Planning Mechanisms process is addressed in 15.4.6. This section includes reviewing the HMP alongside other plans, regulations, and policies that relate to the HMP.
<b>44CFR 201.7(c)(3)(v):</b> The mitigation strategy shall include identification of current and potential sources of Federal, tribal, or private funding to implement mitigation activities.	Mitigation action funding strategies are included in each mitigation action section.	Funding strategies are included in Section 15.2.1, Cost.
<b>44CFR 201.7(c)(4)(i):</b> The plan maintenance process must include a section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan.	Section V: Implementation and Maintenance outlines the process for ensuring the plan is reviewed, maintained, and updated along with other relevant plans.	Section 15.4.3 to 15.4.6 detail the multiple steps the Tribe can take to effectively review, maintain, and update their plan and ensure it is integrated with other relevant plans.
<b>44CFR 201.7(c)(4)(ii):</b> The plan maintenance process must include a system for monitoring implementation of mitigation measures and project closeouts.	Section V: Implementation and Maintenance describes how the Tribe should and can review and update the plan on a regular basis, including the responsibilities for the plan maintenance and steps for monitoring.	Section 15.4.3 involves an Annual Progress Report to regularly monitor the plan's implementation and updating. Appendix B includes blank forms to assist the Tribe with their Mitigation Strategy Evaluation and Mitigation Action Evaluations.
<b>44CFR 201.7(c)(4)(iii):</b> The plan maintenance process must include a process by which the Indian tribal government incorporates the requirements of the mitigation plan into other planning mechanisms such as reservation master plans or capital improvement plans, when appropriate.	Section V: Implementation and Maintenance – Local Plan Integration Process explains how the Tribe can incorporate other relevant plans into the HMP maintenance process.	The plan maintenance process includes incorporation with other relevant plans. This is addressed in Section 15.4.6.

44 CFR Requirement	2006 Hazard Mitigation Plan	2022 Hazard Mitigation Plan
<b>44CFR 201.7(c)(4)(iv): The plan maintenance process must include discussion on how the Indian tribal government will continue public participation in the plan maintenance process.</b>	Section V: Implementation and Maintenance – Ongoing Public Participation addresses public involvement going forward.	Continuing CTCLUSI citizen and community member Involvement is detailed in Section 15.4.5.
<b>44CFR 201.7(c)(4)(v): The plan maintenance process must include a system for reviewing progress on achieving goals as well as activities and projects identified in the mitigation strategy.</b>	Section V: Implementation and Maintenance includes sections for Monitoring, Evaluating and Updating the Plan and Monitoring Progress of Mitigation Actions.	Section 15.4.3 involves an Annual Progress Report to regularly monitor the plan's implementation and updating. Appendix B includes blank forms to assist the Tribe with their Mitigation Strategy Evaluation and Mitigation Action Evaluations.
<b>44CFR 201.7(c)(5): The plan must be formally adopted by the governing body of the Indian tribal government prior to submittal to FEMA for final review and approval.</b>	The adoption resolution is in Appendix E.	The adoption resolution form is in Appendix E.



## 5 Appendix H. Service Area Facilities, Parcels, + Forest Stands

6 *Table H-1. Service Area Facilities*

ID	Ancestral Boundary	County	Facility Name	Facility Type	Acres
1	Within Ancestral Area	Lane	TRC Florence	Casino	2.578088
2	Within Ancestral Area	Coos	Qaxas Housing	Housing	0.035377
4	Within Ancestral Area	Coos	Qaxas Housing	Housing	0.032175
5	Within Ancestral Area	Coos	Administration	Administration	0.40481
6	Within Ancestral Area	Coos	Qaxas Housing	Housing	0.032429
7	Within Ancestral Area	Lane	Brainard Ranch	Ranch	0.021034
8	Within Ancestral Area	Coos	Qaxas Housing	Housing	0.052716
9	Within Ancestral Area	Coos	Quantset	Other	0.110676
10	Within Ancestral Area	Coos	Qaxas Housing	Housing	0.049497
11	Within Ancestral Area	Coos	Community Center	Community	0.186432
12	Within Ancestral Area	Coos	Camp Easter Seal	Camp	0.016601
13	Within Ancestral Area	Lane	Treatment Plant	Water/Wastewater	0.026561
14	Within Ancestral Area	Lane	Casino Admin	Casino	0.359988
15	Within Ancestral Area	Coos	Qaxas Housing	Housing	0.085762
16	Within Ancestral Area	Coos	Tribal Hall	Community	0.112042
17	Within Ancestral Area	Lane	Treatment Plant	Water/Wastewater	0.039176
19	Within Ancestral Area	Coos	Camp Easter Seal	Camp	0.137995
20	Within Ancestral Area	Coos	Tabernig Rental	Other	0.028921
24	Within Ancestral Area	Coos	Qaxas Housing	Housing	0.033069
25	Within Ancestral Area	Coos	Qaxas Housing	Housing	0.052414
26	Within Ancestral Area	Coos	Maintenance	Maintenance	0.024222
27	Within Ancestral Area	Coos	Modular Housing	Housing	0.03366
28	Within Ancestral Area	Coos	Qaxas Housing	Housing	0.032983
29	Within Ancestral Area	Lane	Brainard Ranch	Ranch	0.035757
31	Within Ancestral Area	Coos	Qaxas Housing	Housing	0.084102

ID	Ancestral Boundary	County	Facility Name	Facility Type	Acres
32	Within Ancestral Area	Coos	Qaxas Housing	Housing	0.033215
34	Within Ancestral Area	Coos	Qaxas Housing	Housing	0.032982
35	Within Ancestral Area	Coos	KCBY (demolished)	Communication	0.107007
36	Within Ancestral Area	Coos	Flanagan Rental	Other	0.044009
37	Within Ancestral Area	Coos	Camp Easter Seal	Camp	0.032964
38	Within Ancestral Area	Coos	Bunker	Other	0.014154
40	Within Ancestral Area	Lane	Clubhouse	Community	0.309279
41	Within Ancestral Area	Coos	Qaxas Housing	Housing	0.043105
42	Within Ancestral Area	Lane	Pump Station	Water/Wastewater	0.093585
44	Not Within Ancestral Area	Lane	Lott Rental	Other	0.026407
45	Within Ancestral Area	Coos	Camp Easter Seal	Camp	0.051306
46	Within Ancestral Area	Lane	Sub Station	Power	0.04591
47	Within Ancestral Area	Lane	Maintenance	Maintenance	0.026407
48	Within Ancestral Area	Coos	Qaxas Housing	Housing	0.08652
49	Within Ancestral Area	Lane	Florence Outreach	Other	0.266404
51	Within Ancestral Area	Lane	Maintenance	Maintenance	0.074313
52	Within Ancestral Area	Coos	Neese Rental	Other	0.050138
58	Within Ancestral Area	Lane	Brainard Ranch	Ranch	0.026371
59	Within Ancestral Area	Coos	Qaxas Housing	Housing	0.055313
60	Within Ancestral Area	Coos	Camp Easter Seal	Camp	0.020914
61	Within Ancestral Area	Coos	Qaxas Housing	Housing	0.053058
63	Within Ancestral Area	Coos	Camp Easter Seal	Camp	0.067346
65	Within Ancestral Area	Coos	Qaxas Housing	Housing	0.053039
66	Within Ancestral Area	Coos	Pole Building	Other	0.073052
67	Within Ancestral Area	Coos	Modular DNR	Administration	0.046672
68	Within Ancestral Area	Coos	Modular DNR	Administration	0.044077
70	Within Ancestral Area	Coos	Modular Admin	Administration	0.037763
71	Within Ancestral Area	Coos	TRC Coos Bay	Casino	0.324231
72	Within Ancestral Area	Coos	Storage Units	Other	0.067503

ID	Ancestral Boundary	County	Facility Name	Facility Type	Acres
73	Within Ancestral Area	Coos	Storage Units	Other	0.063663
74	Within Ancestral Area	Coos	Storage Units	Other	0.060719
75	Within Ancestral Area	Coos	Storage Units	Other	0.06303
76	Within Ancestral Area	Coos	Gazebo	Other	0.026564
77	Within Ancestral Area	Coos	Building 12	Other	0.085951
78	Within Ancestral Area	Coos	Caretaker House	Maintenance	0.070412
79	Within Ancestral Area	Coos	Camp Easter Seal	Camp	0.011728
80	Within Ancestral Area	Coos	Camp Easter Seal	Camp	0.019115
81	Within Ancestral Area	Coos	Camp Easter Seal	Camp	0.073847
82	Within Ancestral Area	Coos	Camp Easter Seal	Camp	0.017573
84	Within Ancestral Area	Coos	Camp Easter Seal	Camp	0.018319
85	Within Ancestral Area	Lane	Qaich Housing	Housing	0.067966
86	Within Ancestral Area	Lane	Qaich Housing	Housing	0.074695
87	Within Ancestral Area	Lane	Treatment Plant	Water/Wastewater	0.057466
88	Within Ancestral Area	Coos	Cape Arago Light Station	Lighthouse	0.026933

Table H-2. Service Area Parcels

ID	County	Parcel Address	Tract Name	Tract Number	Type	Alternative Name	Acres
1	Coos	901 LAKESHORE DR	FLANAGAN PIONEER CEMETERY	152T1003	trust		0.28
2	Coos	1297 OCEAN BLVD NW	OCEAN BLVD	149T1068	trust	VICKS	0.69
3	Coos	1325 NEESE ST	1325 NEESE	149T1086	trust		0.21
4	Coos	340 WALLACE ST	MELVILLE	152T1002	trust		2.52
5	Coos	1308 NEESE ST	1308 NEESE	152T1004	trust		0.21
6	Coos	233 WALLACE ST	233 WALLACE/OCEAN	152T1005	trust		0.17
7	Coos	233 WALLACE ST	233 WALLACE/OCEAN	152T1005	trust		0.086
8	Coos	909 FLANAGAN AVE	909 FLANAGAN	N/A	fee		0.17
9	Coos	1245 FULTON AVE	ELKS	149T1062	trust	ADMINISTRATION BUILDING	3.45

ID	County	Parcel Address	Tract Name	Tract Number	Type	Alternative Name	Acres
10	Coos	1245 FULTON AVE	FULTON	149T1074	trust	ADMINISTRATION BUILDING	9.68
11	Coos	580 KINGWOOD AVE	ALISHANEE	149T1116	trust		1.32
12	Coos	580 KINGWOOD AVE	ALISHANEE	149T1116	trust		0.12
13	Coos	93420 COAL BANK LN	FISHER	N/A	fee		2.17
14	Coos	63627 GRAND RD	TABERNIG	N/A	fee		0.1
15	Coos	89092 LIGHTHOUSE WY	GREGORY POINT	152T1010	res	CAPE ARAGO LIGHT STATION	13.9
16	Coos	6624-6702 LIBBY LN	EASON	N/A	fee		17.58
17	Coos	901 LAKESHORE DR	FLANAGAN PIONEER CEMETERY	N/A	fee		2.41
18	Coos	901 LAKESHORE DR	FLANAGAN PIONEER CEMETERY	N/A	fee		0.64
19	Coos	338 WALLACE ST	EMPIRE	152T1001	res	TRIBAL HALL	6.06
20	Coos	1411 OCEAN BLVD	EICHLER	149T1061	trust		0.34
21	Coos	3271-3359 CAPE ARAGO HWY	MILUK VILLAGE	149T1108	trust		1.49
22	Coos	0000 KENTUCK WY LN	KENTUCK SLOUGH	152T1000	res		0.07
23	Coos	1801-1899 PINE ST	CONNECTICUT AVE	149T1063	trust	QAXAS HEIGHTS	4.28
24	Coos	1801-1899 PINE ST	CALIFORNIA AVE	149T1070	trust	QAXAS HEIGHTS	0.47
25	Lane	N/A	MUNSEL LAKE	N/A	fee	SEVERY CULTURAL AREA	118.42
26	Lane	5647 HIGHWAY 126	PETERMAN	152T1007	res	THREE RIVERS CASINO FLOR #1	0.06
27	Lane	5407 N FORK RD	SEVERY	N/A	fee	THREE RIVERS CASINO FLOR #3	0.39
28	Lane	3757 HWY 101	WINDWARD INN	N/A	fee		0.4
29	Lane	3757 HWY 101	WINDWARD INN	N/A	fee		1.53
30	Lane	5701 QAAICH RD	HATCH	149T1060	trust	THREE RIVERS CASINO	7.06
31	Lane	5701 QAAICH RD	HATCH	149T1060	trust	THREE RIVERS CASINO	91.29
32	Lane	5635-5647 HWY 126	DUMAN	N/A	fee	THREE RIVERS CASINO #4	1.05
33	Lane	5635-5647 HWY 126	DUMAN	N/A	fee	THREE RIVERS CASINO #5	0.61
34	Coos	89092 LIGHTHOUSE WY	GREGORY POINT	152T1010	res	CAPE ARAGO LIGHT STATION	10.06

ID	County	Parcel Address	Tract Name	Tract Number	Type	Alternative Name	Acres
35	Lane	212 S 38TH ST	LOTT	149T1088	trust	LOTT HOUSE	0.21
36	Lane	93014 WEST FORK RD	BRAINARD	N/A	fee	DEADWOOD	39.31
37	Coos	63377 COOS HEAD RD	COOS HEAD	N/A	fee		43.38
38	Coos	1415 OCEAN BLVD NW	1415 OCEAN BLVD	N/A	fee		0.34
39	Lane	N/A	OCEAN DUNES	N/A	fee		0.28
40	Lane	N/A	OCEAN DUNES	N/A	fee		39.38
41	Lane	N/A	OCEAN DUNES	N/A	fee		39.20
42	Lane	N/A	OCEAN DUNES	N/A	fee		30.48
43	Lane	3345 MUNSEL LAKE RD	OCEAN DUNES	N/A	fee		26.21
44	Lane	N/A	MUNSEL LAKE VILLAGE	N/A	fee		0.5
45	Lane	N/A	MUNSEL LAKE VILLAGE	N/A	fee		0.62
46	Lane	N/A	MUNSEL LAKE VILLAGE	N/A	fee		0.67
47	Coos	1351 OCEAN BLVD NW	1351 OCEAN BV NW	N/A	fee	THREE RIVERS CASINO CB PRK	0.34
48	Coos	1351 OCEAN BLVD NW	1351 OCEAN BV NW	N/A	fee	THREE RIVERS CASINO CB PRK	0.34
49	Lane	N/A	LANE COUNTY	N/A	fee	THREE RIVERS CASINO #3	2.22
50	Lane	N/A	LANE COUNTY	N/A	fee	THREE RIVERS CASINO #4	2.22
51	Lane	N/A	LANE COUNTY	N/A	fee	THREE RIVERS CASINO #2	2.23
52	Lane	N/A	LANE COUNTY	N/A	fee	THREE RIVERS CASINO #5	0.86
53	Coos	239 WALLACE ST	PULLIS	N/A	fee	TRIBAL HALL #17	0.09
54	Curry	94122-94198 SIXES RIVER RD	SIXES	152T1006	res		1.42
55	Coos	1190 N TEN MILE LAKE	CAMP EASTER SEALS	N/A	fee		6.82
56	Coos	1190 N TEN MILE LAKE	CAMP EASTER SEALS	N/A	fee		8.24
57	Coos	1190 N TEN MILE LAKE	CAMP EASTER SEALS	N/A	fee		0.02
58	Coos	1190 N TEN MILE LAKE	CAMP EASTER SEALS	N/A	fee		0.02
59	Coos	1190 N TEN MILE LAKE	CAMP EASTER SEALS	N/A	fee		0.01



ID	County	Parcel Address	Tract Name	Tract Number	Type	Alternative Name	Acres
60	Coos	1190 N TEN MILE LAKE	CAMP EASTER SEALS	N/A	fee		0.03
61	Coos	1190 N TEN MILE LAKE	CAMP EASTER SEALS	N/A	fee		0.03
62	Coos	1190 N TEN MILE LAKE	CAMP EASTER SEALS	N/A	fee		0.01
63	Coos	1190 N TEN MILE LAKE	CAMP EASTER SEALS	N/A	fee		0.02
64	Coos	1190 N TEN MILE LAKE	CAMP EASTER SEALS	N/A	fee		0.01
65	Coos	1190 N TEN MILE LAKE	CAMP EASTER SEALS	N/A	fee		0.01
66	Coos	1190 N TEN MILE LAKE	CAMP EASTER SEALS	N/A	fee		0.02
67	Coos	1190 N TEN MILE LAKE	CAMP EASTER SEALS	N/A	fee		0.04
68	Lane	N/A	OCEAN DUNES	N/A	fee		0.02
69	Lane	N/A	OCEAN DUNES	N/A	fee		0.39
70	Coos	1801-1899 PINE ST	CALIFORNIA AVE	149T1070	trust	QAXAS HEIGHTS	0.06
71	Coos	91679 CAPE ARAGO HY	FOSSIL POINT	N/A	fee	FOSSIL POINT #2	0.05
72	Coos	NA	FOSSIL POINT	N/A	fee	FOSSIL POINT #3	3.66
75	Coos		Coal Bank Slough		fee		13.57
76	Coos		Coal Bank Slough		fee		8.03
77	Coos		Coal Bank Slough		fee		14.43
79	Douglas		Lower Smith		res		4934.78
80	Douglas		Macy		res		37.28
81	Coos		Talbot		res		36.61
82	Coos		Tioga		res		4565.54
83	Douglas		Umpqua Eden		res		144.56
84	Lane		Upper Lake Creek		res		4960.74
85	Coos				fee		0.69
86	Coos		Coos Head		res		47.15

10 Table H-3. Service Area Forest Stands

ID	Ancestral Boundary	County	Tract	Trees	Acres
1	Within Ancestral Area	Coos	Tioga	324.340057	12.626472
2	Within Ancestral Area	Coos	Tioga	678.005676	14.66396
3	Within Ancestral Area	Coos	Tioga	2348.354004	14.704205
4	Within Ancestral Area	Coos	Tioga	312.411346	45.98167
5	Within Ancestral Area	Douglas	Upper Smith	395.041565	45.064413
6	Within Ancestral Area	Douglas	Upper Smith	272.521423	25.965986
7	Within Ancestral Area	Coos	Tioga	390.345306	6.261876
8	Within Ancestral Area	Douglas	Upper Smith	433.85672	18.810322
9	Within Ancestral Area	Douglas	Upper Smith	232.409363	33.919695
10	Within Ancestral Area	Douglas	Upper Smith	128.206787	26.64639
11	Within Ancestral Area	Douglas	Upper Smith	334.889343	24.882484
12	Within Ancestral Area	Douglas	Upper Smith	212.515533	38.003193
13	Within Ancestral Area	Douglas	Upper Smith	116.175911	15.033189
14	Within Ancestral Area	Douglas	Upper Smith	427.400055	50.91738
15	Within Ancestral Area	Douglas	Upper Smith	218.21875	45.344662
16	Within Ancestral Area	Douglas	Upper Smith	210.67099	29.116043
17	Within Ancestral Area	Douglas	Upper Smith	244.835449	18.204032
18	Within Ancestral Area	Douglas	Upper Smith	390.315826	11.072827
19	Within Ancestral Area	Douglas	Upper Smith	385.672638	40.467426
20	Within Ancestral Area	Douglas	Upper Smith	327.742737	33.48052
21	Within Ancestral Area	Douglas	Upper Smith	234.698914	5.572883
22	Within Ancestral Area	Douglas	Upper Smith	615.284363	20.808343
23	Within Ancestral Area	Douglas	Upper Smith	342.452301	40.550173
24	Within Ancestral Area	Douglas	Upper Smith	131.464539	33.80841
25	Within Ancestral Area	Douglas	Upper Smith	433.579132	15.298139
26	Within Ancestral Area	Douglas	Upper Smith	67.797676	21.024889
27	Within Ancestral Area	Douglas	Upper Smith	347.942719	48.757073

ID	Ancestral Boundary	County	Tract	Trees	Acres
28	Within Ancestral Area	Douglas	Upper Smith	144.562988	3.005534
29	Within Ancestral Area	Douglas	Upper Smith	328.96347	20.084075
30	Within Ancestral Area	Douglas	Upper Smith	380.211121	61.394414
31	Within Ancestral Area	Douglas	Upper Smith	87.85305	163.269363
32	Within Ancestral Area	Coos	Tioga	1722.097778	5.77763
33	Within Ancestral Area	Douglas	Upper Smith	34.175781	3.290769
34	Within Ancestral Area	Douglas	Upper Smith	181.423767	156.160605
35	Within Ancestral Area	Douglas	Upper Smith	157.565338	14.755801
36	Within Ancestral Area	Douglas	Upper Smith	296.99115	39.508379
37	Within Ancestral Area	Coos	Tioga	416.860291	30.526586
38	Within Ancestral Area	Douglas	Upper Smith	402.458954	15.500089
39	Within Ancestral Area	Douglas	Upper Smith	328.322449	33.461625
40	Within Ancestral Area	Douglas	Upper Smith	457.945892	52.434037
41	Within Ancestral Area	Douglas	Upper Smith	278.417755	28.186469
42	Within Ancestral Area	Douglas	Upper Smith	305.444824	10.893927
43	Within Ancestral Area	Douglas	Upper Smith	366.771667	25.462992
44	Within Ancestral Area	Douglas	Upper Smith	436.154022	5.036687
45	Within Ancestral Area	Douglas	Upper Smith	270.490173	20.317316
46	Within Ancestral Area	Douglas	Upper Smith	478.830566	10.791372
47	Within Ancestral Area	Douglas	Macy	567.154114	37.277153
48	Within Ancestral Area	Douglas	Upper Smith	207.626205	24.397042
49	Within Ancestral Area	Douglas	Upper Smith	154.634689	15.368837
50	Within Ancestral Area	Douglas	Upper Smith	223.337463	19.78863
51	Within Ancestral Area	Coos	Tioga	169.619736	5.319602
52	Within Ancestral Area	Douglas	Upper Smith	395.348969	5.157163
53	Within Ancestral Area	Douglas	Upper Smith	276.569794	26.408196
54	Within Ancestral Area	Douglas	Upper Smith	404.08606	10.889121
55	Within Ancestral Area	Coos	Tioga	342.562805	29.4992
56	Within Ancestral Area	Coos	Tioga	747.087585	19.003776

ID	Ancestral Boundary	County	Tract	Trees	Acres
57	Within Ancestral Area	Coos	Tioga	285.781464	20.548793
58	Within Ancestral Area	Coos	Tioga	318.839966	26.662425
59	Within Ancestral Area	Coos	Tioga	296.267761	13.86737
60	Within Ancestral Area	Coos	Tioga	441.713562	24.729946
61	Within Ancestral Area	Coos	Tioga	437.455811	12.669055
62	Within Ancestral Area	Douglas	Upper Smith	216.436066	35.653813
63	Within Ancestral Area	Coos	Tioga	1032.564453	31.755369
64	Within Ancestral Area	Douglas	Upper Smith	275.35849	23.977549
65	Within Ancestral Area	Coos	Tioga	314.37674	38.380692
66	Within Ancestral Area	Douglas	Upper Smith	413.369354	22.064565
67	Within Ancestral Area	Douglas	Upper Smith	188.935303	24.100794
68	Within Ancestral Area	Douglas	Upper Smith	109.433868	10.0561
69	Within Ancestral Area	Douglas	Upper Smith	276.173798	42.711722
70	Within Ancestral Area	Douglas	Upper Smith	171.404022	96.158184
71	Within Ancestral Area	Coos	Tioga	789.426331	28.624987
72	Within Ancestral Area	Coos	Tioga	627.41156	35.537779
73	Within Ancestral Area	Coos	Tioga	286.919556	10.886401
74	Within Ancestral Area	Coos	Tioga	326.449921	105.889289
75	Within Ancestral Area	Coos	Tioga	201.096298	38.250974
76	Within Ancestral Area	Coos	Tioga	368.369049	15.874981
77	Within Ancestral Area	Coos	Tioga	451.046417	36.1107
78	Within Ancestral Area	Coos	Tioga	477.191406	34.435935
79	Within Ancestral Area	Coos	Tioga	734.381531	12.724786
80	Within Ancestral Area	Coos	Tioga	471.504089	23.552031
81	Within Ancestral Area	Coos	Tioga	709.35144	30.671876
82	Within Ancestral Area	Coos	Tioga	686.694153	12.331548
83	Within Ancestral Area	Coos	Tioga	395.418121	23.476062
84	Within Ancestral Area	Coos	Tioga	545.747925	64.036446
85	Within Ancestral Area	Coos	Tioga	649.531006	22.668567

ID	Ancestral Boundary	County	Tract	Trees	Acres
86	Within Ancestral Area	Coos	Tioga	2087.83252	47.462795
87	Within Ancestral Area	Coos	Tioga	2227.508545	13.250047
88	Within Ancestral Area	Coos	Tioga	582.487488	26.586411
89	Within Ancestral Area	Coos	Coos Head	480.029755	47.151644
90	Within Ancestral Area	Coos	Tioga	617.261108	11.331141
91	Within Ancestral Area	Coos	Tioga	325.790894	17.484441
92	Within Ancestral Area	Coos	Tioga	278.103912	8.844538
93	Within Ancestral Area	Coos	Tioga	259.219116	10.426651
94	Within Ancestral Area	Coos	Tioga	507.798706	18.842621
95	Within Ancestral Area	Coos	Tioga	304.094269	27.116885
96	Within Ancestral Area	Coos	Tioga	672.677795	5.371309
97	Within Ancestral Area	Coos	Tioga	470.750305	9.638038
98	Within Ancestral Area	Coos	Tioga	1709.309937	43.296886
99	Within Ancestral Area	Coos	Tioga	2824.016846	9.998644
100	Within Ancestral Area	Coos	Tioga	1061.540283	67.778474
101	Within Ancestral Area	Coos	Tioga	601.822998	202.323952
102	Within Ancestral Area	Coos	Tioga	567.359802	32.976524
103	Within Ancestral Area	Coos	Talbot	359.832794	36.614188
104	Within Ancestral Area	Coos	Tioga	3456.730469	1.661028
105	Within Ancestral Area	Coos	Tioga	478.271698	82.027171
106	Within Ancestral Area	Coos	Tioga	611.137085	24.81644
107	Within Ancestral Area	Coos	Tioga	283.621765	200.939426
108	Within Ancestral Area	Coos	Tioga	323.981781	13.726957
109	Within Ancestral Area	Coos	Tioga	1347.210327	6.25509
110	Within Ancestral Area	Coos	Tioga	473.9133	11.919989
111	Within Ancestral Area	Coos	Tioga	549.746582	57.126731
112	Within Ancestral Area	Coos	Tioga	499.768158	44.925608
113	Within Ancestral Area	Coos	Tioga	1014.550903	35.605746
114	Within Ancestral Area	Coos	Tioga	985.157959	12.824648



ID	Ancestral Boundary	County	Tract	Trees	Acres
115	Within Ancestral Area	Coos	Tioga	632.562012	19.767363
116	Within Ancestral Area	Coos	Tioga	496.616333	43.346961
117	Within Ancestral Area	Coos	Tioga	723.836914	21.542351
118	Within Ancestral Area	Coos	Tioga	1019.616638	45.629583
119	Within Ancestral Area	Coos	Tioga	380.094543	10.998457
120	Within Ancestral Area	Coos	Tioga	436.344116	41.894533
121	Within Ancestral Area	Coos	Tioga	3118.849854	15.804616
122	Within Ancestral Area	Coos	Tioga	1045.488159	10.503737
123	Within Ancestral Area	Coos	Tioga	568.247009	31.500875
124	Within Ancestral Area	Lane	Upper Lake Cr.	275.045105	23.087332
125	Within Ancestral Area	Lane	Upper Lake Cr.	114.95192	6.073207
126	Within Ancestral Area	Lane	Upper Lake Cr.	3641.394531	12.541801
127	Within Ancestral Area	Lane	Upper Lake Cr.	413.564972	10.864755
128	Within Ancestral Area	Lane	Upper Lake Cr.	1067.68457	73.03838
129	Within Ancestral Area	Lane	Upper Lake Cr.	602.071045	105.860149
130	Within Ancestral Area	Lane	Upper Lake Cr.	149.997498	7.429316
131	Within Ancestral Area	Lane	Upper Lake Cr.	177.240433	12.331229
132	Within Ancestral Area	Lane	Upper Lake Cr.	240.851471	5.246089
133	Within Ancestral Area	Lane	Upper Lake Cr.	362.43927	41.065523
134	Within Ancestral Area	Lane	Upper Lake Cr.	262.059021	43.498932
135	Within Ancestral Area	Lane	Upper Lake Cr.	426.30545	29.988867
136	Within Ancestral Area	Lane	Upper Lake Cr.	418.879486	50.348446
137	Within Ancestral Area	Lane	Upper Lake Cr.	464.984833	31.92612
138	Within Ancestral Area	Lane	Upper Lake Cr.	187.183014	72.320054
139	Within Ancestral Area	Lane	Upper Lake Cr.	438.525757	18.562861
140	Within Ancestral Area	Lane	Upper Lake Cr.	173.333832	11.398672
141	Within Ancestral Area	Lane	Upper Lake Cr.	499.542511	17.077478
142	Within Ancestral Area	Lane	Upper Lake Cr.	467.627808	5.161259
143	Within Ancestral Area	Lane	Upper Lake Cr.	288.437927	5.698781

ID	Ancestral Boundary	County	Tract	Trees	Acres
144	Within Ancestral Area	Lane	Upper Lake Cr.	567.10907	39.373684
145	Within Ancestral Area	Lane	Upper Lake Cr.	247.702316	23.139287
146	Within Ancestral Area	Lane	Upper Lake Cr.	124.145798	27.117435
147	Within Ancestral Area	Lane	Upper Lake Cr.	1232.520996	32.704669
148	Within Ancestral Area	Lane	Upper Lake Cr.	816.793884	43.251946
149	Within Ancestral Area	Lane	Upper Lake Cr.	670.878601	100.140101
150	Within Ancestral Area	Lane	Upper Lake Cr.	593.401428	8.34767
151	Within Ancestral Area	Lane	Upper Lake Cr.	158.133804	135.847453
152	Within Ancestral Area	Lane	Upper Lake Cr.	294.763	11.292345
153	Within Ancestral Area	Lane	Upper Lake Cr.	425.297333	37.221737
154	Within Ancestral Area	Lane	Upper Lake Cr.	2546.765869	42.898762
155	Within Ancestral Area	Lane	Upper Lake Cr.	920.892578	321.480282
156	Within Ancestral Area	Lane	Upper Lake Cr.	389.203735	7.676086
157	Within Ancestral Area	Lane	Upper Lake Cr.	202.231934	47.72529
158	Within Ancestral Area	Lane	Upper Lake Cr.	369.502533	6.117959
159	Within Ancestral Area	Lane	Upper Lake Cr.	1645.164307	23.26043
160	Within Ancestral Area	Lane	Upper Lake Cr.	554.039917	16.611533
161	Within Ancestral Area	Lane	Upper Lake Cr.	651.843994	28.437794
162	Within Ancestral Area	Lane	Upper Lake Cr.	458.947876	159.958044
163	Within Ancestral Area	Lane	Upper Lake Cr.	1145.027466	89.649033
164	Within Ancestral Area	Lane	Upper Lake Cr.	665.048889	177.285549
165	Within Ancestral Area	Lane	Upper Lake Cr.	167.629105	15.158558
166	Within Ancestral Area	Lane	Upper Lake Cr.	310.585602	25.399251
167	Within Ancestral Area	Lane	Upper Lake Cr.	553.332886	4.253216
168	Within Ancestral Area	Lane	Upper Lake Cr.	1588.604736	25.761912
169	Within Ancestral Area	Lane	Upper Lake Cr.	283.367676	118.240853
170	Within Ancestral Area	Lane	Upper Lake Cr.	343.098145	32.016181
171	Within Ancestral Area	Lane	Upper Lake Cr.	607.08844	9.592134
172	Within Ancestral Area	Lane	Upper Lake Cr.	291.249908	50.02144

ID	Ancestral Boundary	County	Tract	Trees	Acres
173	Within Ancestral Area	Lane	Upper Lake Cr.	148.585052	7.428387
174	Within Ancestral Area	Lane	Upper Lake Cr.	397.382294	97.252094
175	Within Ancestral Area	Lane	Upper Lake Cr.	213.952011	9.115571
176	Within Ancestral Area	Lane	Upper Lake Cr.	1026.748413	6.898152
177	Within Ancestral Area	Lane	Upper Lake Cr.	158.1828	11.856737
178	Within Ancestral Area	Lane	Upper Lake Cr.	425.85199	18.561176
179	Within Ancestral Area	Lane	Upper Lake Cr.	227.393372	13.720325
180	Within Ancestral Area	Lane	Upper Lake Cr.	278.639893	7.80075
181	Within Ancestral Area	Lane	Upper Lake Cr.	371.677826	13.979122
182	Within Ancestral Area	Coos	Tioga	541.212646	1.721687
183	Within Ancestral Area	Lane	Upper Lake Cr.	312.015839	2.55855
184	Within Ancestral Area	Coos	Tioga	773.407654	24.32901
185	Within Ancestral Area	Douglas	Upper Smith	146.821716	20.161247
186	Within Ancestral Area	Douglas	Upper Smith	330.290283	49.482421
187	Within Ancestral Area	Douglas	Upper Smith	330.290283	48.165725
188	Within Ancestral Area	Douglas	Upper Smith	327.085632	25.140504
189	Within Ancestral Area	Douglas	Upper Smith	330.290283	34.812681
190	Within Ancestral Area	Douglas	Upper Smith	279.671631	24.07065
191	Within Ancestral Area	Douglas	Upper Smith	279.671631	26.131257
192	Within Ancestral Area	Douglas	Upper Smith	124.733688	150.654542
193	Within Ancestral Area	Coos	Tioga	626.643677	45.306157
194	Within Ancestral Area	Douglas	Upper Smith	124.733688	16.745726
195	Within Ancestral Area	Douglas	Upper Smith	146.821716	25.400401
196	Within Ancestral Area	Douglas	Upper Smith	124.733688	6.234605
197	Within Ancestral Area	Douglas	Upper Smith	279.671631	62.296403
198	Within Ancestral Area	Douglas	Upper Smith	330.290283	40.285059
199	Within Ancestral Area	Douglas	Upper Smith	330.290283	65.75458
200	Within Ancestral Area	Douglas	Upper Smith	109.433868	43.319947
201	Within Ancestral Area	Douglas	Upper Smith	327.085632	52.388601

ID	Ancestral Boundary	County	Tract	Trees	Acres
202	Within Ancestral Area	Douglas	Upper Smith	327.085632	14.257901
203	Within Ancestral Area	Douglas	Upper Smith	279.671631	6.233101
204	Within Ancestral Area	Douglas	Upper Smith	279.671631	25.741342
205	Within Ancestral Area	Douglas	Upper Smith	330.290283	15.302413
206	Within Ancestral Area	Douglas	Upper Smith	347.377838	24.487489
207	Within Ancestral Area	Douglas	Upper Smith	279.671631	20.643427
208	Within Ancestral Area	Douglas	Upper Smith	327.085632	13.373812
209	Within Ancestral Area	Douglas	Upper Smith	347.377838	49.077233
210	Within Ancestral Area	Douglas	Upper Smith	330.290283	20.676691
211	Within Ancestral Area	Douglas	Upper Smith	279.671631	16.014497
212	Within Ancestral Area	Douglas	Upper Smith	330.290283	25.677036
213	Within Ancestral Area	Douglas	Upper Smith	327.085632	5.953746
214	Within Ancestral Area	Douglas	Upper Smith	327.085632	43.015755
215	Within Ancestral Area	Douglas	Upper Smith	279.671631	58.891335
216	Within Ancestral Area	Douglas	Upper Smith	330.290283	43.051523
217	Within Ancestral Area	Douglas	Upper Smith	330.290283	5.649772
218	Within Ancestral Area	Douglas	Upper Smith	330.290283	13.735524
219	Within Ancestral Area	Douglas	Upper Smith	327.085632	92.435449
220	Within Ancestral Area	Douglas	Upper Smith	279.671631	15.819907
221	Within Ancestral Area	Douglas	Upper Smith	279.671631	10.844305
222	Within Ancestral Area	Douglas	Upper Smith	146.821716	47.555089
223	Within Ancestral Area	Douglas	Upper Smith	279.671631	13.718077
224	Within Ancestral Area	Douglas	Upper Smith	124.733688	19.868611
225	Within Ancestral Area	Douglas	Upper Smith	279.671631	36.706405
226	Within Ancestral Area	Douglas	Upper Smith	124.733688	149.245832
227	Within Ancestral Area	Douglas	Upper Smith	146.821716	246.063568
228	Within Ancestral Area	Douglas	Upper Smith	146.821716	2.791448
229	Within Ancestral Area	Douglas	Upper Smith	146.821716	70.643334
230	Within Ancestral Area	Douglas	Upper Smith	330.290283	27.613529

ID	Ancestral Boundary	County	Tract	Trees	Acres
231	Within Ancestral Area	Douglas	Upper Smith	279.671631	31.016955
232	Within Ancestral Area	Douglas	Upper Smith	330.290283	41.312809
233	Within Ancestral Area	Douglas	Upper Smith	146.821716	9.953203
234	Within Ancestral Area	Douglas	Upper Smith	109.433868	80.202006
235	Within Ancestral Area	Douglas	Upper Smith	330.290283	120.146369
236	Within Ancestral Area	Douglas	Upper Smith	146.821716	25.159863
237	Within Ancestral Area	Coos	Tioga	504.075897	41.899531
238	Within Ancestral Area	Douglas	Upper Smith	279.671631	39.977173
239	Within Ancestral Area	Douglas	Upper Smith	347.377838	15.639005
240	Within Ancestral Area	Douglas	Upper Smith	330.93988	35.322829
241	Within Ancestral Area	Douglas	Upper Smith	327.085632	65.007443
242	Within Ancestral Area	Douglas	Upper Smith	347.377838	5.111787
243	Within Ancestral Area	Douglas	Upper Smith	347.377838	19.667817
244	Within Ancestral Area	Douglas	Upper Smith	347.377838	36.379937
245	Within Ancestral Area	Douglas	Upper Smith	279.671631	13.989968
246	Within Ancestral Area	Douglas	Upper Smith	327.085632	31.293831
247	Within Ancestral Area	Douglas	Upper Smith	327.085632	38.047716
248	Within Ancestral Area	Douglas	Upper Smith	327.085632	40.174611
249	Within Ancestral Area	Douglas	Upper Smith	330.290283	32.343308
250	Within Ancestral Area	Douglas	Upper Smith	347.377838	13.960942
251	Within Ancestral Area	Douglas	Upper Smith	327.085632	28.966229
252	Within Ancestral Area	Douglas	Upper Smith	347.377838	20.006298
253	Within Ancestral Area	Douglas	Upper Smith	347.377838	27.106937
254	Within Ancestral Area	Douglas	Upper Smith	327.085632	18.343957
255	Within Ancestral Area	Douglas	Upper Smith	327.085632	7.737279
256	Within Ancestral Area	Douglas	Upper Smith	347.377838	24.416844
257	Within Ancestral Area	Douglas	Upper Smith	347.377838	20.227463
258	Within Ancestral Area	Douglas	Upper Smith	327.085632	24.539116
259	Within Ancestral Area	Douglas	Upper Smith	347.377838	22.725892



ID	Ancestral Boundary	County	Tract	Trees	Acres
260	Within Ancestral Area	Douglas	Upper Smith	330.93988	26.152253
261	Within Ancestral Area	Douglas	Upper Smith	347.377838	4.607841
262	Within Ancestral Area	Douglas	Umpqua Eden	490.685547	135.373352
263	Within Ancestral Area	Douglas	Upper Smith	330.290283	35.062003
264	Within Ancestral Area	Douglas	Upper Smith	347.377838	32.588414
265	Within Ancestral Area	Coos	Tioga	626.643677	13.753824
266	Within Ancestral Area	Coos	Tioga	561.949158	29.610003
267	Within Ancestral Area	Douglas	Upper Smith	330.93988	4.04173
268	Within Ancestral Area	Coos	Tioga	626.643677	10.357686
269	Within Ancestral Area	Coos	Tioga	504.075897	11.421016
270	Within Ancestral Area	Coos	Tioga	504.075897	33.44138
271	Within Ancestral Area	Douglas	Upper Smith	347.377838	49.003092
272	Within Ancestral Area	Douglas	Upper Smith	347.377838	12.821488
273	Within Ancestral Area	Douglas	Upper Smith	347.377838	10.549013
274	Within Ancestral Area	Douglas	Upper Smith	330.290283	19.672604
275	Within Ancestral Area	Douglas	Upper Smith	327.085632	43.42258
276	Within Ancestral Area	Douglas	Upper Smith	347.377838	35.881073
277	Within Ancestral Area	Douglas	Upper Smith	347.377838	5.231711
278	Within Ancestral Area	Coos	Tioga	626.643677	30.047095
279	Within Ancestral Area	Coos	Tioga	785.874268	24.972395
280	Within Ancestral Area	Douglas	Upper Smith	327.085632	49.757671
281	Within Ancestral Area	Coos	Tioga	626.643677	37.144808
282	Within Ancestral Area	Coos	Tioga	626.643677	5.738132
283	Within Ancestral Area	Douglas	Upper Smith	327.085632	21.412423
284	Within Ancestral Area	Douglas	Upper Smith	330.290283	38.222492
285	Within Ancestral Area	Douglas	Upper Smith	330.93988	47.392358
286	Within Ancestral Area	Douglas	Upper Smith	330.290283	5.4896
287	Within Ancestral Area	Douglas	Upper Smith	279.671631	27.263053
288	Within Ancestral Area	Douglas	Upper Smith	330.93988	48.429682

ID	Ancestral Boundary	County	Tract	Trees	Acres
289	Within Ancestral Area	Coos	Tioga	626.643677	8.862656
290	Within Ancestral Area	Coos	Tioga	626.643677	11.941639
291	Within Ancestral Area	Coos	Tioga	626.643677	23.475947
292	Within Ancestral Area	Coos	Tioga	626.643677	38.99417
293	Within Ancestral Area	Coos	Tioga	626.643677	38.784352
294	Within Ancestral Area	Coos	Tioga	626.643677	13.866963
295	Within Ancestral Area	Coos	Tioga	626.643677	20.798479
296	Within Ancestral Area	Coos	Tioga	626.643677	30.366175
297	Within Ancestral Area	Coos	Tioga	545.760681	148.452554
298	Within Ancestral Area	Coos	Tioga	545.760681	2.964501
299	Within Ancestral Area	Coos	Tioga	626.643677	23.433327
300	Within Ancestral Area	Coos	Tioga	626.643677	21.181552
301	Within Ancestral Area	Coos	Tioga	504.075897	27.458506
302	Within Ancestral Area	Coos	Tioga	785.874268	24.717373
303	Within Ancestral Area	Coos	Tioga	626.643677	54.812283
304	Within Ancestral Area	Coos	Tioga	626.643677	32.99546
305	Within Ancestral Area	Coos	Tioga	626.643677	26.622308
306	Within Ancestral Area	Coos	Tioga	626.643677	19.114898
307	Within Ancestral Area	Coos	Tioga	626.643677	35.109829
308	Within Ancestral Area	Coos	Tioga	1193.487671	14.159813
309	Within Ancestral Area	Coos	Tioga	626.643677	13.198088
310	Within Ancestral Area	Coos	Tioga	545.760681	66.434231
311	Within Ancestral Area	Coos	Tioga	545.760681	46.065367
312	Within Ancestral Area	Coos	Tioga	785.874268	11.915146
313	Within Ancestral Area	Coos	Tioga	785.874268	45.078037
314	Within Ancestral Area	Coos	Tioga	785.874268	22.333789
315	Within Ancestral Area	Coos	Tioga	785.874268	13.677644
316	Within Ancestral Area	Coos	Tioga	626.643677	17.536457
317	Within Ancestral Area	Coos	Tioga	626.643677	28.550939

ID	Ancestral Boundary	County	Tract	Trees	Acres
318	Within Ancestral Area	Coos	Tioga	626.643677	24.486222
319	Within Ancestral Area	Coos	Tioga	626.643677	28.459429
320	Within Ancestral Area	Coos	Tioga	626.643677	48.752593
321	Within Ancestral Area	Coos	Tioga	561.949158	12.823795
322	Within Ancestral Area	Coos	Tioga	626.643677	44.384936
323	Within Ancestral Area	Coos	Tioga	626.643677	9.831957
324	Within Ancestral Area	Coos	Tioga	561.949158	14.177936
325	Within Ancestral Area	Coos	Tioga	626.643677	83.919653
326	Within Ancestral Area	Coos	Tioga	626.643677	13.117103
327	Within Ancestral Area	Coos	Tioga	626.643677	37.81634
328	Within Ancestral Area	Coos	Tioga	626.643677	142.088251
329	Within Ancestral Area	Coos	Tioga	626.643677	7.83732
330	Within Ancestral Area	Coos	Tioga	626.643677	10.598995
331	Within Ancestral Area	Coos	Tioga	626.643677	6.248002
332	Within Ancestral Area	Douglas	Upper Smith	330.290283	33.673349
333	Within Ancestral Area	Coos	Tioga	626.643677	4.423989
334	Within Ancestral Area	Coos	Tioga	785.874268	15.80792
335	Within Ancestral Area	Coos	Tioga	626.643677	46.630672
336	Within Ancestral Area	Coos	Tioga	626.643677	220.957185
337	Within Ancestral Area	Coos	Tioga	504.075897	6.984193
338	Within Ancestral Area	Coos	Tioga	626.643677	46.506475
339	Within Ancestral Area	Coos	Tioga	561.949158	3.07927
340	Within Ancestral Area	Coos	Tioga	626.643677	395.81957
341	Within Ancestral Area	Lane	Upper Lake Cr.	762.811401	69.01174
342	Within Ancestral Area	Lane	Upper Lake Cr.	423.200958	7.479444
343	Within Ancestral Area	Lane	Upper Lake Cr.	305.707214	18.028843
344	Within Ancestral Area	Lane	Upper Lake Cr.	305.707214	57.99656
345	Within Ancestral Area	Lane	Upper Lake Cr.	389.365295	16.733884
346	Within Ancestral Area	Lane	Upper Lake Cr.	806.228638	27.021332

ID	Ancestral Boundary	County	Tract	Trees	Acres
347	Within Ancestral Area	Lane	Upper Lake Cr.	762.811401	40.530343
348	Within Ancestral Area	Lane	Upper Lake Cr.	762.811401	4.700369
349	Within Ancestral Area	Lane	Upper Lake Cr.	762.811401	202.280421
350	Within Ancestral Area	Lane	Upper Lake Cr.	305.707214	143.469317
351	Within Ancestral Area	Lane	Upper Lake Cr.	762.811401	27.284369
352	Within Ancestral Area	Lane	Upper Lake Cr.	277.146667	18.95156
353	Within Ancestral Area	Lane	Upper Lake Cr.	762.811401	14.927829
354	Within Ancestral Area	Lane	Upper Lake Cr.	305.707214	34.715393
355	Within Ancestral Area	Lane	Upper Lake Cr.	305.707214	53.594775
356	Within Ancestral Area	Lane	Upper Lake Cr.	460.812469	32.586482
357	Within Ancestral Area	Lane	Upper Lake Cr.	460.812469	14.430273
358	Within Ancestral Area	Lane	Upper Lake Cr.	213.531357	36.456759
359	Within Ancestral Area	Lane	Upper Lake Cr.	762.811401	21.315833
360	Within Ancestral Area	Lane	Upper Lake Cr.	213.531357	151.992128
361	Within Ancestral Area	Lane	Upper Lake Cr.	806.228638	173.946136
362	Within Ancestral Area	Lane	Upper Lake Cr.	762.811401	45.223454
363	Within Ancestral Area	Lane	Upper Lake Cr.	806.228638	44.678882
364	Within Ancestral Area	Lane	Upper Lake Cr.	762.811401	7.483214
365	Within Ancestral Area	Lane	Upper Lake Cr.	170.056473	15.709961
366	Within Ancestral Area	Lane	Upper Lake Cr.	460.812469	18.849538
367	Within Ancestral Area	Lane	Upper Lake Cr.	806.228638	30.659633
368	Within Ancestral Area	Lane	Upper Lake Cr.	806.228638	124.915947
369	Within Ancestral Area	Lane	Upper Lake Cr.	806.228638	21.378776
370	Within Ancestral Area	Lane	Upper Lake Cr.	762.811401	28.151538
371	Within Ancestral Area	Lane	Upper Lake Cr.	806.228638	9.395168
372	Within Ancestral Area	Lane	Upper Lake Cr.	806.228638	8.143477
373	Within Ancestral Area	Lane	Upper Lake Cr.	762.811401	33.110003
374	Within Ancestral Area	Lane	Upper Lake Cr.	567.109009	113.069174
375	Within Ancestral Area	Lane	Upper Lake Cr.	170.056473	9.828046

ID	Ancestral Boundary	County	Tract	Trees	Acres
376	Within Ancestral Area	Lane	Upper Lake Cr.	806.228638	151.607881
377	Within Ancestral Area	Lane	Upper Lake Cr.	762.811401	7.53026
378	Within Ancestral Area	Lane	Upper Lake Cr.	806.228638	44.14274
379	Within Ancestral Area	Lane	Upper Lake Cr.	762.811401	9.768951
380	Within Ancestral Area	Lane	Upper Lake Cr.	305.707214	16.949528
381	Within Ancestral Area	Lane	Upper Lake Cr.	806.228638	65.901989
382	Within Ancestral Area	Lane	Upper Lake Cr.	762.811401	10.812315
383	Within Ancestral Area	Lane	Upper Lake Cr.	460.812469	46.878516
384	Within Ancestral Area	Lane	Upper Lake Cr.	762.811401	6.231143
385	Within Ancestral Area	Lane	Upper Lake Cr.	806.228638	83.729372
386	Within Ancestral Area	Lane	Upper Lake Cr.	806.228638	6.120519
387	Within Ancestral Area	Lane	Upper Lake Cr.	389.365295	28.163672
388	Within Ancestral Area	Lane	Upper Lake Cr.	389.365295	46.209768
389	Within Ancestral Area	Lane	Upper Lake Cr.	806.228638	12.485345
390	Within Ancestral Area	Lane	Upper Lake Cr.	806.228638	9.409044
391	Within Ancestral Area	Lane	Upper Lake Cr.	806.228638	52.779412
392	Within Ancestral Area	Lane	Upper Lake Cr.	806.228638	12.010897
393	Within Ancestral Area	Lane	Upper Lake Cr.	806.228638	174.94299
394	Within Ancestral Area	Lane	Upper Lake Cr.	213.531357	5.137307
395	Within Ancestral Area	Lane	Upper Lake Cr.	305.707214	42.031365
396	Within Ancestral Area	Douglas	Upper Smith	146.821716	1.861657
397	Within Ancestral Area	Lane	Upper Lake Cr.	305.707214	9.864628
398	Within Ancestral Area	Douglas	Upper Smith	0	2.462975
399	Within Ancestral Area	Coos	Tioga	0	14.544076
400	Within Ancestral Area	Douglas	Upper Smith	0	1.838368
401	Within Ancestral Area	Lane	Upper Lake Cr.	0	1.831076
402	Within Ancestral Area	Lane	Upper Lake Cr.	0	1.604716
403	Within Ancestral Area	Lane	Upper Lake Cr.	0	3.872097



## Appendix I. References

- Administration, N. A. (2020). *Sea level*. Retrieved from <https://climate.nasa.gov/vital-signs/sea-level/>
- Agency for Toxic Substances and Disease Registry. (2005). *Public health assessment and guidance manual - Chapter 6: exposure evaluation: Evaluating exposure pathways*. Retrieved from <https://www.atsdr.cdc.gov/hac/phamanual/ch6.html#>
- Alberta Water Portal Society. (2014). *Environmental impacts of flooding*. Retrieved from <https://albertawater.com/what-are-the-consequences-of-flooding/environmental>
- Barnett, E. A., Weaver, C. S., Meagher, K. L., Haugerud, R. A., Wang, Z., Madin, I. P., . . . Darienzo, M. (2009). *Earthquake hazards and lifelines in the interstate 5 urban corridor: Cottage Grove to Woodburn, Oregon*. Retrieved from [https://pubs.usgs.gov/sim/3028/sim3028\\_back.pdf](https://pubs.usgs.gov/sim/3028/sim3028_back.pdf)
- Benioff Zone. (2021). *World of Earth Science. Encyclopedia.com*, pp. <https://www.encyclopedia.com/earth-and-environment/geology-and-oceanography/geology-and-oceanography/benioff-zone>. Retrieved from W.
- Bloom, D., Cadarette, D., & Sevilla, J. (2018). *Epidemics and economics*. Retrieved from Finance and Development vol. 5(2): <https://www.imf.org/external/pubs/ft/fandd/2018/06/economic-risks-and-impacts-of-epidemics/bloom.htm#:~:text=Fear%20of%20infection%20can%20result,can%20lead%20to%20decreased%20trade>.
- Bolt, B. A. (2020). *Earthquake*. Retrieved from Encyclopedia Britannica: <https://www.britannica.com/science/earthquake-geology>
- Buis, A. (2019). *Can climate affect earthquakes, or are the connections shaky?* Retrieved from National Aeronautics and Space Administration: <https://climate.nasa.gov/news/2926/can-climate-affect-earthquakes-or-are-the-connections-shaky/>
- California Independent System Operator. (n.d.). *What is a flex alert?* Retrieved from <https://www.flexalert.org/what-is-flex-alert>
- Center for Disease Control. (2013). *Health effects of tsunamis*. Retrieved from <https://www.cdc.gov/disasters/tsunamis/healtheff.html>
- Center for the Study of the Pacific Northwest. (n.d.). *Lesson seven: The changing world of Pacific Northwest Indians*. Retrieved from <http://www.washington.edu/uwired/outreach/cspn/Website/Classroom%20Materials/Pacific%20Northwest%20History/Lessons/Lesson%207/7.html>
- Centers for Disease Control. (2016). *Pandemic severity assessment framework (PSAF)*. Retrieved from <https://www.cdc.gov/flu/pandemic-resources/national-strategy/severity-assessment-framework.html>
- Centers for Disease Control. (2019). *Infectious disease after a disaster*. Retrieved from <https://www.cdc.gov/disasters/disease/infectious.html>
- Centers for Disease Control. (2020). *Coping with stress*. Retrieved from <https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/managing-stress-anxiety.html>

- Centers for Disease Control. (2020). *Diseases carried by vectors*. Retrieved from <https://www.cdc.gov/climateandhealth/effects/vectors.htm>
- Centers for Disease Control. (2020). *Extreme heat*. Retrieved from <https://www.cdc.gov/disasters/extremeheat/index.html>
- Centers for Disease Control. (2020). *Health alert network (HAN)*. Retrieved from <https://emergency.cdc.gov/han/>
- Centers for Disease Control. (2020). *Health implications of drought*. Retrieved from <https://www.cdc.gov/nceh/drought/implications.htm>
- Centers for Disease Control. (2020). *Protect yourself from the dangers of extreme heat*. Retrieved from <https://www.cdc.gov/nceh/toolkits/extremeheat/default.html>
- Centers for Disease Control. (2020). *Why it matters: The pandemic threat*. Retrieved from <https://www.cdc.gov/globalhealth/healthprotection/fieldupdates/winter-2017/why-it-matters.html>
- Centers for Disease Control and Prevention. (2020). *Identifying the source of the outbreak*. Retrieved from <https://www.cdc.gov/coronavirus/2019-ncov/cases-updates/about-epidemiology/identifying-source-outbreak.html#:~:text=An%20outbreak%20is%20called%20an,classified%20as%20a%20pandemic>
- Centers for Disease Control. (n.d.). *Pandemic severity index mitigation slides*. Retrieved from <https://www.cdc.gov/media/pdf/MitigationSlides.pdf>
- City of Salem. (2020). *Updated - What you need to know about fires and Salem's drinking water safety*. Retrieved from <https://www.cityofsalem.net/Pages/what-you-need-to-know-about-fires-and-salems-drinking-water-safety.aspx#:~:text=Oregon%20Health%20Authority%20is%20our,in%20constant%20communication%20with%20OHA>
- Code of Federal Regulations. (2013). *Title 44, subchapter G-Public assistance project administration, part 201-Mitigation planning, section 201.2 definitions*. Retrieved from United States Government Publishing Office: <https://www.govinfo.gov/app/details/CFR-2013-title44-vol1/CFR-2013-title44-vol1-sec201-6/context>
- Cole, D. (2014, September 16). *Which contagious diseases are the deadliest?* Retrieved from National Public Radio: <https://www.npr.org/sections/goatsandsoda/2014/09/16/347727459/which-contagious-diseases-are-the-deadliest>
- Committee on Consumers and the Public Interest. (2019). *Consumers & catastrophes*. Retrieved from <https://pubs.naruc.org/pub/16F6F370-92B2-5780-4C6D-D1754303DA02>
- Confederated Tribes of Coos Lower Umpqua and Siuslaw Indians. (2018). *Tribal estuary response plan*. Retrieved from <https://ctclusi.org/wp-content/uploads/2020/09/CTCLUSI-Estuary-Response-Plan-2018.pdf>
- Confederated Tribes of Coos, Lower Umpqua, & Siuslaw. (2018). *Coos Head area master plan (revised)*. Retrieved from <https://ctclusi.org/wp-content/uploads/2020/09/CHAMP-002.pdf>

- Confederated Tribes of Coos, Lower Umpqua, & Siuslaw. (2020). *CTCLUSI reflects on 36th year of restoration*. Retrieved from <https://ctclusi.org/tag/public-law-98-481/>
- Confederated Tribes of Coos, Lower Umpqua, & Siuslaw. (2020). *Tribal council contact info*. Retrieved from <https://ctclusi.org/tribal-council/>
- Confederated Tribes of Coos, Lower Umpqua, & Siuslaw. (2020). *Tribal court and peacegiving*. Retrieved from <https://ctclusi.org/tribal-court-peacegiving/>
- Confederated Tribes of Coos, Lower Umpqua, & Siuslaw. (2021). *Finance department*. Retrieved from <https://ctclusi.org/finance-department/>
- Confederated Tribes of Coos, Lower Umpqua, & Siuslaw. (2021). *Housing department*. Retrieved from <https://ctclusi.org/housing-department/>
- Confederated Tribes of Coos, Lower Umpqua, & Siuslaw. (2021). *Tribal planning department*. Retrieved from <https://ctclusi.org/planning-department/>
- Confederated Tribes of Coos, Lower Umpqua, & Siuslaw. (n.d.). *CTCLUSI forestry*. Retrieved from <https://ctclusi.org/forestry-management/>
- Confederated Tribes of Coos, Lower Umpqua, & Siuslaw. (n.d.). *Department of natural resources and culture*. Retrieved from <https://ctclusi.org/department-of-natural-resources-culture/>
- Confederated Tribes of Coos, Lower Umpqua, & Siuslaw. (n.d.). *History*. Retrieved from <https://ctclusi.org/history/>
- Confederated Tribes of Coos, Lower Umpqua, & Siuslaw. (n.d.). *Human resources and job opportunities*. Retrieved from <https://ctclusi.org/human-resources-job-opportunities/>
- Confederated Tribes of Coos, Lower Umpqua, & Siuslaw. (n.d.). *Tribal enrollment*. Retrieved from <https://ctclusi.org/enrollment/>
- Confederated Tribes of Coos, Lower Umpqua, & Siuslaw. (n.d.). *Tribal government*. Retrieved from <https://ctclusi.org/governmentandfacilities/>
- Confederated Tribes of Coos, Lower Umpqua, & Siuslaw. (n.d.). *Tribal police*. Retrieved from <https://ctclusi.org/tribal-police/>
- Confederated Tribes of Coos, Lower Umpqua, and Siuslaw. (2010). *Long range transportation plan (LRTP) FY 2010 update (resolution no. 10-076)*. Retrieved from <https://ctclusi.org/wp-content/uploads/2020/09/LRTP-FY-2010.pdf>
- Constible, J. (2019). *Climate change and health in California*. Retrieved from National Resource Defense Council: <https://www.nrdc.org/sites/default/files/climate-change-health-impacts-california-ib.pdf>
- Councils and Committees. (2021). *State interagency hazard mitigation team (IHMT)*. Retrieved from <https://www.oregon.gov/oem/Councils-and-Committees/Pages/IHMT.aspx>
- Dalton, M. M., & Fleishman, E. (2021). *Fifth Oregon climate assessment*. Retrieved from Oregon Climate Change Research Institute: <https://oregonstate.app.box.com/s/7mynjzhda9vunbzqib6mn1dcpd6q5jka>

- David Ford Consulting Engineers & Riverside Technology Inc. (2004). *Evaluation of National Weather Service flood severity categories and use of gage station flood history information*. Retrieved from [https://www.weather.gov/media/water/David\\_Ford.pdf](https://www.weather.gov/media/water/David_Ford.pdf)
- Department of Homeland Security. (2016). *2016 wildland fires and potential impacts to critical infrastructure*. Retrieved from <https://www.hsdl.org/?view&did=792605>
- Department of Land Conservation and Development. (n.d.). *Natural hazards mitigation planning*. Retrieved from Oregon.gov: [https://www.oregon.gov/lcd/nh/pages/mitigation-planning.aspx?utm\\_source=LCD&utm\\_medium=egov\\_redirect&utm\\_campaign=https%3A%2F%2Fforegov.gov%2Flcd%2Fhaz%2Fpages%2Fnhmp.aspx](https://www.oregon.gov/lcd/nh/pages/mitigation-planning.aspx?utm_source=LCD&utm_medium=egov_redirect&utm_campaign=https%3A%2F%2Fforegov.gov%2Flcd%2Fhaz%2Fpages%2Fnhmp.aspx)
- Derven, R. (2020). *Experts speak: COVID-19's impact on commercial real estate*. Retrieved from NAIOP Commercial Real Estate Development Association: <https://www.naiop.org/en/Research-and-Publications/Magazine/2020/Summer-2020/Business-Trends/Experts-Speak-on-COVID19s-Impact-on-Commercial-Real-Estate>
- Douglas County Oregon. (2021). *The Archie Creek fire - One year later*. Retrieved from <https://douglascounty-oregon.us/CivicAlerts.aspx?AID=56>
- Douglas County Planning Department and Emergency Management. (2016). *Douglas County 2016 multi-jurisdictional natural hazard mitigation plan*. Retrieved from <https://douglascounty-oregon.us/DocumentCenter/View/4360/Natural-Hazard-Mitigation-Plan-PDF>
- Editors of Encyclopedia Britannica. (2015). *Mass movement*. Retrieved from <https://www.britannica.com/science/mass-movement>
- Editors of Encyclopedia Britannica. (2020). *Wildfire*. Retrieved from <https://www.britannica.com/science/wildfire>
- Editors of the Encyclopedia Britannica. (2020). *Erosion*. Retrieved from <https://www.britannica.com/science/erosion-geology>
- Environmental Defense Fund. (n.d.). *Extreme weather gets a boost from climate change*. Retrieved from <https://www.edf.org/climate/climate-change-and-extreme-weather>
- Environmental Protection Agency. (2020). *Toxics release inventory (TRI) program*. Retrieved from <https://www.epa.gov/toxics-release-inventory-tri-program>
- Environmental Protection Agency. (n.d.). *Climate change indicators: Weather and climate*. Retrieved from <https://www.epa.gov/climate-indicators/weather-climate#:~:text=Scientific%20studies%20indicate%20that%20extreme,storms%2C%20floods%2C%20and%20droughts.>
- Environmental Protection Agency. (n.d.). *Health and ecological hazards caused by hazardous substances*. Retrieved from <https://www.epa.gov/emergency-response/health-and-ecological-hazards-caused-hazardous-substances>
- Federal Aviation Administration. (2021). *What are dangerous goods?* Retrieved from [https://www.faa.gov/hazmat/what\\_is\\_hazmat/](https://www.faa.gov/hazmat/what_is_hazmat/)

- Federal Emergency Management Agency. (2007). *Multi-hazard mitigation planning guidance under the Disaster Mitigation Act of 2000*. Retrieved from <https://www.hsd1.org/?abstract&did=476620>
- Federal Emergency Management Agency. (2007). *Risk management series: Design guide for improving critical facility safety from flooding and high winds*. Retrieved from <https://www.wbdg.org/FFC/DHS/fema543.pdf>
- Federal Emergency Management Agency. (2009). Retrieved from <https://training.fema.gov/hiedu/docs/ballen%20-%20vulnerable%20populations.pdf>
- Federal Emergency Management Agency. (2010). *Tribal multi-hazard mitigation planning guidance*. Retrieved from [https://emilms.fema.gov/IS318/assets/tribal\\_planning\\_guidance\\_may2010.pdf](https://emilms.fema.gov/IS318/assets/tribal_planning_guidance_may2010.pdf)
- Federal Emergency Management Agency. (2011). *Oregon - Tsunami wave surge (FEMA-1964-DR)*. Retrieved from <https://www.fema.gov/pdf/news/pda/1964.pdf>
- Federal Emergency Management Agency. (2019). *Hazardous materials incidents: Guidance for state, local, tribal, territorial, and private sector partners*. Retrieved from <https://www.fema.gov/sites/default/files/2020-07/hazardous-materials-incidents.pdf>
- Federal Emergency Management Agency. (2019). *Stafford Act, as amended, and related authorities (FEMA P-592)*. Retrieved from [https://www.fema.gov/sites/default/files/2020-03/stafford-act\\_2019.pdf](https://www.fema.gov/sites/default/files/2020-03/stafford-act_2019.pdf)
- Federal Emergency Management Agency. (2019). *Tribal mitigation planning handbook*. Retrieved from [https://www.fema.gov/sites/default/files/2020-06/fema-tribal-planning-handbook\\_05-2019.pdf](https://www.fema.gov/sites/default/files/2020-06/fema-tribal-planning-handbook_05-2019.pdf)
- Federal Emergency Management Agency. (2020). *Archie Creek fire: Erosion threat assessment/reduction team (ETART) summary report*. Retrieved from <https://gscdn.govshare.site/1aa8ace4addf06592a8d7dcb775413bf10fd1ec6/ETARTSummary-ArchieFire.pdf>
- Federal Emergency Management Agency. (2020). *Disaster declarations for states and counties*. Retrieved from <https://www.fema.gov/data-visualization/disaster-declarations-states-and-counties>
- Federal Emergency Management Agency. (2021). *Disaster declarations for tribal nations*. Retrieved from <https://www.fema.gov/data-visualization/disaster-declarations-tribal-nations>
- Federal Emergency Management Agency. (n.d.). *Chapter 2: Types of floods and floodplains*. Retrieved from <https://training.fema.gov/hiedu/docs/fmc/chapter%20-%20types%20of%20floods%20and%20floodplains.pdf>
- Governor's Wildfire Economic Recovery Council. (2021). *Recovering and rebuilding from Oregon's 2020 wildfires: Key findings and recommendations*. Retrieved from <https://www.oregon.gov/gov/policy/Documents/WERC-2020/Wildfire%20Report%20FINAL.pdf>
- Guzzetti, F., Gariano, S. L., Peruccacci, S., Brunetti, M. T., Marchesini, I., Rossi, M., & Melillo, M. (2020). *Geographical landslide early warning systems*. Retrieved from *Earth-Science Reviews* (vol. 200): <https://doi.org/10.1016/j.earscirev.2019.102973>

- Hazen. (2019). *Orange County sanitation district climate resiliency study*. Retrieved from Orange County Sanitation District: [https://www.hazenandsawyer.com/uploads/downloads/Orange-County\\_Climate-Resiliency.pdf](https://www.hazenandsawyer.com/uploads/downloads/Orange-County_Climate-Resiliency.pdf)
- ICLEI Local Governments for Sustainability USA. (2015). *Integrating hazard mitigation and climate adaptation planning: Case studies and lessons learned*. Retrieved from <https://iclei.org/wp-content/uploads/2015/08/Integrating-Hazard-Mitigation-and-Climate-Adaptation-Planning.pdf>
- Insurance Information Institute. (2020). *Facts and statistics: Wildfires*. Retrieved from <https://www.iii.org/fact-statistic/facts-statistics-wildfires>
- Jordan, R. (2019, March 15). *How does climate change affect disease?* Retrieved from Stanford University: <https://earth.stanford.edu/news/how-does-climate-change-affect-disease#gs.j6pvmd>
- Kenney, S. (2019). *How wildlife weathers California's deadly wildfires*. Retrieved from KCET Public Media Group of Southern California: <https://www.kcet.org/shows/earth-focus/how-wildlife-weathers-californias-deadly-wildfires>
- Konrad, C. P. (2016). *Effects of urban development on floods*. Retrieved from United States Geological Survey: <https://pubs.usgs.gov/fs/fs07603/>
- Krider, E. P. (n.d.). *Lightning damage*. Retrieved from Encyclopedia Britannica: <https://www.britannica.com/science/thunderstorm/Lightning-protection>
- Lane County Hazard Mitigation & Emergency Management Emergency Management Team. (2018). *Lane County multi-jurisdictional hazard mitigation plan*. Retrieved from [https://lanecounty.org/UserFiles/Servers/Server\\_3585797/File/Government/County%20Departments/Emergency%20Management/Hazard%20Mitigation%20Plan/20180828\\_\\_MASTER\\_MJ-NHMPUpdate\\_Final.pdf](https://lanecounty.org/UserFiles/Servers/Server_3585797/File/Government/County%20Departments/Emergency%20Management/Hazard%20Mitigation%20Plan/20180828__MASTER_MJ-NHMPUpdate_Final.pdf)
- Leahy, S. (2019). *Off the charts heat to affect millions in the U.S. in coming decades*. Retrieved from National Geographic: <https://www.nationalgeographic.com/environment/2019/07/extreme-heat-to-affect-millions-of-americans/#close>
- Lentile, L. B., Morgan, P., Hudak, A. T., Bobbitt, M. J., Lewis, S. A., Smith, A. S., & Robichaud, P. R. (2007). *Post-fire burn severity and vegetation response following eight large wildfires across the western United States*. Retrieved from Fire Ecology 3, 91-108: <https://doi.org/10.4996/fireecology.0301091>
- Madhav, N., Oppenheim, B., Gallivan, M., Mulembakani, P., Rubin, E., & Wolfe, N. (2017, November 27). *Disease control priorities: Improving health and reducing poverty (3rd ed.)*. Retrieved from United States National Library of Medicine: <https://www.ncbi.nlm.nih.gov/books/NBK525302/>
- Mauger, G. S., Lee, S. Y., & Won, J. (2018). *Mapping the future of flood risk for the Stillaguamish & Snohomish rivers*. Retrieved from [https://cig.uw.edu/wp-content/uploads/sites/2/2019/11/Final\\_Report\\_SnohoCD-Flooding\\_2019-11-01.pdf](https://cig.uw.edu/wp-content/uploads/sites/2/2019/11/Final_Report_SnohoCD-Flooding_2019-11-01.pdf)
- Mayo Clinic Staff. (2019). *Infectious diseases*. Retrieved from Mayo Clinic: <https://www.mayoclinic.org/diseases-conditions/infectious-diseases/symptoms-causes/syc-20351173>



- McNamee, G., Highsmith, L., & Richard, M. (2021). *Oregon*. Retrieved from Encyclopedia Britannica: <https://www.britannica.com/place/Oregon-state>
- Megahed, N., & Ghoneim, E. (2020, June 24). *Antivirus-built environment: Lessons learned from COVID-19 pandemic*. Retrieved from Elsevier Public Health Emergency Collection, 61: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7313520/>
- Mendenhall, J. (2019). *Wildfire's impact on our environment*. Retrieved from Utah Department of Environmental Quality: <https://deq.utah.gov/communication/news/featured/wildfires-impact-on-our-environment#:~:text=Wildfire%E2%80%99s%20Impact%20on%20Our%20Environment%201%20Air%20Quality,more%20than%201,500%20residents,%20and%20destroyed%20more>
- Mulkern, A. C. (2020, October 20). *California's mega fires have arrived 30 years early*. Retrieved from Scientific American: <https://www.scientificamerican.com/article/californias-mega-fires-have-arrived-30-years-early/>
- National Academy of Sciences. (2008). *Glossary*. Retrieved from <https://www.ncbi.nlm.nih.gov/books/NBK45750/>
- National Centers for Environmental Information. (2021). *Climate at a glance*. Retrieved from National Oceanic and Atmospheric Administration: <https://www.ncdc.noaa.gov/cag/>
- National Centers for Environmental Information. (n.d.). *Drought: Monitoring economic, environmental, and social impacts*. Retrieved from National Oceanic and Atmospheric Administration: <https://www.ncdc.noaa.gov/news/drought-monitoring-economic-environmental-and-social-impacts#:~:text=Drought%20can%20also%20affect%20people's,even%20loss%20of%20human%20life.>
- National Geographic Society. (2019). *Wildfires*. Retrieved from National Geographic: <https://www.nationalgeographic.org/encyclopedia/wildfires/>
- National Integrated Drought Information System. (2020). *California-Nevada drought early warning systems*. Retrieved from <https://www.drought.gov/drought/dews/california-nevada>
- National Integrated Drought Information System. (2021). *By location: States, California*. Retrieved from <https://www.drought.gov/states/california>
- National Integrated Drought Information System. (2021). *Drought impacts*. Retrieved from Drought.gov: <https://www.drought.gov/impacts>
- National Integrated Drought Information System. (2021). *U.S. seasonal drought outlook*. Retrieved from <https://www.drought.gov/data-maps-tools/us-seasonal-drought-outlook>
- National Oceanic and Atmospheric Administration. (2018). *Tsunamis*. Retrieved from <https://www.noaa.gov/education/resource-collections/ocean-coasts/tsunamis>
- National Oceanic and Atmospheric Administration. (2019). *What is a tsunami?* Retrieved from <https://oceanservice.noaa.gov/facts/tsunami.html>
- National Oceanic and Atmospheric Administration and National Weather Service. (2018). *Tsunami frequently asked questions*. Retrieved from

- <https://www.tsunami.gov/?page=tsunamiFAQ#targetText=The%20amount%20of%20movement%20of,cause%20landslides%20that%20generate%20tsunamis>
- National Oceanic and Atmospheric Administration and National Weather Service. (2020). *Pacific tsunami warning center (PTWC)*. Retrieved from <https://wcawwc.arh.noaa.gov/?page=history>
- National Oceanic and Atmospheric Administration and National Weather Service. (2021). *Storm prediction center*. Retrieved from <https://www.spc.noaa.gov/>
- National Oceanic and Atmospheric Administration Climate.gov Staff. (2016). *El Niño and La Niña: Frequently asked questions*. Retrieved from <https://www.climate.gov/news-features/understanding-climate/el-ni%C3%B1o-and-la-ni%C3%B1a-frequently-asked-questions>
- National Oceanic and Atmospheric Administration. (n.d.). *Heat index*. Retrieved from <https://www.weather.gov/safety/heat-index>
- National Oceanic and Atmospheric Administration. (n.d.). *Storm events database*. Retrieved from <https://www.ncdc.noaa.gov/stormevents/choosedates.jsp?statefips=6%2CCALIFORNIA>
- National Oceanic and Atmospheric Administration. (n.d.). *Tsunami frequently asked questions*. Retrieved from <https://www.tsunami.gov/?page=tsunamiFAQ#targetText=The%20amount%20of%20movement%20of,cause%20landslides%20that%20generate%20tsunamis>.
- National Park Service. (2017). *Wildland fire behavior*. Retrieved from <https://www.nps.gov/articles/wildland-fire-behavior.htm>
- National Park Service. (2018). *Wildfire causes and evaluations*. Retrieved from <https://www.nps.gov/articles/wildfire-causes-and-evaluation.htm>
- National Weather Service. (2009). *National weather service glossary*. Retrieved from <https://w1.weather.gov/glossary/>
- National Weather Service. (2021). *NWS forecast office Portland, OR*. Retrieved from <https://www.weather.gov/pqr/>
- National Weather Service. (2021). *NWS watch, warning, advisory display*. Retrieved from <https://www.spc.noaa.gov/products/wwa/>
- National Weather Service. (2021). *Wildfire safety, smoke forecasted, and evacuation information and links for Southern Oregon and Northern California*. Retrieved from [https://www.weather.gov/mfr/wildfire?fbclid=IwAR3Yv4U9qe-1A\\_WAAwUjZqZf3gaJcXUSZPppUDp-6nSRsnIOJr3Aw\\_O6k\\_o](https://www.weather.gov/mfr/wildfire?fbclid=IwAR3Yv4U9qe-1A_WAAwUjZqZf3gaJcXUSZPppUDp-6nSRsnIOJr3Aw_O6k_o)
- National Weather Service. (n.d.). *Los Angeles/Oxnard local area: Climate prediction center (CPC) outlooks*.
- National Weather Service. (n.d.). *The enhanced Fujita scale (EF Scale)*. Retrieved from <https://www.weather.gov/oun/efscale>
- National Weather Service. (n.d.). *Thunderstorm brochure*. Retrieved from Weather.gov: <https://www.weather.gov/media/safety/Thunderstorm-brochure17.pdf>

- National Weather Service. (n.d.). *Tornado definition*. Retrieved from <https://www.weather.gov/phi/TornadoDefinition>
- National Weather Service. (n.d.). *Tsunami dangers*. Retrieved from [https://www.weather.gov/jetstream/tsu\\_dangers](https://www.weather.gov/jetstream/tsu_dangers)
- National Weather Service. (n.d.). *Understanding wildfire warnings, watches and behavior*. Retrieved from <https://www.weather.gov/safety/wildfire-ww>
- National Weather Service. (n.d.). *Watch/warning/advisory definitions*. Retrieved from <https://www.weather.gov/lwx/warningsdefined#Coastal%20Flood%20Watch>
- Nelsen, M. (2020). *Historic September 2020 fires and Labor Day windstorm*. Retrieved from Fox 12 Weather Blog: <https://fox12weather.wordpress.com/historic-september-2020-fires-labor-day-windstorm/>
- Occupational Safety and Health Administration. (2013). *1910 subpart H - Hazardous materials*. Retrieved from <https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910SubpartH>
- Office of Disease Prevention and Health Promotion. (2020). *Immunization and infectious diseases*. Retrieved from HealthyPeople.gov: <https://www.healthypeople.gov/2020/topics-objectives/topic/immunization-and-infectious-diseases>
- Office of the State Fire Marshal. (2021). *Hazardous substance (HazMat) incident search: Hazardous substance incident reports, 2021*. Retrieved from <https://www.oregon.gov/osp/programs/sfm/Pages/Hazardous-Incident-Information.aspx>
- Oregon Department of Forestry & Oregon Department of Geology and Mineral Industries. (2007). *Emergency warning system procedures for debris flows in western Oregon*. Retrieved from <https://www.oregongeology.org/Landslide/ODFDebrisFlowWarningTechOverview.pdf>
- Oregon Department of Forestry. (2021). *Season fire statistics detail reports*. Retrieved from [https://apps.odf.oregon.gov/DIVISIONS/protection/fire\\_protection/fires/SeasonFireStats.asp](https://apps.odf.oregon.gov/DIVISIONS/protection/fire_protection/fires/SeasonFireStats.asp)
- Oregon Department of Forestry and United States Forest Service. (n.d.). *Advanced Oregon wildfire risk explorer*. Retrieved from [https://tools.oregonexplorer.info/OE\\_HtmlViewer/index.html?viewer=wildfireplanning](https://tools.oregonexplorer.info/OE_HtmlViewer/index.html?viewer=wildfireplanning)
- Oregon Department of Geology and Mineral Industries. (2020). *Statewide landslide information database for Oregon (SLIDO)*. Retrieved from <https://www.oregongeology.org/slido/>
- Oregon Department of Geology and Minerals Industries. (n.d.). *Oregon tsunami clearinghouse/Resource library*. Retrieved from <https://www.oregongeology.org/tsuclearinghouse/faq-tsunami.htm>
- Oregon Department of Transportation. (2012). *ODOT's climate change adaptation strategy report*. Retrieved from <https://www.oregon.gov/odot/Programs/TDD%20Documents/Climate-Change-Adaptation-Strategy.pdf>
- Oregon Department of Transportation. (2021). *State of Oregon: Oregon railroads*. Retrieved from <https://www.oregon.gov/ODOT/Data/Documents/Railroads.pdf>

- Oregon Health Authority. (2018). *Disease outbreaks*. Retrieved from <https://www.oregon.gov/oha/PH/DISEASESCONDITIONS/COMMUNICABLEDISEASE/DISEASESURVEILLANCEDATA/ANNUALREPORTS/Documents/2018/2018-DiseaseOutbreaks.pdf>
- Oregon Health Authority Public Health Division. (2010). *Selected reportable communicable disease summary*. Retrieved from <https://www.oregon.gov/oha/PH/DISEASESCONDITIONS/COMMUNICABLEDISEASE/DISEASESURVEILLANCEDATA/ANNUALREPORTS/Documents/2010/arpt10.pdf>
- Oregon Health Authority Public Health Division. (2014). *Selected reportable communicable disease summary*. Retrieved from <https://www.oregon.gov/oha/PH/DISEASESCONDITIONS/COMMUNICABLEDISEASE/DISEASESURVEILLANCEDATA/ANNUALREPORTS/Documents/2014/arpt14.pdf>
- Oregon Health Authority Public Health Division. (2019). *Annual communicable disease summary index*. Retrieved from <https://www.oregon.gov/oha/PH/DISEASESCONDITIONS/COMMUNICABLEDISEASE/DISEASESURVEILLANCEDATA/ANNUALREPORTS/Pages/arpt.aspx>
- Oregon Office of Emergency Management. (2020). *2020 Oregon wildfire spotlight*. Retrieved from <https://storymaps.arcgis.com/stories/6e1e42989d1b4beb809223d5430a3750>
- Oregon Office of Emergency Management. (2021). *ShakeAlert in Oregon*. Retrieved from <https://www.oregon.gov/oem/hazardsprep/Pages/orshakealert.aspx>
- Oregon Office of Emergency Management. (2021). *State interagency hazard mitigation team (IHMT)*. Retrieved from <https://www.oregon.gov/oem/Councils-and-Committees/Pages/IHMT.aspx>
- Oregon Office of Emergency Management. (n.d.). *Cascadia subduction zone*. Retrieved from <https://www.oregon.gov/oem/hazardsprep/Pages/Cascadia-Subduction-Zone.aspx>
- Oregon Public Health Division. (2020). *Oregon school immunization law summary, 2020*. Retrieved from <https://www.oregon.gov/oha/PH/PREVENTIONWELLNESS/VACCINESIMMUNIZATION/GETTINGIMMUNIZED/Documents/SchLawSum.pdf>
- Oregon State University. (n.d.). *Generalized geologic setting of the Pacific Northwest*. Retrieved from Cascadia Earthscope Earthquake and Tsunami Education Program: <https://ceetep.oregonstate.edu/sites/ceetep.oregonstate.edu/files/resources/earthquakes-volcanoes-pacific-nw.pdf>
- Oregon Wildfire Risk Explorer. (2019). *Oregon wildfire risk explorer - Advanced report*. Retrieved from [http://www.projectwildfire.org/wp-content/uploads/2019/10/2019-Sisters-CWPP-Appendix-A\\_Risk-Explorer-Report.pdf](http://www.projectwildfire.org/wp-content/uploads/2019/10/2019-Sisters-CWPP-Appendix-A_Risk-Explorer-Report.pdf)
- Pacific Northwest Seismic Network. (n.d.). Retrieved from Frequently asked questions: Earthquakes in Washington and Oregon: <https://pnsn.org/outreach/faq#:~:text=Benioff%20Zone%20earthquakes%2C%20also%20known,earthquakes%20in%20Washington%20and%20Oregon.&text=This%20fault%20generated%20a%20very,in%20the%20Puget%20Basin%20region.>

- Pacific Northwest Seismic Network. (n.d.). *Deep earthquakes*. Retrieved from <https://pnsn.org/outreach/earthquakesources/deepearthquakes>
- Pacific Northwest Seismic Network. (n.d.). *PNW earthquake sources overview*. Retrieved from <https://pnsn.org/outreach/earthquakesources>
- Palmer, S., Magsino, S., Bilderback, E., Poelstra, J., Folger, D., & Niggemann, R. (2007). *Layer: HEHRP seismic site class*. Retrieved from Washington State Department of Natural Resources: [https://www.dnr.wa.gov/Publications/ger\\_wigm\\_seismic\\_site\\_class.html](https://www.dnr.wa.gov/Publications/ger_wigm_seismic_site_class.html)
- Pipeline and Hazardous Materials Safety Administration. (2020). *Incident statistics*. Retrieved from <https://www.phmsa.dot.gov/hazmat-program-management-data-and-statistics/data-operations/incident-statistics>
- Pörtner, H. O., Roberts, D. C., Masson-Delmotte, V., Zhai, P., Tignor, M., Poloczanska, E., . . . Weyer, N. M. (2019). *Special report on the ocean and cryosphere in a changing climate: Summary for policymakers*. Retrieved from <https://www.ipcc.ch/srocc/chapter/summary-for-policymakers/>
- Pörtner, H. O., Roberts, D., Masson-Delmotte, V., Zhai, P., Tignor, M., Poloczanska, E., . . . (eds.), . . . W. (2019). *IPCC special report on the ocean and cryosphere in a changing climate*. Retrieved from <https://www.ipcc.ch/srocc/chapter/summary-for-policymakers/>
- Prestemon, J. P., Hawbaker, T. J., Bowden, M., Carpenter, J., Brooks, M. T., Abt, K. L., . . . Scranton, S. (2013). *Wildfire ignitions: A review of the science and recommendations for empirical modeling*. Retrieved from United States Forest Service Southern Research Station: [https://www.srs.fs.fed.us/pubs/gtr/gtr\\_srs171.pdf](https://www.srs.fs.fed.us/pubs/gtr/gtr_srs171.pdf)
- Quigley, M. C., Attanayake, J., King, A., & Prideaux, F. (2020). *A multi-hazards earth science perspective on the COVID-19 pandemic: The potential for concurrent and cascading crises*. Retrieved from *Environment Systems and Decisions*, 40, 199-215: <https://link.springer.com/article/10.1007/s10669-020-09772-1>
- Radeloff, V. C., Helmers, D. P., Kramer, H. A., Mockrin, M. H., Alexandre, P. M., Bar-Massada, A., . . . Stewart, S. I. (2018). *Rapid growth of US wildland-urban interface raises wildfire risk*. Retrieved from *Proceedings of the National Academy of Sciences* 115(13) 3314-3319: <https://doi.org/10.1073/pnas.1718850115>
- Ready.gov. (2020). *Floods*. Retrieved from <https://www.ready.gov/floods#:~:text=Flooding%20is%20a%20temporary%20overflow,lead%20to%20injury%20or%20death>.
- Ready.gov. (2020). *Landslides and debris flow*. Retrieved from <https://www.ready.gov/landslides-debris-flow>
- Ready.gov. (2020). *Severe weather*. Retrieved from <https://www.ready.gov/severe-weather>
- Ready.gov. (2021). *Extreme heat*. Retrieved from <https://www.ready.gov/heat>
- SeaLevelRise.org. (n.d.). *Oregon's sea level is rising*. Retrieved from <https://sealevelrise.org/states/oregon/>

- State Interagency Hazard Mitigation Team. (2020). *Oregon Natural Hazards Mitigation Plan*. Retrieved from [https://www.oregon.gov/lcd/NH/Documents/Approved\\_2020ORNHMP\\_00\\_Complete.pdf](https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_00_Complete.pdf)
- State of Oregon Department of Geology and Mineral Industries. (n.d.). *Earthquakes in Oregon*. Retrieved from <https://www.oregongeology.org/earthquakes/earthquakehome.htm>
- State of Oregon Department of Geology and Mineral Industries. (n.d.). *Earthquakes in Oregon*. Retrieved from <https://www.oregongeology.org/earthquakes/earthquakehome.htm>
- The National Severe Storms Laboratory. (n.d.). *Severe weather 101*. Retrieved from <https://www.nssl.noaa.gov/education/svrwx101/>
- The National Severe Storms Laboratory. (n.d.). *Severe weather 101 - Damaging wind basics*. Retrieved from <https://www.nssl.noaa.gov/education/svrwx101/wind/>
- The National Severe Storms Laboratory. (n.d.). *Severe weather 101 - Hail*. Retrieved from National Oceanic and Atmospheric Administration: <https://www.nssl.noaa.gov/education/svrwx101/hail/>
- United States Climate Resilience Toolkit. (2019). *Coastal erosion*. Retrieved from <https://toolkit.climate.gov/topics/coastal-flood-risk/coastal-erosion#:~:text=As%20global%20sea%20level%20rises,structures%20and%20loss%20of%20land>
- United States Department of Agriculture Natural Resources Conservation Service. (2019). *Web soil survey home*. Retrieved from <https://websoilsurvey.nrcs.usda.gov/app/>
- United States Department of the Interior and United States Geological Survey. (2014). *The 1964 great Alaska earthquake and tsunamis - A modern perspective and enduring legacies*. Retrieved from <https://pubs.usgs.gov/fs/2014/3018/pdf/fs2014-3018.pdf>
- United States Department of the Interior Indian Affairs. (n.d.). *Human vs. naturally occurring wildfires*. Retrieved from <https://www.bia.gov/bia/ots/dfwfm/bwfm/wildfire-prevention-and-education/home-bureau-indian-affairs-bia-trust-services-division-forestry-and-wildland-fire-management-branch#:~:text=Naturally%20occurring%20wildfires%20are%20most,fires%2C%20depending%20on%2>
- United States Forest Service. (n.d.). *Adjective class rating*. Retrieved from <http://www.wfas.net/index.php/fire-danger-rating-fire-potential--danger-32/class-rating-fire-potential-danger-51>
- United States Forest Service. (n.d.). *Fire effects on the environment*. Retrieved from <https://www.fs.usda.gov/pnw/page/fire-effects-environment#:~:text=But%20fire%20can%20be%20deadly,landscape%20may%20be%20long%20lasting>
- United States Forest Service. (n.d.). *Interagency wildland fire air quality response program*. Retrieved from <https://sites.google.com/wildlandfiresmoke.us/iwfaqrp>
- United States Geological Survey. (2004). *Landslide types and processes*. Retrieved from <https://pubs.usgs.gov/fs/2004/3072/fs-2004-3072.html>



- United States Geological Survey. (2006). *Tsunamis and tsunami hazards*. Retrieved from [https://www.usgs.gov/special-topic/water-science-school/science/tsunamis-and-tsunami-hazards?qt-science\\_center\\_objects=0#qt-science\\_center\\_objects](https://www.usgs.gov/special-topic/water-science-school/science/tsunamis-and-tsunami-hazards?qt-science_center_objects=0#qt-science_center_objects)
- United States Geological Survey. (2014). *2014 seismic hazard map - Oregon*. Retrieved from <https://www.usgs.gov/media/images/2014-seismic-hazard-map-oregon>
- United States Geological Survey. (2016). *The severity of an earthquake*. Retrieved from <https://pubs.usgs.gov/gip/earthq4/severitygip.html>
- United States Geological Survey. (2017). *M 7.5 scenario earthquake - Devils Mountain fault*. Retrieved from [https://earthquake.usgs.gov/scenarios/eventpage/bssc2014574\\_m7p5\\_se/region-info](https://earthquake.usgs.gov/scenarios/eventpage/bssc2014574_m7p5_se/region-info)
- United States Geological Survey. (2017). *ShakeAlert - An earthquake early warning system for the United States west coast: Fact sheet 2014-3083*. Retrieved from <https://pubs.er.usgs.gov/publication/fs20143083>
- United States Geological Survey. (n.d.). *Earthquake glossary: Benioff zone*. Retrieved from <https://earthquake.usgs.gov/learn/glossary/?term=Benioff%20zone>
- United States Geological Survey. (n.d.). *Earthquake magnitude, energy release, and shaking intensity*. Retrieved from [https://www.usgs.gov/natural-hazards/earthquake-hazards/science/earthquake-magnitude-energy-release-and-shaking-intensity?qt-science\\_center\\_objects=0#qt-science\\_center\\_objects](https://www.usgs.gov/natural-hazards/earthquake-hazards/science/earthquake-magnitude-energy-release-and-shaking-intensity?qt-science_center_objects=0#qt-science_center_objects)
- United States Geological Survey. (n.d.). *How can climate change affect natural disasters?* Retrieved from [https://www.usgs.gov/faqs/how-can-climate-change-affect-natural-disasters-1?qt-news\\_science\\_products=0#qt-news\\_science\\_products](https://www.usgs.gov/faqs/how-can-climate-change-affect-natural-disasters-1?qt-news_science_products=0#qt-news_science_products)
- United States Geological Survey. (n.d.). *Impervious surfaces and flooding*. Retrieved from [https://www.usgs.gov/special-topic/water-science-school/science/impervious-surfaces-and-flooding?qt-science\\_center\\_objects=0#qt-science\\_center\\_objects](https://www.usgs.gov/special-topic/water-science-school/science/impervious-surfaces-and-flooding?qt-science_center_objects=0#qt-science_center_objects)
- United States Geological Survey. (n.d.). *Landslides 101*. Retrieved from [https://www.usgs.gov/natural-hazards/landslide-hazards/science/landslides-101?qt-science\\_center\\_objects=0#qt-science\\_center\\_objects](https://www.usgs.gov/natural-hazards/landslide-hazards/science/landslides-101?qt-science_center_objects=0#qt-science_center_objects)
- United States Geological Survey. (n.d.). *Modified Mercalli intensity scale*. Retrieved from <https://www.usgs.gov/media/images/modified-mercalli-intensity-scale>
- United States Geological Survey. (n.d.). *Seismic seiches*. Retrieved from [https://www.usgs.gov/natural-hazards/earthquake-hazards/science/seismic-seiches?qt-science\\_center\\_objects=0#qt-science\\_center\\_objects](https://www.usgs.gov/natural-hazards/earthquake-hazards/science/seismic-seiches?qt-science_center_objects=0#qt-science_center_objects)
- United States Geological Survey. (n.d.). *ShakeMap scientific background*. Retrieved from <https://web.archive.org/web/20110623092131/http://earthquake.usgs.gov/earthquakes/shake-map/background.php#intmaps>
- United States Geological Survey. (n.d.). *What are the different types of landslide hazard maps? What do they mean?* Retrieved from American Geosciences Institute: <https://www.americangeosciences.org/critical-issues/faq/what-are-different-types-landslide-hazard-maps-what-do-they-mean>

- United States Geological Survey. (n.d.). *What are the effects of earthquakes?* Retrieved from [https://www.usgs.gov/natural-hazards/earthquake-hazards/science/what-are-effects-earthquakes?qt-science\\_center\\_objects=0#qt-science\\_center\\_objects](https://www.usgs.gov/natural-hazards/earthquake-hazards/science/what-are-effects-earthquakes?qt-science_center_objects=0#qt-science_center_objects)
- United States Geological Survey. (n.d.). *What are tsunamis?* Retrieved from [https://www.usgs.gov/faqs/what-are-tsunamis?qt-news\\_science\\_products=0#qt-news\\_science\\_products](https://www.usgs.gov/faqs/what-are-tsunamis?qt-news_science_products=0#qt-news_science_products)
- United States Geological Survey. (n.d.). *What is a landslide and what causes it?* Retrieved from [https://www.usgs.gov/faqs/what-a-landslide-and-what-causes-one?qt-news\\_science\\_products=0#qt-news\\_science\\_products](https://www.usgs.gov/faqs/what-a-landslide-and-what-causes-one?qt-news_science_products=0#qt-news_science_products)
- United States Geological Survey. (n.d.). *What is an earthquake and what causes them to happen?* Retrieved from [https://www.usgs.gov/faqs/what-earthquake-and-what-causes-them-happen?qt-news\\_science\\_products=3#qt-news\\_science\\_products](https://www.usgs.gov/faqs/what-earthquake-and-what-causes-them-happen?qt-news_science_products=3#qt-news_science_products)
- United States Geological Survey. (n.d.). *What is it about an earthquake that causes a tsunami?* Retrieved from [https://www.usgs.gov/faqs/what-it-about-earthquake-causes-a-tsunami?qt-news\\_science\\_products=0#qt-news\\_science\\_products](https://www.usgs.gov/faqs/what-it-about-earthquake-causes-a-tsunami?qt-news_science_products=0#qt-news_science_products)
- United States Government Publishing Office. (2010). *Content details: 44 CFR 201.7 - Tribal mitigation plans*. Retrieved from <https://www.govinfo.gov/app/details/CFR-2010-title44-vol1/CFR-2010-title44-vol1-sec201-7>
- University of Oregon, Community Service Center, & Oregon Partnership for Disaster Resilience. (2016). *Curry County natural hazard mitigation plan (vol. 1)*. Retrieved from <https://www.brookings.or.us/Archive/ViewFile/Item/477>
- URS. (2006). *Hazard mitigation plan for the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians*.
- URS. (2006). *Hazard mitigation plan for the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians (v. 1)*.
- US General Services Administration. (n.d.). *Hazardous materials management (HAZMAT)*. Retrieved from <https://www.gsa.gov/buying-selling/purchasing-programs/requisition-programs/gsa-global-supply/supply-standards/hazardous-materials-management-hazmat>
- Washington Emergency Management Division. (2018). *Washington State enhanced hazard mitigation plan*. Retrieved from <https://mil.wa.gov/asset/5d1626c2229c8>
- Weeman, K., & Lynch, P. (2018). *New study finds sea level rise accelerating*. Retrieved from National Aeronautics and Space Administration: <https://climate.nasa.gov/news/2680/new-study-finds-sea-level-rise-accelerating/>
- Western Forestry Leadership Coalition. (2010). *The true cost of wildfire in the western U.S.* Retrieved from [https://www.blm.gov/or/districts/roseburg/plans/collab\\_forestry/files/TrueCostOfWilfire.pdf](https://www.blm.gov/or/districts/roseburg/plans/collab_forestry/files/TrueCostOfWilfire.pdf)
- Western Regional Climate Center. (n.d.). *Climate of Oregon*. Retrieved from [https://wrcc.dri.edu/Climate/narrative\\_or.php](https://wrcc.dri.edu/Climate/narrative_or.php)

- Williams, R. A., Stephenson, W. J., Odum, J. K., & Worley, D. M. (1997). *High-resolution surface-seismic imaging techniques for NEHRP soil profile classifications and earthquake hazard assessments in urban areas*. Retrieved from United States Geological Survey: <https://pubs.usgs.gov/of/1997/ofr-97-501/ofr-97-501.html>
- Woods Hole Oceanographic Institution. (n.d.). *El Niño & other oscillations*. Retrieved from <https://www.whoi.edu/know-your-ocean/ocean-topics/ocean-circulation/el-nio-other-oscillations/>
- World Health Organization. (2018). *Managing epidemics: Key facts about major deadly diseases*. Retrieved from <https://www.who.int/emergencies/diseases/managing-epidemics-interactive.pdf>
- World Health Organization. (n.d.). *Climate change and human health - Risk and responses*. Retrieved from <https://www.who.int/globalchange/climate/en/chapter6.pdf>
- World Health Organization. (n.d.). *Disease outbreaks*. Retrieved from <https://www.who.int/teams/environment-climate-change-and-health/emergencies/disease-outbreaks/>
- World Health Organization. (n.d.). *Landslides*. Retrieved from [https://www.who.int/health-topics/landslides#tab=tab\\_2](https://www.who.int/health-topics/landslides#tab=tab_2)
- World Health Organization. (n.d.). *Wildfires*. Retrieved from [https://www.who.int/health-topics/wildfires#tab=tab\\_1](https://www.who.int/health-topics/wildfires#tab=tab_1)
- World Meteorological Organization. (2004). *A definition of severe weather*. Retrieved from [https://www.wmo.int/pages/prog/www/DPS/Meetings/Wshop-SEEF\\_Toulouse2004/Doc3-1\(1\).doc](https://www.wmo.int/pages/prog/www/DPS/Meetings/Wshop-SEEF_Toulouse2004/Doc3-1(1).doc)